Northeastern Tree Planting & Reforestation

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Tree planting . . . yea!

Homework? . . . blech!

As a landowner or tree enthusiast, you might have thought your homework days ended earlier in your life. But if you are reading this, you are probably looking for ways to make the most out of a tree planting project. This chapter will orient you to several steps to take well before obtaining and planting trees for conservation. Your efforts will provide the groundwork for a successful and satisfying tree planting project. This and the chapters that follow, will direct you through the choices you will make to achieve your conservation goals, including techniques for planting good trees in the right places. People who are unfamiliar with tree planting in the Northeast will find this chapter to be a mix of practical tips and thought-provoking ideas.

If you have paged through a tree nursery catalog or tree seedling sales flyer, you might find the choices and options dizzying. Photographs, charts, and tree descriptions entice you with visions of beauty, wildlife value, utility, and perfect placement on the landscape. With some pre-planning and thoughtful decisions, your trees will someday make you proud to be the planter. They will serve the purposes you hope they will and provide all the environmental benefits trees can. Lack of planning and poor decisions may result in a collage of stunted, unhealthy, or unexpectedly dense or sparse trees for all your labor.

Planning for reforestation should begin with a conversation with your forester to develop or review a plan and consider all your options for success in your objectives. Photo – P. Smallidge

Fit tree planting into a wider land stewardship plan

The trees you are planting can eventually change the long-term attractiveness, wildlife value, and even the financial equity of your land. Presumably, you would like to enhance all three of these aspects. This can be done with a sensible land stewardship plan. Tree planting may be a part of such a plan, depending on your intentions, available labor, and financial resources.

Look beyond one conservation project to consider how several projects may relate to each other. With thoughtful planning, you will leverage one project to benefit another. These projects may happen several years apart, but you gain efficiency by thoughtful planning. For example, a landowner planted a variety of Christmas trees in an area that would eventually become a valuable hardwood stand after the Christmas trees were harvested. First, the landowner chose a site to accomplish both projects in a 10-acre field with loamy soil. In the first year of the plan, Christmas trees were planted with wide spacing. In the fourth year, hardwoods like oaks, hickories, and maple were interplanted. For several more years, the Christmas trees sheltered the hardwoods. When the fast-growing Christmas trees were harvested, there was ample sunlight and nutrients available for the upcoming hardwood species. Good planning helped the landowner meet their long-range goals.

What exactly is driving your interest in tree planting?

As a landowner, you should reflect for a moment on your motivation for planting trees. Among the more common motivations are:

- Intent to change scenery or "fill in" a large open space
- Desire to change or improve wildlife habitat
- Need to reduce wind effects around a home
- Need for more privacy
- Idea that planting is just the right thing to do as a good land steward
- Intent to restore woodlands to their former abundance
- Goal to mark your property boundaries with a conspicuous feature
- Expectation of future timber or maple syrup production income

If you take the extra step of understanding your motivations, you will be able to visualize your long-range goals for tree planting more clearly. Fortunately, you can also bounce your ideas off local conservation and natural resource professionals who have experience with these tree planting projects.

Who to ask for help

Many communities have public and private natural resource professionals ready to help you plan your tree planting projects:

Soil and Water Conservation Districts: Technicians with education and experience in conservation planning. They also often have annual tree seedling sales or lists of nurseries for seedling and other trees. Check your county government telephone and website listings.

Cooperative Extension: Based at the state's land grant university, with county and regional offices, educators will know about natural resource projects appropriate for your locale. Educators can provide basic or complete soil testing, bulletins about tree species and wildlife, and sometimes, a site visit or plan review. Check your county government telephone and website listings.

Forestry or Environmental Protection Department: State-employed foresters (also called public service foresters) who are available to consult and sometimes visit sites for reforestation. They may help write forest stewardship plans and alert you to whether additional government funds are available to supplement your own tree planting costs. Many state forestry departments have tree seedlings for sale through a state nursery program. Check your state government telephone and website listings for a regional office.

Private foresters, tree nursery owners, and natural resource consultants: Specialists who have vast knowledge and experience with forest establishment, transplanting, and regeneration techniques. Consultants can write stewardship plans, locate contractors, lay out planting plans, and help monitor the success of tree planting projects over time. They perform all these services for a professional fee, and sometimes under written contract. Nursery owners can advise on what they have and how the species perform in local areas. Check local telephone and website listings or ask for referrals from public agencies.

Many people are available to help you assess your planting needs and evaluate your progress toward your objectives. Photo – P. Smallidge

Woodland Owner Volunteers: Some states also have teams of trained woodland owner volunteers, usually coordinated by the state Cooperative Extension service. For example, New York has Master Forest Owners, directed by Cornell Cooperative Extension; Pennsylvania has a Forest Stewards Program directed by Penn State University. New England states have Coverts Volunteers. As fellow woodland owners, these volunteers have valuable insights about tree planting and reforestation.

The Twelve Months Before You Plant

Presuming a spring planting, here are some ideal month-by-month steps to take to make the best possible plans for your property and tree planting projects:

As with all landowner activities, defining your objectives is essential for success. This owner plans for future syrup production from a properly spaced planting of sugar maple seedlings with adequate protection from deer. Photo – P. Smallidge

The Year Prior to Planting

April – May

- Review your stewardship plan and identify the planting objectives and how they related to other objectives.
- Request tree seedling flyers from nurseries and Conservation Districts.

May – July

- Draw up a site map, depicting your property boundaries, and existing woodland and field conditions. Mark which projects you would like to see done and where.
- Walk through the site with a shovel to assess the soil moisture, competing weeds, and any limiting features like power lines, easements, and boundaries.
- Meet with natural resource professionals in their office or on-site to review your site map and planting plans.
- Make another assessment of soil and competing weeds.

August - December

- Prepare the site for spring tree planting by removing competing vegetation, laying out tree spacing, and calculating amounts of trees. Perform soil testing for pH and other nutrients.
- Obtain tools and equipment like buckets, tree shelters, and wildlife repellents.

The Year of Planting:

January - March

- Place orders early for tree seedlings and note pick-up or delivery dates. Schedule your time to begin planting immediately after you receive the seedlings.
- Arrange labor assistance and determine various duties.

April - May

- Receive and begin planting tree seedlings in prepared sites.
- Protect seedlings and monitor weather and moisture conditions in the soil.

June – October

- Monthly inspection of seedling to monitor foliage vigor and health.
- Contact local professionals for assistance and strategies if problems develop.
- Control weeds around seedlings and confirm the stability structures that will protect seedlings from deer and rodent damage.

Any additional homework?

This chapter mentions the process of laying out tree spacing, calculating tree numbers, and selecting species. The next chapters - Chapter 2: Planting to meet your goals and Chapter 3: Site assessment - explain how to make these decisions; some assistance from the personnel noted above will help too. Take some additional time to continue planning and narrowing down your intentions for your tree planting project. Once you know the limitations of your planting site, which trees will grow well, and how many of them you need, then you will be ready to obtain and plant your trees.

Resources and additional reading:

Cornell University Cooperative Extension Guide for water quality planning before, during and after forestry operations. www.dnr.cornell.edu/ext/bmp/.

Wisconsin's Forestry Best Management Practices for Water Quality Field Manual (Forestry Publication #93 03Rev). Available from the Division of Forestry at (608) 267-7494.

Ontario, Canada Forestry Extension Notes - Bulletins about tree planting and other forestry conservation topics - available through the Landowner Resource Centre at www.lrconline.com See the extension notes on tree planting and other topics at www.lrconline.com/Extension_Notes_English/forestry/for_index.html.

Penn State University forestry bulletins - Available online at http://pubs.cas.psu.edu.

USDA Forest Service tree planning publications - search the collection of publications at http://www.treesearch.fs.fed.us/.

Chapter 2 – Planting trees to meet your goals

Introduction

So, you have decided it is time to plant some trees! Congratulations! Tree planting is an exciting opportunity to leave a long-term legacy on the ground - a legacy that will benefit people, wildlife, and the environment. You are taking the time to read this bulletin and that will help your understanding of your planting objectives.

Maybe you want to reforest a portion of your property, or you want to block the view the neighbors have of your deck; perhaps you simply want to do something productive and beneficial for nature. Planting individual trees, or groups of trees, and watching them grow, is very rewarding.

Woodland establishment or creating a strategic cluster of trees using transplants is also an important step in improving the ecological conditions of rural property in the Northeast. Whether specifically for wildlife, to develop a future timber stand, or as a windbreak, trees can provide many benefits for humans. This chapter describes how rural property owners can better match their long-range objectives with the trees they plant. We suggest good practices for tree planting and how to deal with potential problems. Below are common examples of long-range goals that we explain later in this bulletin:

- Establishing trees for wood products (timber, fuel wood, etc.)
- Attracting wildlife
- Screening for privacy or reduce a nuisance
- Restoring a field back to a forest, or creating a maple sugar orchard
- Windbreak for home, farm, or road
- Planting to improve a view
- Restoring a forest following a natural disturbance
- Other goals and objectives for tree planting

You may be ready to order tree seedlings to plant, or you may be dreaming of owning property you will someday manage. Either way, you will likely be planting trees to achieve a purposeful result. With some background information, planning, and good planting techniques, you will reduce the frustration people experience when their tree planting projects fail.

An essential step in planning is communication among all those who will help establish, maintain, or utilize the planting. Avoid the temptation to rush into a project. Talk with your spouse, siblings, parents and children. Learn their interests in the property and the planting. Discuss the variety of objectives and how tree planting might contribute to your collective enjoyment of the property, now and in the future.

This chapter describes a variety of common planting objectives, including general recommendations for developing a planting. For your specific planting objective, you may need to mix and match the guidance provided. Other chapters in this bulletin provide more detail on the characteristics of certain species or efficient techniques to accomplish a certain task.

Planting trees to meet your goals

This section reviews many different goals for tree planting and how to meet those goals without compromising the natural ecology of your property. You might visualize the potential for success in your effort as the amount of overlap among three circles (figure 1): one circle represents your objectives or goals, the second circle represents the ecological conditions of the site where you will plant, and the third circle represents the characteristics of the species you intend to plant – what the species needs and what it provides.

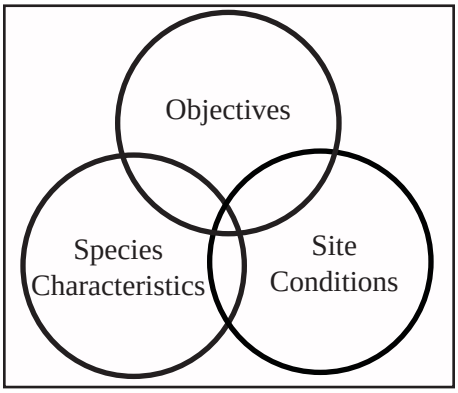


Figure 1. It is essential to find the overlap among your site conditions, ownership objectives, and characteristics of desired species. Some planting projects have more overlap, and thus more choices for species selection, than other other planting projects. Graphic – P. Smallidge

With most woodland activities, the owner's objectives have top priority. However, with tree planting, many failures occur because the owner's objectives for planting and the species they selected did not match the site conditions. Avoid the easy mistakes and only plant tree species that are adapted to your site conditions.

By investing sufficient time and effort in planning you will know where and how much overlap you have and thus increase your potential for success. You cannot control every planting situation and guarantee success, but you can greatly improve your chances. As you will see below, the common theme across all goals is to clearly identify your planting objectives and then select a species that both meets your goals and is compatible with the ecological conditions that occur at the planting site. These guidelines are somewhat generalized to fit many different situations found on different parcels and circumstances. If you feel you need a little more help and specifics, see the list of advisors in "Chapter 1 – Recommended Homework Before Planting."

Establishing trees for wood products

Planting trees to create future timber or fuel wood value is best done with a "reforestation plan," which you would usually develop in consultation with a forestry professional. There are many variables to consider, including soil conditions, site characteristics, choice of tree size, choice of species, financial investment, and disease potential. An experienced forester can provide an analysis of the site and timber productivity with far more clarity than most property owners can. However, the forester needs to understand your goals and your long-term ideas for your property.

Attempts to plant seedlings primarily based on expected future timber value often fail. Many factors, including a mismatch of the site and tree species, deer browse, changes in timber markets, weather conditions, and mismanagement of the developing stand, devalue potential hardwood quality. Timber markets are difficult to predict even a year in advance, so projecting timber demand decades away is almost impossible. It is safe to say that good markets will always exist for high quality trees. However, a species planted in an inappropriate site cannot develop into a high quality tree. Spend your effort tending your forest rather than forecasting distant timber futures.

Natural regeneration is the best option if you have an existing seed source and can control other barriers such as deer and interfering vegetation. This woodlot was correctly harvested to retain the best trees as a seed source for the next forest. Photo – P. Smallidge

Promoting natural regeneration is often the key to timber stand establishment, rather than intentional planting of specific trees. Regeneration is the process in which existing trees reproduce themselves and develop into a natural community, based on the site conditions. Rural property owners can create conditions to promote natural regeneration of desired species, which is often more practical than an artificial plantation of hardwoods. Natural regeneration has the benefit of usually being less expensive to initiate, uses trees that are proven to grow in those soils, and can be established in high densities that produce straight, high quality stems.

For example, in the interest of creating a future stand of red oak and sugar maple, a property owner might be tempted to purchase and plant hundreds of seedlings of these species in an open field. Planting in the field carries many risks to conquer, such as competition from existing vegetation, potentially high deer populations,

and over-exposure on some sites. Some species, like sugar maple and black walnut struggle to survive in windy and dry sites.

It would be more practical to create sheltered conditions that enhance the establishment and development of these hardwood seedlings require by heavily thinning cull trees from a degraded hardwood forest. You might have an abandoned conifer plantation from the 1930's on your property. Hardwood seedlings commonly develop under the canopy of pine stands in New York. The hardwood seed is blown in or transported from surrounding forests by animals. This is an example of creating conditions for natural regeneration.

