



## ABOUT THIS GUIDANCE DOCUMENT

Guidance Documents are tools to help planners design conservation practice specifications by providing supplemental information beyond that in the Conservation Practice Standard (CPS). The information below applies generally in Michigan, but due to varying site conditions, client objectives, etc., this guidance may not always be applicable. Planner expertise is critical to ensuring a successful practice design. Additional references are provided below to aid in planning.

NRCS-MI CPS Tree/Shrub Establishment (Code 612) provides all the criteria that must be met for this practice.

Planners should review the CPS to ensure all applicable criteria are addressed. Guidance marked with a diamond (◆) below reflect specific CPS criteria that typically need to be documented in the plan or Implementation Requirements, to ensure proper practice installation.

## DEFINITION

Establishing woody plants by planting seedlings or cuttings, by direct seeding, or through natural regeneration.

## PURPOSES

- Maintain or improve desirable plant diversity, productivity, and health by establishing woody plants
- Create or improve habitat for desired wildlife species compatible with ecological characteristics of the site
- Control erosion
- Reduce excess nutrients and other pollutants in runoff and groundwater
- Sequester and store carbon
- Restore or maintain native plant communities
- Develop renewable energy systems
- Conserve energy
- Provide for beneficial organisms and pollinators

## CONDITIONS WHERE PRACTICE APPLIES

Tree/shrub establishment can be applied on any site capable of growing woody plants.

Use other conservation practice standards for specialized tree/shrub establishment situations, e.g., Riparian Forest Buffer (Code 391), Alley Cropping (Code 311), Windbreak/Shelterbelt Establishment and Renovation (Code 380), Critical Area Planting (Code 342), Hedgerow Planting (Code 422), Silvopasture (Code 381).

## GUIDANCE

### General Guidance

This Guidance Document primarily applies to tree/shrub establishment by planting seedlings, cuttings, and containerized plants. It does not apply to establishment using direct seeding. For this technique refer to the [Illinois Direct Seeding Handbook](#) (Herman, et. al., 2002).

This Guidance Document also does not apply to natural regeneration applications of 612. For this technique, see the applicable U.S. Forest Service Northern Research Station's "Manager's Handbook":

- [Aspen](#)
- [Balsam fir](#)
- [Black spruce](#)

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- [Black walnut](#)
- [Elm-ash-cottonwood](#)
- [Jack pine](#)
- [Northern hardwoods](#)
- [Northern white cedar](#)
- [Oaks](#)
- [Red pine](#)

Note: while the silvicultural principals in these handbooks are generally sound, they are dated, and do not consider modern-day pests, invasive species, climate change risks, and other factors.

◆ Use NRCS-MI CPS Tree/Shrub Site Preparation (Code 490) to prepare sites for planting, seeding, or natural regeneration, if conditions are not suitable for establishing the desired plants.

Additional facilitating practices are often used in conjunction with Tree/Shrub Establishment to ensure plant establishment and survival. For planning of facilitating practices, see NRCS-MI CPSs Herbaceous Weed Treatment (Code 315), Mulching (Code 484), and other applicable CPSs, and related Guidance Documents.

### **Species and Planting Stock Selection**

◆ Select species that are suited to soil and site conditions, and appropriate for the planned purpose(s). See the [Conservation Tree/Shrub Suitability Groups \(CTSG\) tool](#) to help select plants by soil groups, growth rate, mature height, shade tolerance, deer browse risk and more.

Consider opportunities to favor species that are expected to be better adapted to future climate conditions. Use caution when managing for species that are expected to decline. See [Climate Change Tree Atlas Information: Michigan Ecological Sections](#) (Northern Institute of Applied Climate Science, 2022).

Use native plant species whenever they can effectively address resource concerns and landowner objectives.

An increased species diversity typically yields a more resilient stand with higher wildlife and other conservation values. Consider planting 4 or more species, including 25-50% shrub species in the planting mix.