Examples of species to consider:

Planning for future timber production is a long-term commitment. Several species, such as this northern red oak, are appropriate for multiple objectives that also include wildlife and aesthetics. Photo – P. Smallidge

Several hardwoods exist with good to excellent future timber value in the Northeast. Species value varies greatly throughout the Northeast. Some tree species are excluded because they are susceptible to specific insect or pathogens that might limit future productivity. If future conditions change, you might also add white ash and butternut to this list.

Black cherry (*Prunus serotina*)
Red (Soft) maple (*Acer rubrum*)
Sugar (Hard) maple (*Acer saccharum*)
Red oak (*Quercus rubra*)
White oak (*Quercus alba*)
Black birch (*Betula lenta*)
Yellow birch (*Betula alleghaniensis*)
Yellow poplar (*Liriodendron tulipifera*)
Black walnut (*Juglans nigra*)

Spacing of timber hardwoods:

Your site conditions and goals will dictate how many seedlings will be planted per acre. Generally, plant a potentially productive site at a density of 700 – 1100 trees per acre. The corresponding layout would range from seedlings planted every 6 feet in rows 10 feet apart, to seedlings planted every 6 feet in rows 8 feet apart. Not every seedling will survive since it takes 2 – 5 seedlings to get one full-grown tree. Plan on adding supplemental trees or thinning as time goes on; one establishment year is rarely enough.

How to establish a future timber stand:

Step 1 - Assess the site in which you intend to develop a future timber stand. Note soil condition, potential seed sources, deer pressure, access for future stand management, topography and exposure to sun, and competition. Soil quality will be one of the most important factors to determine what species will regenerate on the site.

Step 2 - Consult with a forester experienced in timber stand development and regeneration. Most states have professional forestry staff available to you through the state forestry agency. Public sector foresters may visit the timber site and help you draft a plan for natural reforestation. They can also provide you with a list of private sector foresters in their state and describe if they are licensed, registered, or enrolled in your state's cooperating forester program. Each state can also provide guidance through the Cooperative Extension Service. Finally, most states have one or more forest owner associations - private organizations composed of forest owners and forestry professionals that can offer advice and or personal experience based on how they have individually planted trees.

Step 3 - Develop a simple written plan to detail actions for stand establishment, site management over the years, control of competing vegetation, and deer deterrence. A reforestation plan would be a few pages in length. Start with a clear statement of why you own your property and why you want to reforest a section of your property. The logic for the reforestation should mesh with at least one of the overall objectives for the property. The reforestation plan would also include the source of juvenile plants, a map of the soils to be reforested, strategies for protecting the seedling from deer and competing vegetation, and how frequently the seedling will be checked to ensure survival and growth are adequate.

Step 4 - Prepare the site by removing grass and other competitive vegetation one season before planting.

Step 5 - If using artificial reforestation, acquire and plant trees necessary to establish the stand or a plantation of cover trees. If relying on natural regeneration, pay attention to seed production in nearby trees and consult with your forester to ensure that adequate seed bed conditions will be available when the seeds are dispersed. Keep records of the process and receipts organized for tax purposes.

Attracting wildlife

Wildlife is usually intended to be the beneficiary of many tree-planting projects: berry-producing shrubs for songbirds, nut trees for turkey and small mammals, evergreens and dense shrubs for cover. Although it takes years for these plantings to mature to the point where they consistently produce wildlife food and shelter, they often attract resting and foraging wildlife and songbirds right away.

There are three strategies you should incorporate to make your wildlife planting as effective as possible: natural arrangement of plants, a variety of non-invasive tree and shrub species, and native-based vegetation choices. These strategies may make a conservation site slightly more labor intensive because mechanized equipment becomes less practical, but over time, the variability of a wildlife planting will create better conditions.

The location and arrangement of a wildlife plot is important. Where possible, plan the new planting to connect woodlots as a corridor of vegetation. Such a corridor should have wide areas (up to 100 feet wide) and more narrow areas (30 feet wide), creating more edges and structural diversity. Along the length of the corridor, mix dense and less dense areas. Use the natural mature height of the trees to create variation in the profile of the planted area. You can put tall trees to the interior and shorter trees to the outside or vice versa. Because different species have different shelter needs, creating a mixed habitat will attract a greater variety of wildlife.

If a corridor-type arrangement is not possible, plan on several irregularly shaped patches along a forest border or surrounding existing trees. As before, consider the mature height of the plants to achieve variation in habitat structures. Curves and small gaps make the patch accessible to more forms of wildlife. An added benefit is having the plot surround a small stream or wet area.

Selecting native or non-invasive vegetation when you are buying tree and shrub seedlings is now recognized as a crucial step toward improving wildlife habitat. Old conservation plantings often included honeysuckle, autumn olive, multiflora rose and other exotic species. These generally have not produced the intended long-term benefits for wildlife. These species lack the branching structure, fruit type, or other characteristics native wildlife need. Moreover, these species have proven to escape into other areas and create problems in their control.

Native species like American cranberry, Eastern red-cedar, elderberry, native dogwood, hawthorn, and sumac have many components favorable to wildlife - berries, edible twigs, shelter, and nutritious seeds. Additionally, native songbirds and mammals are adapted to consuming these at certain times of the year. The nutrition provided by native plants and the seasonal metabolic needs of wildlife, such as energy for migration, are well-matched. Any additional effort you make to obtain and plant native trees and shrubs is a good investment in better environmental conditions for wildlife. Check with your local Cooperative Extension office for information on local and regional native plant nurseries.

Some foreign species have become naturalized, and wildlife will eat their seeds and fruits readily. During your site assessment, you may spot low-quality non-native vegetation, like Austrian or Scotch pine, honeysuckle, autumn olive, or multiflora rose. In most cases, it is appropriate to gradually remove the exotic vegetation and replace it with native species. If you are unclear about species identification, consult your local nature center, Cooperative Extension office, or a book about tree and shrub identification.

How to establish a wildlife planting:

Step 1 - Assess the site in which you intend to develop a wildlife zone. Investigate and map soil conditions to include soil depth, drainage, and fertility. Include sketches of existing plants and trees, connectivity to surrounding woodlots, exposure, and areas of interfering vegetation. A satellite image of your property, available on the Internet, will help you see the big picture of your property relative to your landscape.

Step 2 - Consult with a naturalist, forester, or natural resource or conservation professional experienced in wildlife plot establishment. Ask for recommendations on specific trees and shrubs that will be beneficial to wildlife at the site you have chosen. They will need to know some of the information you have collected, and will probably ask you additional questions.

Step 3 - Develop a simple drawing to guide wildlife plot establishment, arrangement, and site management.

Step 4 - Prepare the site by removing grass and other competitive vegetation one season before planting. Acquire and plant native trees and shrubs you plan to use to attract wildlife.

Examples of species to consider:

Trees and shrubs with high wildlife value
Eastern red cedar (*Juniperus virginiana*)
Black cherry (*Prunus serotina*)
Red oak (*Quercus rubra*)
White oak (*Quercus alba*)
Butternut (*Juglans cinerea*)
White flowering dogwood (*Cornus florida*)
Trembling aspen (*Populus tremuloides*)
Big-toothed aspen (*Populus grandidentata*)
Cottonwood (*Populus deltiodes*)
Hawthorn (*Crataegus* spp.)
American plum (*Prunus americana*)
Elderberry (*Sambucus canadensis*)
Blueberry (*Vaccinium* spp.)
Redtwig dogwood (*Cornus stolonifera*)
American cranberry (*Viburnum trilobum*)
Nannyberry (*Viburnum lentago*)
Service berry (*Amelanchier* spp.)
Arowwood (*Viburnum dentatum*)
Raspberry (*Rubus* spp.)
Eastern juniper (*Juniperus communis*)

Several shrub species are valuable for wildlife because they maintain a low structure and produce accessible and edible fruits. Some species, such as this mapleleaf viburnum, may be sensitive to pests that limit their usefulness in planting. Photo – P. Smallidge

Spacing / layout:

- Trees planted for wildlife do not have standard spacing requirements; in fact, irregular spacing provides good structural diversity.
- To allow for optimal growth, individual trees should be planted 6 - 8 feet from each other; shrubs are planted 4 - 6 feet apart.
- Arrange wildlife plantings into clusters or strips with taller vegetation surrounded by shorter vegetation.
- Mix species together as much as possible.

Screening for privacy or reduce a nuisance

Most rural property owners start their quest for screening or privacy vegetation by asking, "what is fast growing?" The fastest growing trees in the Northeast are hybrid poplars and certain willows on moist sites. Of course, these trees do not have leaves in the winter, so their use as a full screen is somewhat limited. Typically fast-growing evergreens, like white pine and red pine, will only grow rapidly on rich, well-drained soils. This leaves only one practical solution to the question of screening vegetation: blending truly fast growing trees integrated with dense screening trees.

Fast growth in trees is relative and not always immediate. On many rural properties, most seedling trees will take two or three years to establish a root system that will provide for a rapid growth spurt, starting in the third or fourth year after planting. The actual length of time depends on soil conditions, the history of the site, maintenance of the seedlings after planting, and the abundance of deer and competing vegetation.

When planning the location and arrangement of a privacy screen made up of trees, investigate the site carefully. Trees that grow tall should not be planted near or under power lines. Where property boundaries are tight, be certain of the location of the boundary line and stay on your property, unless you communicate with the neighbor to plant closer. Hire a surveyor for a few hours if the property line is unclear. Do not plant trees within 30 feet of structures or septic fields. Try not to create a leafy nuisance for your neighbor every autumn.

The US Department of Agriculture has done considerable work in developing guidelines for windbreaks and snowbreaks through reforestation. Several publications are available through the National Agroforestry Center or your local NRCS or Soil and Water Conservation District. The National Agroforestry Center website is www.unl.edu/nac

An effective privacy screen is comprised of various fast- and moderate-growing trees. As mentioned above, hybrid poplars will grow very fast on most sites. Intersperse such a planting with birch, pine, spruce, wildlife shrubs, and maples. Larger transplants, such as 5 - 6' balled & burlapped evergreens, will speed up the establishment of the screen. When the more permanent trees are established, you must remove the poplars for better light conditions and to control their inevitable decay and break-up. Hybrid poplars grow fast and often die abruptly.

Examples of species to consider:

Fast growing species for privacy
White pine (*Pinus strobus*)
Red pine (*Pinus resinosa*)
Austrian pine (*Pinus nigra*), exotic but not invasive
Scots pine (*Pinus sylvestris*), exotic but not typically invasive
European larch (*Larix decidua*), exotic but not invasive
Norway spruce (*Picea abies*), exotic but not invasive
White birch (*Betula papyrifera*)
Red (Soft) maple (*Acer rubrum*)
Big-toothed aspen (*Populus grandidentata*)
Cottonwood (*Populus deltiodes*)
Shrub willow (*Salix* spp.)
Black locust (*Robina pseudoacacia*), may invade in some circumstances

Spacing:

- Trees planted for screening do not have standard spacing requirements; in fact, tighter spacing provides good screen density.

- To create optimal density, individual trees should be planted 3 - 6 feet from each other; shrubs are planted 2 - 3 feet apart. Over time remove some trees and shrubs to maintain full leafy canopy.
- Arrange screening plantings into clusters or strips with taller vegetation surrounded by shorter vegetation, to provide wildlife habitat.
- Mix species together as much as possible.

How to establish a privacy screen:

Conifers are a common selection for privacy because they often grow quickly, retain foliage throughout the year, and have a variety of aesthetic qualities. Photo – P. Smallidge

Step 1 - Assess the area you are going to screen, noting if there are restrictions such as power lines, septic fields, drainage pipes, structures, or other utilities. Some homeowners associations may restrict what, how, and where you plant so review your local policies before taking any action. Take into account soil conditions and the level of exposure to sun and wind.

Step 2 - Prepare the site by removing grass and other competitive vegetation one season before planting.

Step 3 - Choose a mix of trees that will provide a fast-growing start, combined with moderate-growing trees that will fill in and add diversity in the following years.

Step 4 - Plant the trees in curving clusters, which is more natural than straight rows. Plan a follow up planting in several years to begin a new zone of diversity.

Step 5 - Some species will sprout from the stumps or roots when cut and allow for easy maintenance of dense growth. These species include black locust, shrub willow, and aspen.

Restoring a field back to a forest or creating a maple orchard for syrup production

Rural property owners commonly use seedling trees and shrubs to speed up the process of reforestation of an abandoned agriculture field. Many people enjoy planting trees in fields to help

speed the re-establishment of the native vegetation. After all, agriculture prevents reforestation, so when the fields are no longer being used for farming, accelerating their reversion to woodlands often provides the original land use.

Maple trees, sugar but also red maple, can be planted to create efficient locations for production and collection of sap used to make maple syrup. These specialized plantings are called maple orchards. Maple orchards can be created in an open field or integrated within an existing forest associated with a harvest or some other type of disturbance. There are three special planning considerations for a maple orchard: (1) try to obtain trees that have a high sugar concentration in the sap, (2) layout plantings to simplify the tubing system or collection by buckets, and (3) interplant to maintain approximately 25% mixture of other species to reduce the impacts of insect damage in a monoculture. You might interplant with trees having other desirable characteristics.