◆ Do not use invasive species or state-prohibited or restricted species. See the following for more information:

- [NRCS-MI Invasive Species Guidance](#)
- [Michigan's Invasive Species Program](#)
- [Midwest Invasive Species Information Network](#)
- [Michigan's Prohibited and Restricted Weeds list](#)

◆ Select planting stock that complies with [American Standard for Nursery Stock](#) (AmericanHort, 2014). See Section 11 for seedling standards.

### **Spacing and Layout**

Tree/shrub spacing and densities vary depending on the purpose of planting, and the type of stock being planted. Typical ranges for some common purposes are listed below.

Seedlings (including bare root, plugs and cuttings):

- Timber production:
  - Hardwoods - 545-900/ac.
  - Conifers - 600-1000/ac.
- Wildlife Plantings: 302-1200/ac. Certain wildlife plantings may require densities outside this range. Contact the Michigan NRCS State Biologist for guidance.
- Christmas Trees: 726-1200/ac.

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- Supplemental Underplanting: 200-300 /ac. evenly distributed over the area needing treatment.
- Erosion control: 1000-1200 /ac.

Larger stock (including air-root pruned, containerized, and balled and burlapped stock):

- 20+ per acre if natural regeneration is expected
- 50+ trees per acre if natural regeneration is not expected

Plan row widths to accommodate any anticipated equipment used to maintain the stand after establishment.

**Table 1 - Common Tree/Shrub Densities and Spacings**

Plants/Acre	Spacing (feet)	Plants/Acre	Spacing (feet)	Plants/Acre	Spacing (feet)
1210	6 x 6	681	8 x 8	453	8 x 12
907	6 x 8	622	7 x 10	436	10 x 10
889	7 x 7	544	8 x 10	363	10 x 12
871	5 x 10	538	9 x 9	302	12 x 12
726	6 x 10				

Densities for other spacing designs can be calculated as follows:

$$43560 \div (\text{row width} \times \text{within-row spacing}) = \text{Plants/Acre.}$$

Plan a setback from adjacent property lines or contrasting land uses at least equal to the 20-year height of the trees/shrubs planted, or 20 feet, whichever is smaller. See the [CTSG tool](#) for 20-year plant heights.

Where subsurface drains (tile lines) cross through a tree/shrub planting, and where these drains will remain functional, install a sealed conduit through the planting and extending a minimum of 100 feet beyond large trees and 75 feet beyond small to medium sized trees and shrubs.

### Additional Layout Information for Supplemental Underplanting

Ensure that there is adequate sunlight available for the species to be planted. Use the [CTSG tool](#) to determine the shade tolerance of the species to be underplanted. Consider using a forest densiometer to measure canopy cover.

- Intolerant tree/shrub species ('I' in the CTSG) require full sun and require openings ½ to ⅔ acre in size (diameter of opening: 160-200 feet, measured at tree crown level).
- Species with intermediate shade tolerance (M) require canopy cover of 30-50%, which can be approximated with openings ¼ to ½ acres in size (diameter of opening: 120-160 feet, measured at tree crown level).
- Shade tolerant species (T) can grow in full shade, although 60-80% canopy cover will accelerate the growth and development of underplanted trees/shrubs when compared to full canopy cover. Small openings of 1/10th acre or less (diameter of opening: 80 feet or less, measured at tree crown level) will favor regeneration of shade tolerant species.

Consider additional cutting or killing of overstory trees two or more years after establishment of underplanted trees/shrubs to maintain or increase the amount of available sunlight. See NRCS-MI CPS Forest Stand Improvement (Code 666).

### Common Pre-establishment Supporting Practices

Site Preparation - Site preparation prior to tree/shrub planting is typically necessary on any site with existing vegetation to reduce competition and assure tree survival. Site preparation likely is not needed on bare or very sparsely vegetated sites – recently tilled, following an annual crop (e.g., annual grains, soybeans), moss, sparse Junegrass, etc. If needed, use the NRCS-MI CPS Tree/Shrub Site Preparation (Code 490).