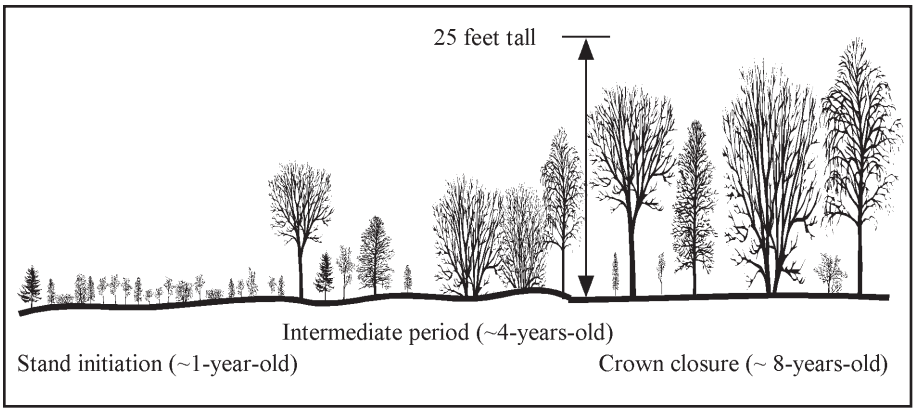
Despite being a respectable goal, one form of this conservation practice has resulted in some ecologically unfavorable conditions during the last few decades. Although many people have established plantations, block planting of monocultures have some drawbacks. You may be able to use some strategies from the other planting objectives we describe in this chapter to achieve your objectives with plantations while minimizing the drawback.

Consider your objectives carefully before establishing a large plantation monoculture to avoid the following:

- Alteration of natural reforestation and successional patterns.
- Rapid conversion of grassland habitat to young evergreen stands. Grassland habitats support many different species of birds, insects, and mammals. Extensive patches of pines are unnatural and less suitable for diverse wildlife.
- Establishment of relatively permanent blocks of conifers like Scotch pines, Austrian pines, Red pines, and Blue spruce that have limited timber or wildlife value.

In some situations, such as when field habitat in your vicinity is scarce, woodland restoration is not always the best option. Rural property owners should weigh their goals for tree planting with the needs of the natural community that surrounds them. It may be better to maintain the open field or to establish a regionally significant plant community. Consult with a forester, a state agency wildlife biologist, or an Extension educator who can provide habitat restoration advice.

Rural property owners planting trees for reforestation may want to mimic some of the lessons we have learned from observing natural reforestation patterns. The two prominent patterns observed in fields that revert to forest are (1) a variety of species are typically present and (2) species thrive in some areas but not others based on local soil patterns.



In some cases, an owner may want to alter the natural course of succession to encourage other species or patterns specific to their objectives. If so, work with a qualified professional to understand the natural processes and what is necessary for successful establishment. Graphic – J. Ward

Using topographic and soils maps you can sketch small-scale patterns of site differences. Find tree species that match these site conditions, and try to plant a variety of species within each site condition. For example, you might plant white oak and black locust on dry areas and sugar maple, yellow birch, and black cherry on more fertile sites. Planting trees in rows will simplify tending the trees later, but the rows do not look natural. Straight rows do not alter ecological processes, but alter the aesthetics of the planting. Random planting, though still matching species with site conditions, looks more natural, but will be more difficult to execute. One possible compromise is to plant in rows within a certain site or patch, but don't align the rows across the entire planting area. Plan ahead for access with tractors or equipment if you do not plant in rows.

Examples of species to consider:

Pioneer species
White pine (*Pinus strobus*)
Red pine (*Pinus resinosa*)
European larch (*Larix deciduas*)
White birch (*Betula papyrifera*)
Trembling aspen (*Populus tremuloides*)
Pin cherry (*Prunus pensylvanica*)
Cottonwood (*Populus deltoides*)
Red oak (*Quercus rubra*)
White oak (*Quercus alba*)
Black locust (*Robina pseudoacacia*)
Yellow-poplar (*Liriodendron tulipifera*)
Black walnut (*Juglans nigra*)

Partially to fully shade tolerant / understory species:

Basswood (*Tilia americana*)
American beech (*Fagus grandifolia*)
Red (Soft) maple (*Acer rubrum*)
Sugar (Hard) maple (*Acer saccharum*)
American chestnut (*Castanea dentata*)
Hazlenut (*Corylus americana*)

How to reforest a field:

Step 1 - Assess the field you are going to reforest, noting patterns of soil and small-scale topography. A forester or technician from your soil and water conservation district can assist. Sketch the patterns that exist and list the species that do well on each planting site.

Step 2 - Prepare the site for individual trees by removing grass and other competitive vegetation one season before planting.

Step 3 - Choose trees that are suited for the soil and tolerance of constant sunshine. Try to find at least a couple complementary species for each site condition. You can repeat the same set of species if the same site conditions repeat in the field.

Step 4 - Plant the trees in their appropriate soil and topography locations. Plan to inspect the trees each year for a few years to ensure they become established.

Windbreak or living snow fence for home, farm, or road

Windbreaks save energy around farms and houses and save labor by blocking the effects of wind on snow removal. In the proper location and arrangement, windbreak trees reduce wind speed significantly. Lower wind speed saves home and farm energy by reducing infiltrated air - cold air that permeates structures. Windbreaks can control where and how much drifting snow deposits on your property as well.

Topographic maps are important tools to help owners consider the position of the planting site, potential soil moisture concerns, and access for planting and maintenance. Photo – P. Smallidge

Many windbreaks fail due to poor planning. The physics of wind and snow drifting is more complicated than most property owners realize.

Where an optimal arrangement of windbreak trees is not possible, you should adapt the following principles to your property conditions:

- The windbreak should be positioned to protect a structure from the prevailing winds – typically west and northwest winds.
- Winding or L-shaped windbreaks are more effective than straight lines of trees.
- Three- to five-row windbreaks provide better stability and wind protection than one- or two-row windbreaks. Additional rows improve the performance of the windbreak. Some government cost-share programs may require a minimum number of trees. Check with your local NRCS, Soil and Water, or state forestry agency before planting.
- A windbreak should be at least 100 feet and no more than 300 feet from the structure or road it is intending to protect.
- The length of the windbreak should extend significantly past the last point of protecting required due to wind wrapping around the ends. A protected structure 50 feet wide would need a windbreak at least 120 feet long.
- The tallest tree species should be located near the center of the windbreak.
- Plant trees in irregular and staggered patterns to provide maximum wind protection.
- Wildlife shrubs planted around the edges of the windbreak will improve wind protection and create suitable habitat.
- Avoid using trees that are sensitive to wind and heat, like firs, ornamental trees, and sugar maples. If you want to plant these trees to satisfy other objectives, plant them on the down-wind side of the wind break.

A windbreak is intended to slow wind due to its density, especially in the winter . Trees need to be spaced so they will grow closely together without forming a solid wall. The ideal density should vary from 60 – 80% along the length of the windbreak. A mix of dense evergreens and deciduous trees will create the best level of perforation. You may increase the effective density by staggering or off-setting the trees in adjacent rows.

Examples of species to consider:

White pine (*Pinus strobus*)
White cedar (*Thuja occidentalis*)
Eastern red cedar (*Juniperus virginiana*)
White spruce (*Picea glauca*)

Red pine (*Pinus resinosa*)
Colorado blue spruce (*Picea pungens*)
Austrian pine (*Pinus nigra*)
Scots pine (*Pinus sylvestris*)
European larch (*Larix decidua*)
Norway spruce (*Picea abies*)
White birch (*Betula papyrifera*)
Black cherry (*Prunus serotina*)
Red (Soft) maple (*Acer rubrum*)
American sycamore (*Platanus occidentalis*)
Trembling aspen (*Populus tremuloides*)
Big-toothed aspen (*Populus grandidentata*)
Cottonwood (*Populus deltiodes*)
Hybrid poplar (*Populus* hybrids)
Black locust (*Robina pseudoacacia*)

Spacing / layout:

- Trees planted for windbreaks do not have standard spacing requirements due to site and species variables
- Good windbreak density is 60 – 80 percent.
- Arrange windbreak plantings into strips with a mix of deciduous and evergreen species. At least one row of the windbreak should be fairly dense evergreens.
- Mix species together as much as possible, and include wildlife-friendly species.

How to plant a windbreak:

Step 1 - Assess the location of the structure(s) or road(s) to be protected and the direction of the prevailing winds. Analyze the soil and determine what other restrictions (property boundaries, utilities, septic area) are present. Make plans to accommodate access by equipment for other land uses such as farming or off-road recreational vehicles.

Step 2 - Make a scale drawing of an ideal windbreak location and arrangement, following the principles noted above. Lay out the pattern you will use and approximately how many of each tree species the site will require. Transfer this drawing to the site using flags to mark the final location. Consult with an experienced conservation or natural resource professional if you are uncertain about your plan.

Step 3 - Choose a mix of trees that will provide adequate density and diversity for the windbreak. Prepare the site by removing grass and other competitive vegetation one season before planting.

Step 4 - Acquire and plant the trees according to your drawing. Plan a follow up planting in several years to begin a new zone of wind protection.

Planting to improve a view

Some rural landowners desire single specimens or clusters of trees to improve the aesthetics of their property . In such cases, long-term thinking will drive selection, siting, and planting. Every person interprets the beauty of trees in their own way, so other than matching species and site there are no rules about what should be planted and where.

If you are striving for enhanced aesthetics through tree planting, consider mixing trees with contrasting characteristics in clusters. From a commonly used window, a cluster of pines can be very attractive. Even more appealing is a light-colored deciduous tree (birch, dogwood, witch hazel) against a darker evergreen background, plus berry-producing shrubs (e.g., winterberry, service berry, or American cranberry) at the edges. This visual layering of tree species is possible only through planning and site preparation.

Birch trees, such as this yellow birch, provide an aesthetic element to an existing woodlot. Select trees that are suited to the soils and environmental conditions. Photo – P. Smallidge

New trees are relatively permanent additions to the home landscape. In just a few years, well-intentioned plantings can become haphazard clumps that block better views. Nursery managers, landscape architects, Master Gardeners, and Extension personnel can help you make good decisions about tree aesthetics.

How to plant trees for aesthetics:

Step 1 - Assess current views to determine where trees would best be positioned. Analyze the soil and determine what other restrictions (property boundaries, utilities, septic area) are present. Visualize how the trees will appear when they grow to full size.

Step 2 - Make a landscape development plan that includes drawings of what views are important and what view should be altered with trees. Consult with an experienced landscaping professional if you are uncertain about your ideas.

Step 3 - Prepare the site by removing grass and other competitive vegetation one season before planting. Choose and acquire trees that will provide the visual appeal you are seeking through as many seasons as possible.

Restoring a forest following a natural disturbance.

At some point in time, many forests will experience major natural disturbances that are out of the control of the property owner. Tornadoes, severe icing, or mudslides create sudden and extensive openings in a forest. Other major disturbances, like intense deer browse or an insect infestation, can significantly degrade forest conditions. Although it is tempting to immediately replant these areas with seedlings, typically it is not necessary.

Few rural property owners know what to do when they venture into their woods to investigate the damage after a natural disturbance. The first consideration is your safety because some disturbances will leave trees that remain hazardous for several years. When you first visit your disturbed forest, the distress of looking at twisted and splintered trees, the change of the forest you've grown to love, or the loss of timber value can be overwhelming. It is during these times when professional help from a forester or natural resource expert can be of greatest help. You have many options, from doing nothing to a complete salvage operation. An experienced professional will help you assess the site, determine your range of options, and advise what would be the best course of action based on your long range goals for your forest. Contact a consultant if you are trying to understand your situation better.

Natural disturbances, such as the wind storm that broke these tree crowns, create opening that allow sun into the forest floor. Small opening will be filled by expansion of existing upper canopy crowns. Larger openings will be filled from below the canopy. Inspect existing established plants. Add new plants as desired. Use caution when working in disturbed areas. Photo – P. Smallidge

The decision to replant trees should be based on your objectives for the area and your property in general, an assessment of the remaining trees, the stability of the site, and the potential for natural regeneration. The number and quality of surviving trees and other site conditions may be adequate for a natural reforestation process to begin again. Planting new trees may be completely unnecessary.

Consider the collapse of an old pine plantation during a severe icing or a summer thunderstorm. The surviving understory might have plenty of hardwood seedlings and saplings already established. On the other hand, it may be better to perform a partial or complete clearing of the site, planning on reforesting with new species better suited to the soils and climate, or species that reflect the property owner's future plans, such as for ruffed grouse habitat.

The decision to replant seedlings to compensate for loss to deer browse or insect infestations also requires sensible analysis and planning. Thousands of seedlings are planted in forests each year, only to be eaten or to die because they cannot survive in the existing site conditions or shade. Where deer have been and will be a problem, fencing, tree shelters, and / or tangled tree tops and limbs are necessary. These barriers will improve the success of the understory planting. In the case of insect infestation, new species of trees of lower susceptibility should be planted. Planting without addressing the disturbance, if necessary, will result in failure.

Foreseeing the long range impact of replanting after a natural disturbance requires professional assistance and good planning. You can increase the resilience of your woodlot to disturbances with ongoing management. A written management plan will help you focus your energy on top priorities and make the most efficient use of your time and energy.

How to replant after a natural disturbance:

Step 1 - Gather facts about the damage, such as the acreage, tree species affected, extent of damage, soil conditions, and immediate and long-term hazards. Use aerial photographs and soil surveys to measure the impact of the event on your woodlot. Your ownership objectives must factor into the decision making process. If your primary objective is hiking and bird watching, then you'll respond differently to a patch blow-down or insect defoliation than someone seeking significant financial returns from their forest.

Step 2 - Consult with a forester or natural resource professional experienced in timber stand development and regeneration. Unless you have been professionally trained do not attempt to remove hazard trees, delimb, or ease tension on twisted trunks, roots, and limbs. If in doubt or with risk, invest in hiring professional loggers trained in hazard tree removal or just leave the area alone.

Step 3 - Work with your forester to develop a simple written plan to chapter stand re-establishment, site management, disposal or sale of salvage wood, and deer deterrence.

Step 4 - Acquire and plant trees if warranted. Keep records of the process and receipts organized for tax and insurance purposes.

Reforestation and tree planting is the only example of rural land management where the owner's objectives are not the most important consideration. Planting species that are not compatible with the existing soils is the most common source of failure. Work with your local Soil and Water Conservation District to learn the soils in the planting site. Develop a list of species suitable for the soils, and then consider which species match your ownership objectives.

Other goals and objectives for tree planting

Many people feel that we can reverse the threat of global warming simply by planting trees. This is not true. We all need to reduce the use of fossil fuels (coal, oil and gas) to bring this about. You can plant trees to reduce the need for electricity in the summer with residential shading. In the winter, windbreak plantings reduce air infiltration and increase the efficiency of heating fuel use.

Tree planting is a physically beneficial recreation for rural property owners. It is a good form of exercise, burning between 200 and 500 calories per hour, depending on the level of exertion. Tree planters also use leg, back, and arm muscles, enhance cardiac vigor, and expose themselves to the personal benefits of sunshine and fresh air after the winter months indoors. If you haven't been physically active or are getting up in years you should consult with your physician before undertaking any physical activity.

For many people, tree planting is an annual ritual. Dormant tree seedlings are among the first things to be planted in the springtime. In addition to accomplishing the multiple goals noted in this chapter, tree planting is a satisfying seasonal habit.

Chapter 3 – Site assessment and site worksheet

The trees you will plant are at a relative disadvantage - if they cannot tolerate the site, they are unable to get up and replant themselves. Improperly placed trees will not thrive and many or most will die, despite all the work you put into the planting project. It happens all the time, but does not have to happen in your situation. You have the ability to quickly assess the site, and work within its limitations. Site conditions, such as soil moisture, soil fertility, and wind exposure, are typically inherent in the site and not easily changed. The best tactic is to pick a tree species that can thrive in the given site conditions. This chapter reviews what goes into a site assessment for tree planting and provides an assessment worksheet.

Rural tree planting projects should start at least one growing season before the trees are purchased and delivered. You, as a rural property owner, probably want to accomplish a particular goal, such as reforestation, creating new wildlife habitat, or establishing a prettier view.

Know and understand the limitations of the site

Trees cannot always grow vigorously wherever you plant them. Most trees have the ability to adapt to a range of conditions, but not all trees are suited for all sites on your property. You need to take into account the limitations of the tree planting site, such as soil moisture, soil fertility, shady conditions, periodic flooding, or exposure to wind and deer browse.

The three limiting factors for tree planting present on all sites are soil texture, types of existing vegetation, and exposure:

Soils:

The ability of soils to drain quickly or their tendency to remain waterlogged controls which species of new trees will survive. Soils can be rated “well drained” to “poorly drained,” with many variations in the middle. Use the soil survey developed for your county to understand the drainage characteristics of the soil at your tree planting site. A soil survey booklet is available at your county Soil and Water Conservation District (SWCD) office. Learn what soil type you are dealing with before ordering trees. The soil survey bulletin will often describe the tree species that will thrive on your soils. Soil survey information is available on the internet at http://websoilsurvey.nrcs.usda.gov/app/.

Your forester or SWCD technician can walk with you on your property and assess the health of existing trees and make recommendations for species likely to thrive. Avoid planting trees that do not have a high probability of success. You can lose several years and considerable effort trying to start species that are not match to the existing soils.

Existing vegetation:

Many sites for tree planting are usually open fields, but some sites have brush or small trees that can compete with new seedlings. Particularly dense wildflowers, like goldenrod, need to be controlled the season before planting. Even tall grass can stifle the growth of new seedlings unless it is cleared with repeated mowing, herbicides, or other techniques. Mice and rabbits can be detrimental to new seedlings, so clearing the site for planting will reduce their cover. As described in subsequent chapters, controlling competing vegetation before planting, and as the seedling establish, helps ensure your success.

Exposure:

Sites sloping toward prevailing winds and intense heat (south or west slopes) require a different mix of trees than protected or less exposed sites. Learn the orientation of the hillside or field where you will plant. Make sure you select trees that are tolerant of the openness or shadiness. For example, oaks tolerate sunnier, hotter areas, compared to maples, which thrive on northern or eastern slopes where sun and wind tends to be less intense.

Other factors:

The potential for deer browse will influence whether artificial protection is necessary or the kinds of trees you plant. Power lines, septic fields, and property boundaries also affect the trees you plant and where you plant them. Avoid frustration or creating problems by inspecting the entire area before you plant your trees. It is easier to prevent a problem than solve a problem.

Site Assessment Worksheet

Check all appropriate items. Bring this worksheet with you to your meeting with a natural resources professional.

My goals for tree planting:

___ Basic reforestation effort
___ Attract wildlife
___ Establish a future timber stand
___ Screen for privacy or to reduce a nuisance
___ Windbreak for home or road
___ Planting to improve a view
___ Restore forest understory, responding to a blowdown, or fixing deer damage
___ Sequester carbon / control air pollution or erosion
___ Special purpose - future Christmas trees or maple sugarbush

Existing vegetation:

___ Currently completely forested
___ Forested with open understory
___ Forested, but with clearings (natural or human-made)
___ Mix of brush and smaller trees
___ Grassy field with scattered brush and small trees
___ Grassy field or mown lawn
___ Recently tilled agriculture field

Deer abundance:

___ Deer are present each week; many plants are browsed and develop "broomed" tops
___ Deer are seen occasionally, usually in winter
___ Deer are very uncommon, no evidence of deer

Soil conditions:

___ Very soggy year-round
___ Ground remains waterlogged in springtime and after heavy rain
___ Ground sometimes soggy, but usually firm - not much clay
___ Ground is often firm, even in springtime and after rain
___ Soil is sandy or gravelly, and gets very dry in summer

Potential seed sources:

___ Adjacent hardwood forest with desired species matured and casting seed.
___ Adjacent immature hardwood forest with seed source potential
___ Potential seed source nearby but not adjacent
___ No potential seed source or adjacent forest comprised of undesirable species.

Slope:

___ Flat
___ Slight slope - facing south west north east
___ Moderate slope - facing south west north east
___ Steep slope - facing south west north east

Feasible weed control techniques:

___ Mowing
___ Weed mats
___ Scalping
___ Mulch layer
___ Furrowing
___ Herbicide

Exposure:

___ Full sun and wind
___ Sunny, yet sheltered from wind
___ Shady and open to wind
___ Shady and sheltered

Chapter 4 – Tree Selection

Choosing trees

Your choice of tree species for planting in the Northeastern Hardwood Region is extensive. There are dozens of species, each with its own characteristics and likelihood of survival. Since tree planting is somewhat permanent, your choices should be deliberate and carefully planned. Use the Tree Selection Chart to guide your choices. It lists many species of trees available for rural forestry projects. Combine your site characteristics with your goals to determine which trees will work. If you have questions, contact a technician with the state forestry agency, your Soil and Water Conservation District, or an educator with the Cooperative Extension System.

The use of the Tree Selection Chart starts with the soil and site conditions. Soil conditions are unlikely to change and will affect the tree for decades. Even if the current year is wet or dry, you must consider the long-term condition of the soil. Once you have identified the soil conditions, make a list of the species that are either recommended or satisfactory. Then select the column that represents the primary reason why you are planting. Look for trees that are recommend in that column and either recommended or satisfactory in the columns for any other reasons why you might plant. You can finally decide if you want conifers or hardwoods. Make a list of all the species that you might use, but prioritize them. Sometimes a particular species isn't available at a local tree supplier because of bad seed years or some other production problem. You will also need to note if the tree is resistant to deer browsing or tolerant of exposed conditions. Depending on the amount of deer pressure in your area or the amount of wind and sun exposure at the planting site, you may need to take additional protective steps.

As an example of using the Tree Selector Chart, if you have a dry sandy site and you are primarily interested in trees for wildlife the recommended and satisfactory trees include: black locust and American plum. You might also though consider some shrubs such as blueberry. We are fortunate to have dozens of tree species to select from, but with each constraint imposed by site or ownership objective, the list narrows.

Tree Selection Table

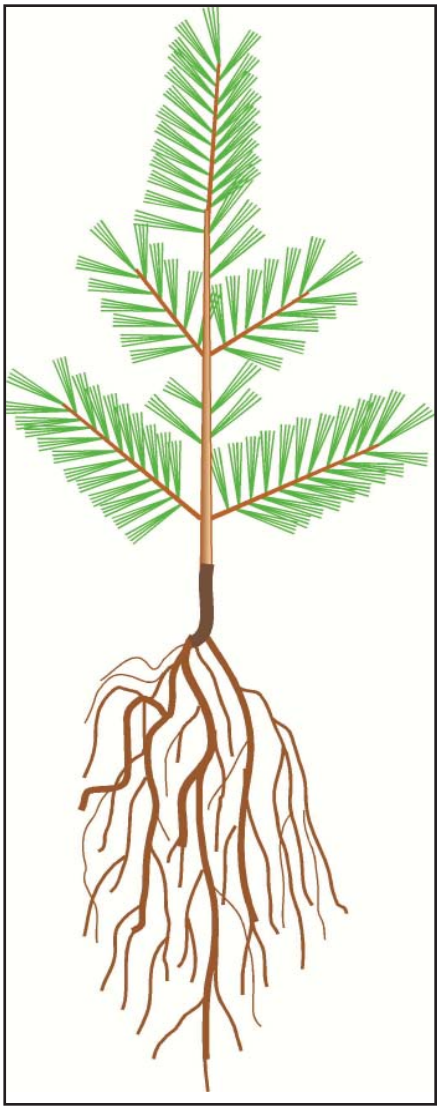
	SOIL			LOCATION / USE					Deer browse likely	Pioneer species	Shade / understory planting
	Damp / heavy	Loamy	Sand / gravel	Windbreak / screen	Timber or lumber	Wildlife	Christmas tree	Streambank / riparian buffer			
Native conifers / evergreens											
White pine (*Pinus strobus*)	F	G	P	G	P	G	G	P	G	G	P
White cedar (*Thuja occidentalis*)	G	G	F	G	P	G	P	G	P	G	F
Eastern red cedar (*Juniperus virginiana*)	F	G	G	G	F	G	P	P	G	G	P
White spruce (*Picea glauca*)	G	G	F	G	P	F	G	P	G	G	P
Canadian hemlock (*Tsuga canadensis*)	P	G	P	F	F	F	P	G	P	P	F
Balsam fir (*Abies balsamea*)	F	G	F	P	P	F	F	F	P	P	F
Red pine (*Pinus resinosa*)	P	G	G	G	P	F	P	F	F	G	P
Native hardwoods											
White ash (*Fraxinus americana*)	G	G	P	F	G	F	P	G	F	P	F
Green ash (*Fraxinus pennsylvanica*)	G	G	F	F	F	F	P	G	F	F	F
White birch (*Betula papyrifera*)	F	G	G	G	P	F	P	F	F	G	P
Black cherry (*Prunus serotina*)	P	G	G	F	G	G	P	F	F	F	F
Red (Soft) maple (*Acer rubrum*)	G	G	F	F	F	F	P	G	F	F	F
Sugar (Hard) maple (*Acer saccharum*)	P	G	F	P	G	G	P	F	P	P	G
Red oak (*Quercus rubra*)	P	G	G	F	G	G	P	F	P	F	F
White oak (*Quercus alba*)	P	G	G	F	G	G	P	F	P	F	F
American chestnut (*Castanea dentata*)	P	G	G	F	F	G	P	F	P	F	G
American sycamore (*Platanus occidentalis*)	G	G	F	P	P	F	P	G	F	F	P
Yellow poplar (*Liriodendron tulipifera*)	P	G	F	P	F	F	P	F	P	F	G
Black walnut (*Juglans nigra*)	P	G	P	P	G	G	P	F	F	F	F
Butternut (*Juglans cinerea*)	P	G	G	F	F	F	P	G	F	F	F
Redbud (*Cercis canadensis*)	P	G	F	P	P	F	P	G	P	F	G
Flowering dogwood (*Cornus florida*)	P	G	F	P	P	G	P	F	P	P	G
Trembling aspen (*Populus tremuloides*)	G	G	F	G	P	F	P	G	F	G	P
Big-toothed aspen (*Populus grandidentata*)	G	G	F	G	P	F	P	G	F	G	P
Cottonwood (*Populus deltiodes*)	G	G	F	G	P	F	P	G	F	G	P
Sweetgum (*Liquidambar styraciflua*)	G	G	P	P	P	F	P	G	F	F	F
Water tupelo (*Nyssa sylvatica*)	G	G	P	P	P	F	P	G	F	F	F
Hawthorn (*Crataegus* sp.)	G	G	G	F	P	G	P	F	F	G	F
American plum (*Prunus americana*)	F	G	G	F	P	G	P	F	F	F	F
Black locust (*Robina pseudoacacia*)	F	G	F	G	F	F	P	G	F	G	P
Hazlenut (*Corylus americana*)	F	G	F	F	P	G	P	G	F	F	G

Good	Fair	Poor
G	F	P

Table developed by Shavonne Sargent Morin.

Chapter 5 – Obtaining seedling trees, wild transplants, and tree seeds

As you watch winter begin to break for the season, you may be getting "itchy fingers" to go and plant some trees. At this point, you should have plenty of information about the soil, the amount of seedling trees you need, the best species for the site, the planned layout, a weed control strategy, and any restrictions the planting site poses. Now it is time to get your planting stock .



Select seedlings for planting that are healthy, have a robust stem, and that have a root system that is large enough to support the stem and foliage. Graphic – J. Ward

Seedling trees and transplants are easy to obtain from state forestry agencies, county conservation services, from local nurseries, by mail, phone, or on-line ordering. To the extent possible, obtain transplants that have been grown in the Northeast, in an area with a similar climate to your location. These trees have acclimated and adapted to our weather conditions and will have a higher survival rate.