Cover Crops - Cover crops or permanent sod strips may be needed around trees/shrubs on sandy or highly erosive

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sites to prevent erosion and damage to seedlings by sandblasting. Cover crops are also used to minimize the risk of more aggressive or invasive vegetation (e.g., Canada thistle) establishing.

Ideally, cover crops should be allowed one growing season prior to planting the trees. This will provide flexibility in case the cover crop doesn't establish adequately, due to unfavorable weather conditions, for instance. If cover crops are needed, use NRCS-MI CPS Cover Crop (Code 340).

### Care of Seedlings

Proper care of seedlings prior to and during the planting process is critical to ensuring a successful planting. Seedlings that have had roots dried, frozen, or subjected to mold or high temperature should be assumed dead and not suitable for planting.

Seedlings should be packed, shipped, and stored until right before planting in wet moss or other similar medium. Seedlings should be kept cool (ideal temperature between 33° and 37° F) and moist through the planting process. Plant seedlings as soon as possible after received. Make plans for cold storage in case planting is delayed, if possible. Exposure to direct sun and wind can kill a seedling in less than 30 seconds.

If seedlings can't be planted right away, store them in a cool, moist, shaded location up to 7 days. Do not stack bundles of trees in layers of more than two deep to allow adequate air circulation and prevent overheating.

If planting is delayed for longer than seven days after receipt and they cannot be kept in cold storage, heel in the seedlings in a shaded area and keep them moist. To heel in seedlings: Dig a trench in the soil, place the seedling in the trench and cover the roots with soil, wetting the soil and roots during the process. See Figure 1. Transplant heeled-in seedlings and resume normal tree planting as soon as suitable conditions exist.



Figure 1. Properly heeled-in bare-root trees. (Photo credit: NC State University)

Do not immerse roots in water or wash soil off roots. Mist seedlings, as needed, to keep them moist. Water absorbent/retention dip may help conserve moisture on seedling roots when planting in dry weather.

### Planting Dates

Plant bare-root stock, seedling plugs, live cuttings, containerized stock or balled and burlapped stock during the dormant season in the Spring after the ground thaws until June 1 as soil moisture and local weather conditions permit or in the Fall, after October 1 until the ground freezes when soil moisture is adequate.

Do not plant seedlings (bare-root or plugs) in the Fall on soils subject to frost-heave action (clays, clay loam, silty clay loams, silts, silt loams, and loams).

### Planting Techniques

Seedlings can be planted by hand (using a dibble bar or similar) or with a tractor-drawn tree planting machine. The latter is often preferred for plantings of more than a couple of acres. Many Conservation Districts in Michigan have tree planters available for rent.

Use equipment and plant on the contour or across the slope, as possible, to minimize erosion potential. Comply with all applicable Best Management Practices (BMPs) contained in [Michigan Forest Best Management Practices for Soil and Water Quality](#) (MDNR and MDEQ, 2018).

Use of a professional tree planting contractor has been shown to significantly increase the chances for successful

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tree establishment.

See [Tree Planting in Michigan](#) (Lantagne and Koelling, 1997) for additional information on planting techniques.

### Seedlings

The planting trench or hole must be deep and wide enough to permit roots to spread out and down without J-rooting or L-rooting. If the roots are too long for the planting equipment, minimal pruning of small end roots may be needed. Do not prune back into the main root system or more than 25% of the total root length (excluding long individual fibrous roots), or to less than 8 inches. Pack soil around each plant firmly to eliminate air pockets after planting.

Plant trees/shrubs vertically with the root collars equal to or up to one inch below the soil surface to ensure adequate coverage of the roots with soil.

### Cuttings

Plant cuttings within 2 days of collection or shipping arrival in the spring before June 1. Plant, with buds pointing up, in firm ground with 1" of cutting exposed above ground.

### Containerized Trees

Dig a hole slightly larger than the container diameter. Gently remove plants from containers before placing in the ground and firmly pack soil around roots to eliminate air pockets. Before planting, loosen any spiraling or compacted roots. Water should be applied generously.