One confusing aspect of buying seedling trees is how different sources might use different common names for their stock. For example, a retailer might call their Eastern Redcedar transplants by the name "Virginia juniper," which is more common in some regions. Both common names refer to the same species, which is also known by the botanical name *Juniperus virginiana*. To avoid buying the wrong species, learn the botanical names of the trees and shrubs you are planting for conservation. If the botanical name is not listed, ask the retailer to provide you with the botanical names, rather than the common names.

Some nurseries and plant research centers have developed hybrid trees, or have patented varieties and clones of some conservation nursery stock. Hybrids are developed to combine several favorable traits into one specimen through cross fertilization. For example, one type of hybrid poplar is called Spike hybrid poplar, recently developed by the USDA Plant Materials Center in Big Flats, NY. It combines the Northeast climate ruggedness of Eastern cottonwood (*Populus deltoides*) and the adaptability and speedy growth of a Lombardy poplar (*Populus nigra*) into one, very-fast growing tree. Clones of this hybrid were selected for additional disease-resistance characteristics. Field test show this hybrid is capable of growing 60 feet or more in 7 years, thus making it potentially useful as a conservation plant or biomass energy source.

Varieties are chosen to express a particular trait, such as showy color. For example, the Autumn Blaze Maple is a variety known commonly as Soft maple and botanically as the variety *Acer rubrum* 'Autumn Blaze.' When you are evaluating a variety, make sure the particular trait fits with your plans and surrounding land uses. A 'Gobbler' Sawtooth oak is a variety chosen for prolific nut production. This is potentially acceptable in a wildlife planting, but is less appropriate near a maple sugarbush, where squirrel damage to sap collection equipment is a concern.

Clones are seedling trees derived from plant tissue culture and are genetically identical. They are acceptable where consistency is desirable, such as in a Christmas tree planting or sugarbush planting.

Where to buy trees for conservation

Many county soil and water conservation district offices and state departments of environmental protection host conservation tree sales in the spring. These trees are economical and most are grown in the state where they are sold. The quality, service, and selection are typically good and will be a good source for most landowners. These sales are done for just a short period in late winter and delivery or pick up tends to be restricted. As a landowner, you will have to plan your planting around the availability of your seedlings from these sources. To find out what trees might be available and when, visit or call your local soil and water conservation or department of environmental protection offices, including those in nearby counties. Ask about the availability of tree seedlings and the terms for delivery or pick-up; use past sales to get a sense of what would be available in the planting season coming up or ask if anything different will be available.

Retail tree nurseries generally offer a wider variety of species and will usually guarantee the quality of the stock they sell and ship to you. Their ordering and delivery season may be more flexible and they rarely run short of the stock they list in their catalogs. In addition, the sales literature is descriptive, with photographs, special uses, and spacing and soil type recommendations. All this service carries a higher price, but with less risk and better recourse if something does not turn out as promised. You can find these nurseries locally, on the Internet, at garden shows, and through forest owner association magazines. There are many nurseries that focus on growing stock, not selling plant materials, so avoid inquiring at wholesale nurseries that do not have public retail sales. Use retail nurseries with a substantially similar climate to the location where you are planting to ensure adaptability.

Sizes of transplant trees

Several different types of transplantable trees are available to rural property owners. The larger the diameter of the root collar, the greater the likelihood of success. Seedlings with larger root collars have typically been given additional care and time and thus will cost more.

Seedlings (1-3 year) are economical and easy to handle. Costing less than a dollar each, they are often compared to a "pencil with roots." Their branches will be small and stubby, and the root system is frail. The nursery code 3-0 indicates three years of growth in one bed, for example, before sale to you.

Transplants (3-5 year) cost more, but are more resilient to the stress of transplanting. Transplants look and feel more like a real tree with branches and a more substantial root system. These trees have been transplanted in the nursery to promote development. The code 3-2 indicates three years in one bed, then two in a second bed, before being offered for sale.

Tublings are pencil-sized trees in synthetic tube-shaped containers. They have been grown in a greenhouse and hardened off outdoors. Tublings have dense root systems and thus have good survival rates.

Bare-root saplings are somewhat older trees, 2 - 5 feet tall. They are the most costly bare-root stock available, but usually less expensive than containerized trees. With good transplanting and care in the first year or two, they will quickly develop into trees of substantial size.

Containerized seedlings, both conifer and hardwoods, are typically more expensive than bare root seedlings. Containerized seedlings typically are easier to plant and establish more readily than bare roots seedlings. Photo – P. Smallidge

Containerized trees come in many sizes, expressed either by the diameter of the trunk (e.g. 1 to 1.5 inches) or by the size of the container (e.g. 5 gallon pot). They are heavy, but easy to transport, and transplant quite well.

Mature balled and burlapped trees are available from most retail nurseries. These trees often require mechanical equipment to move around, and will cost considerably more per tree. However, they often transplant well and the resulting change in the landscape is immediately noticeable. Hardwood

trees are usually sold according to the diameter of the trunk (e.g. 2 to 2.5 inches), whereas pines and other softwoods are sold by approximate height (e.g. 4 to 5 foot).

Cuttings

With the right equipment, attention to detail, and plenty of time, it is possible to propagate trees and shrubs by taking cuttings. This method of plant division involves cutting off a small branch from an existing tree, treating it with rooting hormones, positioning it in a growing medium, and providing optimal conditions for it to root and grow for eventual transplant. Although the steps are not complicated, taking and growing cuttings is tedious work, and success can vary among species. The resulting seedling is a clone of the original and will be genetically equal to the parent tree.

Developing cuttings is advantageous where you want to replicate the desirable characteristics of a particular tree. It might be one with exceptional fruit or nut growth, or one with a family or historical connection. Keep in mind that the cutting is a genetic copy, and will have the same disease susceptibility and specific site adaptation of the original as well.

The basic steps for propagating cuttings are listed below. Due to the wide range of researched techniques for each species, these guidelines are generalized to orient you to the basic process:

1) Choose the parent tree and determine what time of year and which part of the tree is best for taking cuttings. Woody cuttings are generally taken from mid-summer through fall.

2) Prepare the pot or trays you will be using, obtain rooting hormone, and moisten the growing media.

3) Cut a 4 - 6 inch portion from a branch - about as thick as a pencil. Label the cutting regarding parentage, species, and date. Score the base of the cutting as necessary to encourage root cell development. Dip in rooting hormone and stick into prepared, moistened planting medium.

4) Cover with a plastic tent and place in a bright greenhouse or window, maintaining proper ambient and root zone temperature. Some cuttings should be rested in a cool, dark location through the winter.

5) After roots develop (observed in drainage holes, not tugged), transplant the tree cutting into a prepared bed outdoors, using necessary acclimation to outdoor conditions.

6) Cultivate the tree for eventual transplant to its permanent location.

The US Forest Service and Cooperative Extension system have resources that describe specific methods for propagating trees by cuttings, listed in the Additional Reading section below.

Wildings

Wildings are trees transplanted from the wild to your property. The success rate of wildings depends on the fertility and drainage of the soil, the transplanting procedure, and the immediate care of the tree after planting. Attempts to shovel trees out of the woods and into a field generally fail.

The advantages of using wildings as planting stock are their tolerance of the general climate and relatively inexpensive acquisition costs. The disadvantages are the amount of time and effort to maximize success. It can take several years to prepare and transplant a desired tree or shrub from its original site to one you have selected. During this time, the plant is pruned above and below the soil, and monitored for regrowth. For most people this is a tedious, difficult process compared to purchasing nursery stock.

One way improve the transplanting of wild trees and shrubs is to first prune roots and branch tips of the desired sapling or shrub in the spring, preferably 2 growing seasons in advance of the actual transplanting. Begin the root pruning process by slicing down into the soil with a spade. Position the spade away from the trunk, but within the zone you will be transplanting. Step down firmly on the spade and wiggle the handle to fully insert the spade into the soil. Continue this process around half the diameter of the transplanting zone. The following spring, repeat the process on the other half of the roots. Branch tip pruning will remove as many branch tips as possible, to where side branchlets emerge. The combination of branch and root pruning before transplanting will encourage more root growth close in to the main trunk and reduce the transpirational loss of water because of fewer leaves.

Wildings will transfer to their permanent site better if they are first moved to a transplant bed of fertile, well-drained soil. This transition bed will allow for increased root growth and better overall vigor before being planting in the final site.

Tree seeds

Propagating forest trees by direct seeding has some advantages and many disadvantages as a reforestation technique. This process allows nature to sort out the best eventual species for the site. Like cuttings, there are lots of variables that change how one might establish a tree planting from seed. The basic steps for collecting and germinating tree seeds are listed below.

Due to the wide range of researched techniques for each species, these guidelines are generalized to orient you to the basic process:

1) Determine which species of trees are suitable for the planting site and to meet your goals. Take into account the soil limitations, sun and wind exposure, drought susceptibility, and potential for animal damage.
2) Collect mature seed from the desired forest trees. Species like sugar maple and red oak have excessive "high mast" crops every 4 - 6 years in which the trees produce abundant seed. Other years, some seeds will be hard to find.
3) Separate viable from non-viable seed by floating or other sorting techniques.
4) Subject seeds to the proper "stratification" or cold treatment as needed.
5) Prepare the soil seed bed to provide the necessary conditions for optimal seed germination.
6) Set aside a small sample of the seeds to germinate under optimal conditions, such as in a damp potting medium in a bright greenhouse. Broadcast or hand-plant the remaining seeds throughout the planting site. It is reasonable to expect less than half the seed you distribute will germinate, and even less will survive to maturity. Rodents can significantly reduce the amount of seed that survives to germinate.
7) Plan to repeat these steps in future years to augment the planting site with additional species.

Resources and additional reading:

Dirr, Michael. Manual of woody landscape plants : their identification, ornamental characteristics, culture, propagation and uses (1998).

Bonner, F.T. and R. P. Karrfalt. 2008. Woody plant seed manual. Available on-line at www.rngr.net/Publications/wpsm/folder_contents. USDA Agric. Hndbk. 727.

Chapter 6 – Site preparation and planting

Prepare the site for seedling trees

By the middle of the summer, some seedling tree planting projects look lost and hopeless amid a field of tall grasses and weeds. When competing vegetation gets out of hand, we often go out with a mower, weed trimmer, or tank of herbicides to beat back the rival plants. Inevitably, some new seedlings get chopped by errant blades or otherwise damaged. Weeds can grow inside tree tubes to heroic proportions, stifling the seedling tree inside. Much of this work and loss is unnecessary if the site was prepared properly before the seedling planting began.

Herbicides can be sprayed from ATVs with a few extra attachments. Spot treatments, at the specific planting location, will reduce the amount of herbicide needed to control vegetation. Photo – S. Dewey, Utah State University, bogwood.org

Preparing a tree planting site properly can reduce the need for herbicides, lead to better tree growth, increase the success rate, and make it easier to get the bare root seedlings planted before they lose their vigor. Site prep involves mowing, scalping, furrowing, or the judicious use of herbicides before the trees are planted.

When mowing or brushhogging a site to be planted, time the mowing to ensure minimal growth before tree planting. For a spring planting, it is best to mow the planting site in August, then again in October to reduce weed vigor as much as possible. The existing vegetation should be cut as low as possible. This will make it easier to plant your trees and reduces the cover of rodents that will chew on seedlings. It is not necessary to clear the entire field, just the zones where trees will be planted. Mowing will need to be repeated as the competing vegetation starts to grow, but if you are starting with a cleaner slate, you will be less likely to mow down your seedling investment.

Scalping can be done by hand, or by using a sod cutter – anything that removes the layer of vegetation, but not the top soil, around the planting site. By hand, use a flat spade on a low angle. Kick the blade just under the vegetation to scalp it off from the roots. You should then have a dish-sized patch of bare soil where the seedling will be planted. A sod cutter has an adjustable horizontal blade that slices of the sod layer in long strips. To use these machines, your site should be somewhat smooth. Once the sod is

cut, it can be flopped over, rolled up, or just cut away from your planting site. Rolls of sod are very heavy, so don't plan on moving them very far on your own. Once the tree is in, reduce weeds from re-emerging with mulch or a weed mat.

Furrowing is a practical way to improve drainage and create weed-free planting areas simultaneously. A furrowing attachment on a tractor gouges into the soil and flips a layer of topsoil over, on top of the sod. This ridge is immediately ready for planting. The narrow trough will collect water while the new tree seedling is raised above the existing soil surface. Use caution to avoid creating unmowable areas when future vegetation control becomes necessary. It is difficult to operate mowing attachments over the furrow's ridge.

To kill vegetation that might compete with seedling trees, you can use flame weeding devices, available through organic farming, hardware, and forestry supply sources. A weed flamer burns living vegetation with a blue-hot flame, like a propane torch. The idea is to kill the "crown" of the weed, where it emerges from the soil. The nozzle pattern is adjustable, giving a fan-shaped flame that covers a wider area with each pass. They are not meant to be used on dry or dead vegetation (fire hazard) that is abundant in the spring. Of course, flaming weeds means hauling around the 20-lb. propane canister, which is done with a dolly cart. Keep a few buckets of water on hand in case the surrounding vegetation beings to burn.

Broad-spectrum herbicides also kill vegetation in your proposed tree planting site. Most herbicides will not work in cooler weather and should be used the growing season before tree planting starts. There are many types now available to consumers. If you use an herbicide, carefully follow the label instructions. Choose an herbicide labeled for the plants you are trying to control. Contact an educator at your local Cooperative Extension office or the state forestry agency for herbicide guidelines and precautions.

Soil pH and tree planting

If you are serious about having a successful a planting project, sample the soil acidity (pH) before deciding which seedlings to purchase. Most trees thrive where the soil pH level is 6.2 to 6.8. Soil amendments are often beneficial for seedling trees. If possible, find out if pH levels at the nursery are recorded and make adjustments to your soil accordingly using lime, peat moss, or other soil conditioners. Technicians and educators with the Soil and Water Conservation District and Cooperative Extension can give you guidelines on adjusting your tree planting zone soil pH.

Any changes you make to the soil will be limited, and will serve only to help the seedling tree survive the shock of transplanting.

Properly plant each tree

The day you pick up or receive delivery of seedling trees is often exciting and daunting, depending on how many you ordered. You should have already studied this and other tree planting guides to learn how to plant. Maybe you had a chance to help a friend or neighbor do some planting so you'll know what to expect. At least a week before you receive your trees, make sure you have the tools and supplies needed to make your tree planting project go smoothly. This will leave time to acquire the tools you don't have.

Correct planting method is essential to assure a successful effort. Periodically during the planting process, check seedlings to confirm they were planted at the correct depth and that the soil is adequately packed to eliminate air pockets.

If you neglected to prepare the site during the previous growing season your work on planting day will be greater and likelihood of success reduced. If you are both tenacious and optimistic you can make an effort to quickly reduce competing vegetation by mowing down tall grass, pruning away woody vegetation, and staking out your planting area. Develop a simple drawing to help you plan where and how many of each seedling to plant.

Recommended tools and supplies

Digging tool(s)	Buckets or seedling bags
Access to water	Pruners
Marker / flagging	Planting plan
Damp sawdust, shredded newspaper, or peat moss	

Potentially useful tools and supplies

Mulch	Cart or wheelbarrow
Fertilizer pellets	Tree shelters / stakes
Hydration gel	Refreshments

The time period from removal from a nursery bed to establishment on your property is stressful for tree seedlings. Factors that will increase or decrease the survival rate of seedlings are weather, seedling transportation and handling, reduction of competition, and planting techniques.

Planting weather

In the Northeast, hardwood and evergreen seedlings are best planted in the spring, during April and May. Late enough to allow working of the soil, but before the buds have started to break. More mature transplants can be planted in the fall (September / October) but will also do better if planted in the spring. If planted in the fall, trees need extra mulch to ensure they survive the winter.

The best weather for tree planting is a cool, cloudy day without much wind. These conditions will reduce problems from drying or heat stress. Although the soil is usually moist or soggy, avoid planting in the rain, which can flood young seedlings and fatigue the planter. If the weather is predicted to be warm or dry when you are planting, take extra measures to protect the seedlings.

A bucket is useful to hold moist sawdust that will keep the roots moist during the planting process. Handle seedlings gently to avoid damage to roots.
Graphic – J. Ward

Seedling handling and transportation

The most sensitive part of a tree seedling is the root system. Comprised of delicate plant tissue and fine fibers that are virtually invisible to the eye, seedling roots subjected to rough handling will die back, usually killing the whole tree. The longer a seedling is exposed to the air, the less likely it will successfully transplant.

Seedling handling tips:

- Handle seedlings by the stem, not the roots.
- Leave protective bags and wraps around the roots as much as possible.
- Keep seedlings cool and slightly moist, and in a darkened place.
- Prevent seedlings from being crushed or squeezed.
- As soon as you receive seedlings, make sure their species is conspicuously labeled. Use surveyor's flagging and a permanent marker to label bags.
- Plant seedlings within a day or two of delivery.
- When planting, carry seedlings in a bucket of damp sawdust, shredded paper, or peat moss, rather than flooding the seedlings in water.
- Extract from storage only as many seedlings as you can plant in the field quickly; keep the partially filled storage bags shut.
- Place unplanted stock in the shade or under a vehicle or loose tarp in open fields.

Reduction of competition

Seedling trees interspersed in tall grasses and vegetation seldom survive. Although field grass looks flattened in the spring, it tends to grow up and over the tops of recently planted seedlings. The seedlings not only disappear from view (and are then inadvertently mown down), they cannot keep up as surrounding plants more effectively acquire nutrients and water.

Your last chance to help seedling survival before planting is to clear away existing vegetation from the planting location right before planting. Sites prepared before the seedlings arrived will be immediately ready to plant. Scalp away the sod layer where you are planting or at least cut down surrounding vegetation. You will need to return for more vegetation control within a few weeks.

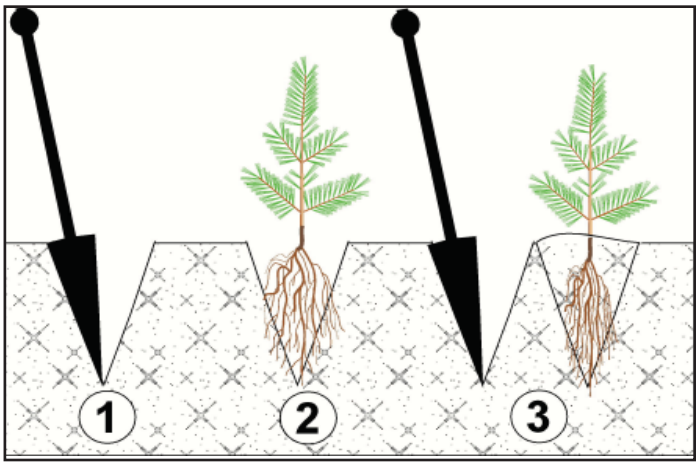
Planting techniques

Hand planting

Most rural property owners plant seedlings by hand, using a planting bar, a mattock, spade, or shovel. As long as the slit or hole is large enough to accommodate the roots without crushing or bending them, any such tool is fine.

Planting with hand tools:

1) Dig or punch a hole in the soil that will be big enough for the seedling root system.
2) Place and stabilize the seedling at the correct level, so the root collar is even with or just above the soil surface.
3) Arrange the roots carefully to prevent bending or exposure.
4) Backfill the hole completely so subsurface air pockets are eliminated.
5) Tug gently at the base of the seedling to ensure placement. It should stand straight with no roots exposed to the air.
6) Place mulch if available around the seedling to reduce weeds and protect the tender root zone.



The essential elements of planting require that the tree be planted at the correct depth and without air pockets that might cause drying of the roots. Graphic – J. Ward

You will find that in a bunch of seedlings, there is considerable variety in seedling height, stem diameter, root length, and overall vigor. If seedling roots are excessively long, trim the tips so they fit in the hole better. If you ordered a few extra seedlings, discard the seedlings with small root systems or small diameter stems to save the cost and frustration of trying to keep them alive. Alternatively, weaker seedlings should be planted closer together as fewer will survive.

Machine planting

Mechanized tree planters are often necessary for large planting projects or where human labor is in short supply. The only difference is that furrow digging (and sometimes tree placement) is done by the machine. The principles of vegetation control, root placement and planting depth are the same as hand planting.

Mechanized planters are usually towed behind a tractor or large ATV. The seedlings are handled carefully and loaded into a covered hopper. Progressing through the prepared field, a small plow opens a furrow, and the seedling is inserted. Packing wheels drive the topsoil back into the hole, planting the tree.

Mechanized tree planters are best operated on flat or gently sloping sites of well drained soil. Rocks, woody debris, and roots interfere with the mechanisms, so they must be removed first. Sites with poor drainage can be damaged by tree planting machines, so be sure to check soil conditions first.

If you are using a planting machine, learn how to use it well before your seedlings arrive. Clean the machine and make sure all parts are operating and sturdy. Should your tree planter break down, the seedlings might not survive the time of repair.

Fall planting of tree seedlings

Tree seedlings can be planted in the fall in the Northeastern hardwood region, adding a second opportunity for tree establishment. With winter dormancy approaching, and the likely possibility of winter drying, special management will increase the success of your efforts.

Evergreens and conifers do not fare as well after fall plantings compared to spring. Their need for water continues through the chill of winter. However, the planting process damages root hairs that will not recover sufficiently between planting time and the onset of winter. These seedlings will simply dry out.

Hardwoods seedlings that have entered into dormancy may tolerate fall planting. They have no foliage to maintain and will not require much moisture through the winter. All the root protection techniques noted above are still important.

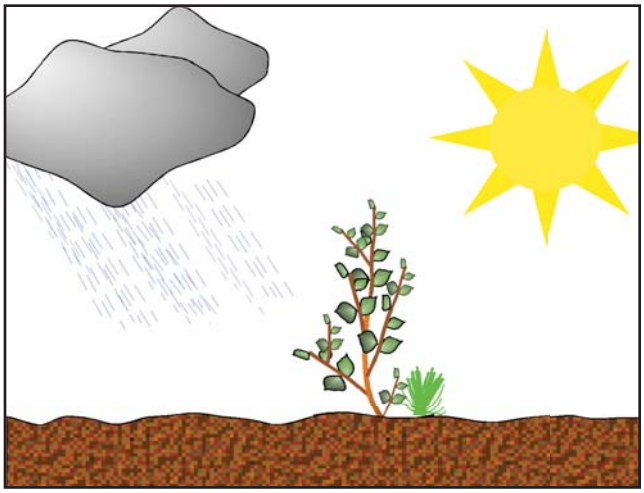
Seedlings can be planted from the first frost until the ground is nearly frozen, allowing a greater period of planting opportunity. Because most vegetation is dead or dormant in the fall and temperatures are low, soggy ground will persist longer than in the

spring. Thus, fall planting is best done on well drained sites. Seedlings planted in the fall are highly susceptible to mammal damage. Deer, rabbits, and voles are seeking tender bark for their own dietary needs. It is critical to provide sturdy tree shelters for these plants.

Chapter 7 – Post-planting seedling care and protection

A reforestation program is as successful as the number of seedlings that survive and grow into mature trees. Newly-planted trees face many threats, including weed competition, mammal browse, soil moisture, undesirable form, and crowding from other trees. Since you have already put much effort into planning, tree selection, site assessment, and planting, it is important to look after the seedlings for several more years. You should develop a management plan to address the factors listed below, with specific steps to limit the potential problems.

Trees can survive and grow under unique and often stressful combinations of environmental conditions (e.g., light, moisture, soil, and space). Different species of trees require different combinations of these factors, depending on their particular adaptations (see Chapter 4). Healthy, fast-growing seedlings occur where the environmental conditions available match the optimum growth and development needs for the species mix present. When one or more necessary factors are in short supply, the growth and development of seedlings are affected. Where a serious soil moisture shortage exists, for example, increasing the abundance of light, space, or soil nutrients would not likely increase seedling growth. As soil moisture is increased, however, a corresponding increase in the growth could be expected until some other factor becomes limiting.



Seedlings need the same resources and protection that your garden plants need. In addition to sunlight, reduced competition, and adequate moisture, seedlings need protection from browsing by deer and other mammals. Graphic – J. Ward

You have a lot of control over these factors, without adding extra expense or labor. For example, you can avoid having a seedling drown in soggy soils by better matching trees to the site in the first place. Alternatively, you can choose seedlings that deer do not prefer to browse, rather than providing fences or shelters for the trees. Below are techniques and materials you can use to protect your seedlings in their first few years. No brand bias is intended by listing or not listing in this publication.

Trees change in their sensitivity to environmental factors as they mature. Young seedlings in their first and second years may easily

succumb to drought stress, browsing, and low light conditions. As seedlings develop, they accumulate energy reserves that allow them to compensate for changing environmental conditions, and balance the demands of the leaves with the root system's ability to collect moisture and nutrients.

Reforestation Success

Three factors largely determine the success of a reforestation project:

A brush saw, including personal protective equipment, is an example of a organic, mechanical approach to controlling competing vegetation near planted seedlings. Photo – J. Ward

1. Competing plants can overwhelm seedlings and must be controlled. A variety of plants, such as hay-scented fern, multi-flora rose, autumn olive, goldenrods, and grass, can form layers so dense they prevent planted species from thriving. These interfering plants may form dense root layers through which seedlings cannot compete or penetrate, cause dense shade that stresses seedlings, or provide habitat for rodents that eat seeds.
2. Protecting seedlings from deer will allow growth of seedlings beyond browsing heights. Deer impacts can vary locally, depending on deer herd size and alternative sources of browse. If deer are browsing forest vegetation, strategies to control the deer herd or to protect the plants, or both, must be used to ensure regeneration success. Rabbits and voles can also cause extensive damage.
3. Adequate moisture the first year allows new roots to develop. Newly planted seedlings lose many of their roots between lifting in the nursery and planting in the fields. The lack of roots makes the seedlings vulnerable to drought during their first years until new roots are formed.

Controlling weeds near seedlings

Once your tree seedlings are in the ground, they are subjected to continuous competition with the other plants growing around them. Nearby grasses, wildflowers, shrubs and trees draw away nutrients, soak up water, and reduce sunlight availability. You have many weed control options around tree seedlings - periodic mowing, mulching, weed mat placement, hoeing, furrowing,

flaming, and herbicide application. These techniques can be combined for more effective weed control results.

Proper site preparation before planting will make weed control much easier in subsequent seasons (see Chapter 6 - Site Preparation and Planting). Your efforts to reduce competition early on will minimize the challenge of weed control after planting. Even with adequate site preparation, weeds will encroach on most tree seedlings, reducing seedling survival rate, especially on marginal soil or during drought stress.

From the weed techniques described below, evaluate the economic cost, labor, availability of protective clothing and equipment, and then choose the techniques that best fit your reforestation project. If none of these practices are feasible for you, weed competition will be an ongoing problem for your seedlings.

Mowing weeds around tree seedlings

Mowing is straightforward, but labor-intensive and tends to have mixed results. It is difficult to mow carefully around each seedling without cutting it down. Most mowers cannot get close enough to small seedlings to be fully effective for the first few years. Even though competing plants can be mowed, their roots survive, interfering with the tree seedling roots and reducing the value of your hard work.