### Balled and Burlapped Trees

When handling stock, never lift a tree at the stem or trunk. Handle stock at the root ball. Dig a hole 1 1/2 times as wide as the root ball and about the same depth as the root ball. Remove any rope, wire, or plastic twine from the tree. Pull back burlap around trunk and fold down into the hole. Carefully place the tree in the hole and firmly pack soil around roots to eliminate air pockets. Water should be applied generously.

### Tree/Shrub Protection

Newly established trees and shrubs often require supplemental measures to protect them from herbivores, including deer and rabbits. The need for these measures can be reduced by selecting trees/shrubs that are listed as a "low deer browse risk" in the [CTSG tool](#). The method chosen should consider the local site conditions and herbivore pressure, as well as material cost, and installation and maintenance factors.

Ensure that inspection and maintenance requirements are included in the 612 Operation and Maintenance (O&M) Plan.

### Bud Caps

Bud caps are simply small pieces of paper that are stapled onto the terminal leader of pine trees to protect them from deer browse damage, through the winter months. They typically need to be reapplied annually until the trees are at least 4 feet tall.

See [Protect Pine Tree Seedlings from Deer Browsing with Paper Bud Caps](#) (MN DNR, 1997) for more information on making and installing bud caps.

### Tree Shelters

Tree shelters are solid or mesh tubes placed over trees to protect them from herbivores, and to alter the micro-environment around the plant. They are most often used on hardwood trees as they tend to concentrate growth vertically, rather than laterally. Shrubs and conifers, due to their broader growth form, are not compatible with narrow tree shelters (typically around 4" in diameter).

Shelters should be a minimum of 4 feet tall, but 5 feet is recommended, especially in areas with deep snow.

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Shelters should be fastened – usually with two zip-ties or similar – to a wooden stake firmly installed in the ground. Hardwood stakes are most commonly used as they are cost-effective and relatively long-lived. Bamboo stakes are not recommended, as they tend to rot at the ground line after a few years.

Use and maintain mesh netting on top of each shelter until the terminal leader of the seedling emerges from the shelter.

Maintain shelters, at a minimum, until the trees grow beyond deer browse height (5 feet, typically, but may vary by locale and snow depth). As trees often need additional support after growing in a shelter, leaving the shelters in place for an additional 3 to 5 years is recommended.

For additional information on use, types, and costs of tree shelters, see [Tree Shelters: A Multipurpose Forest Management Tool](#) (Pennsylvania State University, 2004).

### Tree Cages

Trees/Shrubs can be protected using do-it-yourself welded wire tree cages, typically 4 to 5 feet tall and 2-3 feet in diameter. Because they can be built with a much larger diameter than commercial tree shelters, this technique works well for conifers and shrubs.

Building and installing tree cages is labor-intensive and the materials can be costly, so this technique is generally used on smaller scale tree/shrub establishment projects, or on select trees within a larger planting – those that are more expensive, more critical to the planting design, or more prone to deer damage.

See [When You Need a Tree Cage](#) (Cook, 2020) for more information on this technique.

### Temporary Exclusion Fencing

Many types of exclusion methods can be effective at preventing deer damage to newly established trees/shrubs. Some of these methods include temporary electric fencing, peanut butter fence, polytape fence, and various types of high-tensile and woven-wire type of fences.

Specific fencing design information is beyond the scope of this IR. See [Prevention and Control of Wildlife Damage: Deer](#) (Craven and Hygnstrom, 1994) for information on different exclusion options. Follow applicable criteria in NRCS CPS Fence (Code 382).

### Repellents

Deer repellents are chemicals that rely on odor or taste to discourage deer browse. They typically need to be re-applied every 6-12 weeks, at least during the times of the year when herbivore damage is expected to be highest. In some cases, repellents may be needed throughout the year. Because of this need for frequent reapplication, and because, like other protective measures, repellents should be used until the seedlings are 4 to 5 feet tall, repellents are best suited to smaller planting projects, where this ongoing labor is feasible.

See [Nuisance Wildlife Repellent Handbook](#) (MN DNR), and [Comparison of Commercial Deer Repellents](#) (USFS, 2001) for information about selecting and using repellents.