If you choose to mow around tree seedlings in a field, use mowing patterns that cut down vegetation on all sides if the tree. There are many fields in the Northeast where the trees are hidden in long strips of tall vegetation. Not only can mowing between the rows encourage more aggressive competition, the seedling is at a disadvantage because it is overtopped by taller vegetation within the row. Tree seedlings should be cleared on all sides.

Loosing tying colorful biodegradable flagging to every third or fourth seedling will allow you see your rows and lessen the chances of mowing new seedlings. More frequent flagging may be necessary on rocky soils where planting straight rows is difficult, if not impossible. If you mow between rows, either make a second pass perpendicular to the first pattern, or come through with a smaller mowing device to clear the other two sides near the seedling. If necessary, fabricate a guard that will prevent the mower blade from passing over the seedling. This accident is easier than you think.

Unearthing weeds

If your labor resources are abundant or if the project is not very large, use a heavy-duty hoe to dig up weedy plants in the vicinity of each seedling. Each weed plant needs to be dislodged from the ground without damaging adjacent seedlings. This operation gives you the opportunity to monitor your seedlings and soil conditions.

On a larger scale, you will need a tractor or an ATV to pull a furrowing blade or power tiller alongside the rows of planted trees, churning over the soil to disrupt competing weeds. This practice also reduces the habitat of mammals like mice and voles that may chew on new seedlings. Till or disc along and across planted tree rows for the most effective weed control.

Using herbicides around tree seedlings

Herbicides are chemicals widely available for weed control around tree seedlings. They offer convenience, good results when used as directed, and lasting effects. On the other hand, they pose a contamination risk to careless users, require specific weather conditions to work, and weeds need to be at a susceptible stage depending on the herbicide. You must follow label directions, including personal safety precautions, to make herbicides worthwhile. Do not use substances that are not labeled specifically for killing weeds. Contact your local Cooperative Extension office for information on the proper procedures on safely cleaning equipment, disposal of cleaning materials, and recommended safety equipment and supplies.

The two herbicides most people will use around tree seedlings are broad-spectrum herbicides and broad-leaf herbicides. Broad-spectrum herbicides, like glyphosate, are designed to kill all plants to which they are applied. Broad-leaf herbicides, like 2,4-D, are formulated to kill non-grass weeds (and sometimes small trees), leaving grasses unaffected. A broad-spectrum or "non-selective" herbicide will control nearly all the competing weeds if properly used.

Most landowners will use a hand-held or backpack sprayer in tree planting projects. With rubber gloves, boots, eye protection and other personal protective equipment listed on the label, you walk from tree-to-tree, spraying the weeds to be killed. The label will list how warm and dry the weather needs to be for the product to work and if a secondary product can be added to improve performance. Use of a marker dye will improve spraying efficiency allowing you to see where the herbicide is being applied. Follow these directions with care.

Depending on season and seedling height, it may be necessary to shield the young tree from direct spray and chemical drift. Avoid working in breezy or excessively warm conditions. A section of lightweight metal or plastic pipe 8 - 12 inches in diameter can be placed over the seedling during spraying. If the herbicide chemical does not contact the leaves of the tree, it will usually not pose any harm. Spray on all sides of the seedling, and continue on to the next tree. Complete (100%) weed control is not needed and may result in seedlings being frost heaved out of the ground if there is an open winter with little snow after the first growing season.

Flaming weeds

New technology and concerns about herbicide contamination have led to wider use of direct heating with propane torches (flaming) to control weeds. Tree planters can use these specialized tools to blast the root collar of weeds with intense gas heat. Flame weeding control is better before planting than after planting. Flaming around seedlings requires considerable caution should be done when weeds are damp from rain, fog, or dew to reduce the risk of starting a fire by igniting dead leaves and twigs. This technique works best when the weeds are young, small, and actively growing. Use a long flaming wand, and a fan-shaped flame nozzle. The fuel can be transported with a large-wheeled cart on flat fields with little logging slash. Small backpack units are commercially available for use over rough terrain, wet soils, or areas with logging slash.

During some seasons, when ground vegetation is dry, flame weeding preparation of planting sites may require two people. One person to operate the flame weeding equipment and a second person with a water supply to extinguish hot spots.
Photo – P. Smallidge

The same respect given to chainsaws must be given to propane torches. The torches produce a 2000 F degree or hotter flame that can cause severe burns. At a minimum, thick clothing should be made of natural fibers. Synthetic fibers melt and can stick to skin causing extensive burns. Durable leather gloves, boots, and eye protection should be worn. A fire extinguisher and basic tools for accidental fires should be on the site. A backpack water sprayer, or other water supply, will help control any accidental ignitions.

Mulching seedlings

A layer of bark, pine needle, or wood chip mulch will reduce weed growth in the vicinity of the seedling. Mulch will also

trap moisture and cool the soil favorably where tender roots are growing. On cool sites, mulch may delay the onset of root growth in the spring. As the mulch slowly breaks down, it adds trace amounts of nutrients directly to the soil. The mulch layer should be 2" thick after planting, piled in a 12-inch radius circle around the seedling. Do not allow the mulch to touch the seedling stem. This provides habitat for voles that can kill seedlings by eating the bark and girdling the seedling.

Depending on the source of the mulch, the effort to transport and place mulch around each seedling will approximately double the tree planting labor and cost. Although mulch will reduce competing plants, weeds will eventually grow up through the mulch. Mulch performs best if existing weeds were previously destroyed by herbicides, scalping, or flaming.

Weed mats are synthetic disks, permeable to water and air, that restrict weed growth. They add to the expense and labor of tree planting, but are easy to transport and position around the seedlings.

Protecting seedlings from browse damage

Browsing is a common threat in the Northeast. The 11-year old seedling on the left was not protected from browse, but the 5-year old seedling on the right was protected. Photo – J. Ward

Tree shelters

Tree shelters are plastic panels or tubes placed around newly planted seedlings and held upright with sturdy stakes. Tree tubes reduce deer browse and create a favorable growing environment immediately around the seedling. The translucent material allows sunlight to pass through while reducing wind stress, increasing warmth, and protecting the young tree from sudden changes in temperature. They provide mowing protection and make young trees easy to spot in the field.

Tree shelters are expensive, especially when purchased in small quantities. It takes several minutes to set up and secure each tree tube in the field. Without top netting, tubes can fatally trap birds that slide down and cannot climb out. However, when terminal leaders emerged from the shelters, they often become snagged on

the mesh placed over tubes to prevent bird entry. A field check is necessary during the spring growth flush to prevent `goose neck' stems caused by snagged leaders.

Weeds can grow vigorously inside the tube, or vines outside the tubes, unless the weeds are eliminated beforehand, monitored each year, and controlled when needed. It is important to use high quality stakes that will not fail due to rot and the drive the stakes at least one foot into the ground for stability.

Tree tubes are effective at protecting seedlings from damage by deer and rodents. However, tree tubes require annual tending to ensure they are seated on the ground. Photo – P. Smallidge

Tree shelters are most appropriate for valuable hardwood tree planting projects on good soil. They are generally not effective for conifers. Are they "worth it" in your situation? It is impossible to analyze future timber markets to know if the short-term tree shelter investment will provide a desirable economic return. A landowner can usually justify the use of tree shelters by considering the following four factors:

1) The seedlings are high-value trees. Species expected to have high future value (e.g. sugar maple, red and white oak, black cherry) may warrant extra protection in the seedling stage. Expensive seedlings (e.g. fruit trees, black walnut, shagbark hickory) may also warrant the use of tree shelters.
2) Deer, rabbits, and voles prefer to browse the species most often planted and seem to have a preference for nursery stock over natural regeneration. A little browse damage goes a long way in ruining the success of a tree planting project. If your planting stock (e.g. maples, oaks, fruit trees) are preferred by mammalian browsers, then a tree shelter will likely be necessary.
3) Maintenance and monitoring of tree shelters are necessary. Tree shelters are not a 'stick it and forget it' operation. Tree tubes can tip, become weedy, and fail due to incorrect installation. Landowners should inspect each tree shelter seasonally to make sure it is providing the desired protection. If you can not monitor the shelters at periodic intervals, it is not worth installing them in the first place.
4) Cost of replanting is high. If you had to hire tree planting labor, in addition to having high-value species, tree shelters can save you the potential cost of replanting.

Bud caps may be sufficient to protect the terminal buds. Photo – J. Ward

If your project involves a few or all of these factors, you will certainly benefit from using tree shelters for your reforestation project.

A different system is effective for conifer seedlings in areas with high deer populations. A two-foot tall rigid mesh tube supported by a bamboo stake is used to protect seedlings for the first 2-3 years. Once a seedling emerges from the tube, a bud cap is attached to the terminal leader in late summer or early fall. The bud cap provides physical protection from browse damage. A new bud cap is placed every year until the seedling is tall enough to escape browse damage. Bud caps should be placed slightly below the height of the terminal bud to eliminate the potential of snagged on the bud cap during terminal expansion – and forming distorted stems

Fencing

One of the most successful tactics to limit the impact of deer is exclusion with fencing. Numerous types of fencing are available depending on deer density, cost, and aesthetics. An 8-foot high fence should be sufficient in most situations. Although deer can jump this high, they are unlikely to take the risk, especially when other food sources are available. It is imperative that the fence goes close to ground level as deer are as likely to crawl under a fence as they are to jump over the fence.

Fencing can reduce impacts of deer on planted seedling and natural regeneration. Fencing, like other protective measures, requires regular inspection and maintenance. Photo – J. Ward

Few landowners will surround a new tree planting project with tall fencing to reduce deer damage, but it is an option. More often, fencing is appropriate for natural woodlot regeneration projects. Fencing is very effective for protecting seedling growth, and will also allow other plant communities, like native forest wildflowers, to become established. Such fencing does not have to be a permanent part of your

land; after 10 - 12 years, most desired species will be sufficiently tall to be unaffected by deer browse. Like tree shelters (see above), fencing forest seedling projects is practical if the seedlings are high value, deer pressure is significant, the fence can be monitored, and the cost of replanting is high. For example, if a maple syrup producer wanted to regenerate a sugarbush by interplanting expensive high-sugar seedlings, then fencing (or tree shelters) will protect such an investment.

Fencing cost is not limited to installation. Fences are effective only as long as they remain intact. Therefore, there are the additional costs of periodic inspection, especially after strong storms, and repair. Choosing to fence an entire property requires installation of a gate. Deer can, and do, walk on roads to reach feeding areas. Cattle guards may be used to allow vehicles to cross but not deer. However, be sure to extend the guards as deer are much more agile than cows. References for installing and maintaining fencing can be found in the Resources section. You may wish to consult with a local fence contractor unless you have experience in fence installation. Be sure to check with local officials for zoning restrictions and town ordinances before installing your fence.

Browse repellents

Rather than physical protection, property owners may try chemical repellents to reduce damage by deer, rabbits, squirrels, woodchucks, and other mammals. Repellents can only reduce browse damage from deer, not prevent it. Repellents use odors, such as putrescent egg solids, noxious flavors, or irritating compounds (capsaicin), or a combination of these, to deter browsing and chewing. These products have no effect on tree growth. No commercial deer or mammal repellent is completely effective. Field studies have found that blood- and egg-based repellents are the most effective, but there will be some damage. Repellents based on predator urine and bitter tastes have not been found effective. Some products combine odor and taste deterrents, which can improve seedling protection. Rotating through two or more products may also improve repellent effectiveness.

Repellents will work best if they are applied before damage begins in areas of low to moderate deer density. Repellents should be re-applied on a regular basis (every 4 - 5 weeks and after heavy rain) to maintain their potency. Weather conditions need to be dry following the application; winter conditions tend to reduce the effectiveness of repellents.

Maintaining soil moisture

Irrigation

While the species you planted should be matched to the natural soil moisture levels of your site, it is impossible to know how weather patterns will develop during the first few seasons after planting. It might be a rainy and cool period, or you might struggle with an extensive drought and blistering heat within weeks of planting. Seedlings will not survive an extended dry period in their first few years on your property. On well-drained soils, it might take only two rain-free weeks to lose all your effort to dryness. On heavier soils with clay, some appropriately selected seedlings survive a short-duration drought. Mulch will help most seedlings survive a dry growing season, but only if the mulch is applied when the soil is moist.

Evaluate soil moisture by digging a shallow hole in the vicinity of your seedlings. If the soil is cool and clingy, moisture is adequate. Powdery or dusty conditions under the surface call for irrigation.

If you need to add water to a seedling, avoid sloshing water around the stem out of a bucket. Much of the water will run off and evaporate. Devise a system to trickle water around the seedling, so it soaks in and surrounds the root zone. Watering early in the morning and later in the afternoon will reduce loss to evaporation.

Enhancing growth

Fertilizer

Generally, soluble fertilizers are not needed when planting tree seedlings nor for the active growing period. Recall that the species selected for a given site should be able to grow under natural conditions. Applications of broadcast fertilizers tend to favor competing plants and much of the nutrient value is lost to leaching and volatility. However, slow-release fertilizer pellets may be an appropriate and effective addition after the seedlings are taller than competing vegetation for high value species. These compounds are coated with polymers that slowly break down, releasing gradual amounts of plant nutrition to the seedling and boosting early-stage growth. If you want to maximize the success of your tree planting project, and can absorb the cost, wait until several years after planting to verify seedling establishment. Then, after a soil test to determine which nutrients are in short supply, apply a slow release (sometimes called “controlled release”) fertilizer according to labeled rates.

Pruning and thinning

Once a hardwood tree seedling is established, its form can be improved with judicious pruning. The ultimate goal of pruning at a young growth stage is to favor the development of a strong, straight trunk, with well-spaced, healthy subordinate branches. Thinning is the process of removing individual trees to provide proper spacing for overall growth of the new stand. Though it is beyond the scope of this chapter to provide extensive detail, here are some guidelines for pruning and thinning after reforestation:

Pruning

Correct pruning will leave a small diameter wound, as pictured, and a short stub. The tree will quickly heal and does not require any treatment of the wound. Flush cuts leave large diameter wounds.
Photo – J. O'Brien, USDA Forest Service, bugwood.org

- Trees shorter than 15 feet rarely needed pruning. The larger the leaf area, the more energy the tree can put into growth, especially root growth.
- The exception for trees shorter than 15 feet is to eliminate competing main stems (codominant leaders) that can result in low permanent forks. Removing half of one competing stem will maintain the tree's overall leaf area and provide a branch collar that reduces the risk of stain or internal decay. Evaluate each seedling for overall form. It should show a strong, though undeveloped, central stem.
- Conifers with a damaged central leader often form multiple codominant leaders. These extra leaders should be removed within two years of forming to avoid 'cabbage' trees.
- Prune branches before they have a two-inch diameter. Removing larger branches can leave a wound that takes longer to close, increasing the potential of stain or internal decay.
- Consult a pruning guide for pruning at the branch collar to avoid stub and flush cuts.

- Removing more than 25% of the leaf area in any one year can weaken the tree.
- If possible, prune in late winter, before the seedling trees break dormancy. Do not prune when buds and leaves are expanding. This is period of "bark slip" when the bark may easily tear.

Row thinning, as in this hardwood plantation, removes every third row. This technique assumes that all stems are equal enough that the ease of the treatment offsets the extra costs of selecting individual stems for removal. Photo - B. Lockhart, USDA Forest Service, Bugwood.org

Thinning

- Thinning begins after 15 - 20 years, or when the individual tree crowns begin to touch. On very productive sites or in dense initial plantings, this may occur in less than 10 years.
- Evaluate the growth rate of individual trees and mark ones with the highest timber value potential.
- Remove or girdle undesired trees in accordance with an early-stage thinning plan.

Resources and additional reading:

Tree Shelters: A Multipurpose Forest Management Tool. (2004) Mike Jacobson and Dave Jackson. Penn State College of Agricultural Sciences.

Fencing for Forest Regeneration: Does it Pay? (2006) Michael Jacobson. Penn State College of Agricultural Sciences.

Fertilizing, Pruning, and Thinning Hardwood Plantations (FNR-215). 2004. James McKenna and Keith Woeste. North Central Research Station, USDA Forest Service Department of Forestry and Natural Resources, Purdue University.

Chapter 8 – Northeastern agroforestry applications

The combination of agriculture and forest management is called "agroforestry." In the Northeastern US, there are three basic ways to incorporate tree management into farming applications: alley cropping, silvopasture, and riparian buffer development. This chapter describes how these agroforestry systems can work in the Northeast, methods to integrate trees into agriculture, benefits and drawbacks, and how to begin agroforestry applications of tree planting.

Alley Cropping in the Northeast

Alley cropping is a type of agroforestry that is designed to bring together two very different crops for mutual benefit. A long-term tree crop, either hardwoods or conifers is intentionally arranged to allow for a shorter-term crop in-between the rows. The tree crop receives the benefit of space and light in an open-canopy system; the short-term agronomic crop receives the benefit of a sheltering microclimate plus leafy organic matter. The hardwood planting is usually tolerant of sun and wind exposure, like walnuts, oaks, ash, poplar, and willow. Conifers are less commonly used but would need similar tolerances. The short term crop can be anything ranging from annual field crops (corn, soybeans) to hay, vegetables, berries, cut flowers, or nursery stock. You do not have to be a farmer to alley crop – produce gardeners, hobbyists, and wildlife enthusiasts can use this cultivation technique.

Alley cropping allows the owner creativity in the types of trees and short-term crops to cultivate. Map a variety of spacings, and configurations of single or multiple rows before the actual planting occurs.
Photo – M. Mielke, US Forest Service, bugwood.org

Coppice farming is different from alley cropping. Coppice farming means planting rows of fast-growing woody species, such as locust, poplar or willow. After growing to specific dimensions, the stems are harvested en masse for biofuel use, fiber products like paper, fence posts, or for decorative uses.

Alley cropping research is still emerging, since this is a new way to look at tree plantations in the Northeast. Many attempts at setting up an alley crop area will be experimental. However, with guidance from extension educators and conservation technicians, plus some additional background research, landowners can

develop successful tree and crop combinations. A successful alley crop will provide profitable income with effective conservation.

Alley Cropping Examples

There are many potential combinations of alley crop components, so what you plant depends on site limitations, the goals of the landowner, and compatibility of species. One example would be rows of a planned sugar maple plantation, interplanted for the first few years with a cut flower crop or u-pick raspberry. As they mature, the sugar maple trees shed rich, organic leafy matter to build the soil community. Another example would be to combine widely-spaced rows of future Christmas trees with herbs or vegetables. There is no long-term research at this point to establish spacing and species guidelines.

Another instance that simulates alley cropping is to remove rows of older conifer plantations (pines, spruces), and interplant crops that tolerate acid soils and partial shade, like brambles, berries, and ornamentals.

Benefits / drawbacks

Installation of an alley cropping system should identify potential problems, although these typically can be managed:

- Too much competition between trees and short-term crop for water, nutrients, and light.
- Alley cropping requires a high up-front financial investment for uncertain payoff many years later as markets change.
- Considerable planning required; installation and maintenance efficiency may be reduced due to differences in equipment for different, closely-spaced crops.
- Risk of creating unfavorable local growing conditions, like poor air circulation or unintentional disease transmission between species.

To balance these disadvantages, consider the appealing aspects of alley cropping:

- More diverse plantings increase opportunity for income.
- Soil protection by reducing wind and water forces with multiple windbreaks and more frequent no-till strips.
- Good potential to increase soil stability and microbe complexity from leaf organic matter; better use of nutrient cycling.

- Can increase farm production on underutilized acreage and diversify harvest times.
- Potential to reduce pest problems with local diversity in crop composition.

Methods

Alley cropping has several different planting patterns; each is site- and species- specific. No one technique will serve all alley crop plans. A single row of hardwood trees between annual crop rows appears to be most prevalent in the Midwest and Canada, where alley cropping has been adopted at a higher level. Other schemes include multiple rows of hardwoods and softwoods (2 or more rows of trees to divide the crop alley). A few farmers are experimenting with short-rotation woody crops, like coppice willows and poplars that are intended for biofuel use.

First steps

Take time – a few months at least – to evaluate your growing site and your long-term goals before establishing your alley crop system. Make sure you are aware of any limitations, such as drainage, slope, soil rockiness, nuisance wildlife pressure, and the history of the property. You might encounter some unexpected opportunities or problems during this planning phase. Call on your local Cooperative Extension office, Soil and Water Conservation District, the National Agroforestry Center, or permaculture groups that focus on agroforestry education and experimental cropping.

Chose your species combinations carefully. The tree crop needs to be tolerant of full sun, wind exposure, and the soils you have on-site.

Tree species generally suitable for alley cropping include:

Pine and spruce
Maple
Poplar
Locust
Oak
Walnut
Alder
Christmas trees
Larch

The short-term crop is usually much faster maturing and can be woody or non-woody:

Woody crop plants
Brambles (raspberry, blackberry)
Currants
Blueberry
Juneberry and other minor berries
Ornamental shrubs

Non-woody crop plants:

Grain row crops – corn, barley, wheat, soy
Produce row crops – pumpkins, peppers, tomatoes, strawberries, peas, beans
Horticulture crops – cut flowers, herbs, seedling transplants,

Sod crops – hay, grasses and forbs for fuel, clover, wildflowers
Be deliberate in your selection of alley cropping species combinations; there are some interactions you should definitely avoid. Some crops and trees are alternate disease hosts, such as cedar-apple rust or white pine blister rust from currants. Many plants are intolerant of juglone, a compound in walnut trees, but some are compatible. Research is still need to explore all combinations of tree crops and short-term crops potentially used in alley cropping.

Plant the alley crops with an eye to your long-range objectives. This is a protracted commitment of labor and financial cost, so make sure you can follow through each year or identify how you will pass on the alley cropped acreage.

Silvopasture

A silvopasture is a large livestock foraging area intentionally planted with a long-term tree crop. Silvopasture may also take advantage of established forest, with subsequent replanting as necessary. It is intended to merge animal and tree production, making the most of the benefits each can supply to the other. Silvopasture systems involve more than just turning livestock loose into the woods. Silvopasture requires a deliberate effort to manage the grazing intensity by frequently moving livestock and monitoring their impacts on forest trees. Special considerations will be necessary to successfully regenerate the forest. In the Northeastern US, only a few attempts at silvopasturing have been made, so like alley cropping, it is still experimental. Cooperative extension grazing and natural resources specialists can help with ideas for getting started.

Silvopasture Examples

Livestock and tree systems need to be compatible, so species like sheep and cattle are preferred over goats and horses that may browse woody plantings. An example of a timber application would be to combine a locust planting with cattle rearing. Conifers intended for Christmas trees can be mixed with pastured poultry or sheep production. Nut orchards, like Chinese chestnuts, Carpathian walnuts, or hickories can be planted into pastures and spaced widely for optimum sun exposure.

With proper management and tending, goats and other livestock can work well in reforestation areas. On this farm, goats browse in a black locust plantation that has been thinned for fence posts.
Photo – B. Chedzoy, Cornell Cooperative Extension

Benefits / drawbacks

The main benefit of Northeastern silvopasture is to diversify farm income; it can hedge against the price received for a single farm product. Environmentally, silvopastures reduce soil erosion, provide good songbird habitat, and help return organic matter to the ground. Leguminous trees like locust can also nitrify the soil. Livestock receive the benefits of light shading in summer and added vegetative diversity and insects, such as with foraging poultry.

Silvopastures cost more to establish than traditional pastures and require more planning and maintenance to make sure tree and livestock remain compatible over the long term.

First steps

Like with alley crops, take time to evaluate your growing site and your long-term goals before establishing a silvopasture system. In some cases, woodlands can be thinned to develop better forage and allow for pasturing among the remaining trees. Make sure you are aware of any limitations, such as drainage, slope, soil rockiness, toxic tree species, and forage quality. You might encounter some unexpected opportunities or problems during this planning phase.

Silvopasture candidate species combinations:

Christmas trees / sheep, poultry
Nut trees / poultry, sheep, goats
Pine plantation / cattle, sheep
Locust plantation / poultry, cattle, goats
Native hardwoods / sheep, cattle, poultry, goats

Riparian buffers

Widely recognized as a very important conservation practice, riparian buffers are plantations of trees and shrubs, or managed native vegetation, alongside small streams, creeks, drainage swales, floodplains and rivers. These plantings can rectify many of the problems caused by the clearing of riparian areas for agriculture and human development purposes. Streams with riparian buffers are shaded and receive healthy organic matter from the leaves. Dense root systems reduce streamside soil erosion. Wildlife can access food and water in a protected zone. As an agroforestry practice, a riparian buffer may be planted with woody vegetation that can add a profitable enterprise to the ecological benefits.

Riparian buffers are important tools to stabilize stream banks and protect water quality. They also serve as important corridors for wildlife. Photo – P. Bolstad, Univ. MN, bugwood.org

Riparian buffers are designed to include distinct zones, arranged according to distance from the stream channel. Immediately adjacent to the stream is an inner zone - a permanent forest cover, intended to be the main area of protection around the stream. The outer zone is a managed forest zone, where a landowner can plant and manage trees according to their enterprise or conservation plans.

Riparian Buffer Examples

Typically, a mixture of different trees, shrubs, and grasses are planted alongside and outward from exposed streams. This mix will vary depending on the site, soil, climate, and existing vegetation.

A more common scenario is that of a farmer or landowner with an exposed stream course or drainage (no trees or shrubs on either side, often with evident erosion), they are expected to plant into a riparian buffer due conservation program requirements.

They recognize the need for such a planting, but would like the area to offer some income potential or other consumptive values. Here, the landowner might plant elderberry shrubs, which are tolerant of streamside conditions. The elderberries can be harvested as a future crop intended for wine, jellies, or syrup. The riparian buffer could also be planted with a mix of high wildlife-value trees and shrubs, with the intention of improving the hunting lease value on the land.

Benefits / drawbacks

Riparian buffers have many benefits like those mentioned above - erosion control, water quality improvement, wildlife habitat. The drawbacks of looking to riparian buffers for income are the unpredictability, the long-term commitment of land, and the need for additional steps to actually earn income. Riparian areas have soils that are potentially more sensitive to disturbance than upland soils. The more sensitive soils may require alternative types of equipment.

First steps

As with the other agroforestry practices, riparian buffer plantings require planning in consultation with conservation and natural resources professionals. They can help you determine the right mix of species, avoid errors, and provide advice about site limitations.

Use a map of your property to identify streams in need of riparian buffer development. Some streams already have lots of vegetation on the banks, but it might be comprised of undesirable invasive plant species like Japanese knotweed, honeysuckle, multiflora rose, and autumn olive. These sites can be improved by removing the undesirable species, and replacing them with species that further your goals as the landowner.

Resources and additional reading:

The following resources are from: USDA National Agroforestry Center (NAC), East Campus-University of Nebraska-Lincoln, Lincoln, NE www.unl.edu/nac/.

National Agroforestry Center. 2005. Working trees for agriculture. www.unl.edu/nac/.

National Agroforestry Center. 2003. Working trees for livestock. www.unl.edu/nac/.

Hodge, Sandra, H.E. Garrett and J. Bratton. 1999. Alley Cropping: An Agroforestry Practice. Agroforestry Note #12.