### **Supporting Practices for Post-establishment Weed Control**

Typically, weeds should be controlled in a 36” diameter area around each planted seedlings or cuttings until average tree/shrub height is taller than the surrounding weeds. This will typically take 3 to 5 years. However, in some cases, such as where a relatively non-competitive cover crop is used, or where the benefits of visually obscuring the trees/shrubs from deer might exceed the benefits of reduced weed competition, allowing some grass/forb cover near the seedlings may be acceptable. Ensure that the O&M Plan adequately address inspections interventions for weed competition-induced stress and mortality.

### Chemical and Mechanical Weed Control

Use the NRCS CPS Herbaceous Weed Treatment (Code 315) conservation practice standard for chemical or mechanical (tillage) weed control.

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If tillage is used for weed control, care must be taken not to damage plant stems. Keep tillage depths shallow to avoid root damage.

Note: Mowing is not considered a weed control practices in field plantings, as it tends to stimulate root growth of grasses. It can be used between tree rows, however, to improve access, and reduce cover for potentially damaging herbivores.

### Mulch and Fabric Weed Barriers

Use NRCS CPS Mulching (Code 484) for organic or inorganic mulch, including fabric weed barriers.

Mulch is organic or inorganic material that is spread around the individual seedling to help retain soil moisture, moderate soil temperature, and prevent weed growth. Apply mulch in a 3' diameter circle around each seedling, 2 to 3" deep, and pulled back from the plant stem slightly. Straw or other similar mulch generally should be avoided as it can encourage mice and other small herbivores that may damage the seedlings.

Freshly chipped wood mulch should be aged for a few months to minimize the risk of heat damage to the seedlings (chips heat up significantly during the early stages of decay).

Fabric weed barriers are porous, yet opaque material that is installed over a tree or shrub seedling. They permit water to seep through to the seedling but prevent weed growth. They are installed as 3' x 3' squares over individual plants, or as long rolls that can be rolled out over rows of trees.

If weed barriers or mulch will be used for follow-up weed control, site preparation may not be required. However, in sites with aggressive difficult-to-kill weeds (e.g., reed canary grass), mechanical or chemical site preparation should be used prior to planting and installation of the weed barriers or mulch.

### Other Maintenance Information

Consider installing wire flags at a regular interval, e.g., every 4 trees, along each row, to aid in finding the seedlings after planting for inspection and maintenance purposes. This is especially important if small planting stock is used, or the surrounding vegetation will not be mowed. Caution: All flags should be replaced or removed as soon as the plastic flags start to degrade and separate from the wire (typically within 2 to 5 years) as the wires left behind are a significant eye-injury hazard.

Replant if survival drops to a point where the planned purpose is no longer achieved. Typically, a threshold of 80% is set, but it may vary depending on the planting purpose, design, and other factors. The mortality level at which replanting is required should be documented in the plan or Implementation Requirements.

◆ Protect trees and shrubs from fire, insects, disease, and animals until established. See NRCS-MI CPS Firebreak (Code 398) and other applicable CPSs, as needed.

Pruning may be required to remove damaged, diseased, or unwanted limbs to improve health and quality. Refer to the NRCS-MI CPS Tree/Shrub Pruning (Code 660).

## **ADDITIONAL REFERENCES**

Koelling, M.R. and R.B. Heiligmann. 1993. Recommended Species for Christmas Tree Plantings in the North Central United States, North Central Regional Extension Bulletin No. 479. Michigan State University, East Lansing, MI.

[https://www.canr.msu.edu/uploads/234/84938/Recommended\\_Species\\_for\\_Christmas\\_Tree\\_Plantings-optimized.pdf](https://www.canr.msu.edu/uploads/234/84938/Recommended_Species_for_Christmas_Tree_Plantings-optimized.pdf)

Pijut, P.M. 2003. Planting Hardwood Seedlings in the Central Hardwood Region. USDA-FS, Hardwood Tree Improvement and Regen. Center. FNR-210. <https://www.extension.purdue.edu/extmedia/fnr/fnr-210.pdf>