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M. Lewis 12/01



Tree Planting



Forest landowners are engaged in a variety of forest practices but, for many, the driving force behind managing their woodlot is tree planting. Tree planting is popular with forest landowners for a number of reasons. Landowners need no special equipment other than a shovel and pail to plant on their property. They derive personal satisfaction from 'creating' a forest. When the planting is done, they can watch as, year after year, bright green, newly grown trees begin to appear where there was once only weeds and brush. Many people take great pleasure in finding signs of wildlife in a newly planted field where no signs had been before.

Many landowners plant trees for purely economic reasons. Statistics say that each citizen of the United States utilizes the equivalent of one tree per person per year. With our growing population, the demand for quality timber and timber by-products is higher than ever. As mature, quality hardwood timber depletes in acreage, people are replanting these valuable trees. They may plant with long-range goals such as pulpwood and sawlog sales in mind. Although they may not live long enough to watch the harvest of a young black cherry seedling they plant, they can take joy in the fact that they have supplied such a valuable commodity for future generations.

The list of reasons can go on and on, but whatever the reason, tree planting has always been and will always be a very popular forest practice.

However, when planning your tree planting, many factors need to be investigated closely before any on-site work is begun. It is a good idea to have a knowledgeable professional visit the site to be planted before investing any time or money. The following aspects should all be considered before putting a planting plan into action:

Site selection:

What is the topography and will it be easy to work? Is the climate conducive to the selected species? Have a soil profile done on the site. Find out if the soil type, texture, pH, and available nutrients will be desirable to your selected species. If they are not, is there anything you can add to the soil to make it a better planting site? A reasonable idea of soil conditions and fertility can be obtained through the use of a soil auger and county soil survey maps, and observations of the type and condition of the existing vegetation. See your local NRCS or Conservation District office to be sure. Soil test kits are available through Penn State Extension.

Select species:

There may be a favored species to plant in your area or perhaps an extremely valuable one. Often, more than one species will be planted, and if so, how will they compete with each other? Will diseases and pests be a problem? Will the species grow well on your site? Many plantings are a mixture of several species. Hardwood plantations are made up of $\frac{3}{4}$ conifer species and $\frac{1}{4}$ hardwood species. The pines serve as trainer trees and site conditioners for the hardwood seedlings. The pines also help convert a planting from an old-field environment to a woodland environment sooner than a pure hardwood planting. The pine provides good wind protection for the hardwoods, which may also increase growth rates and add to the wildlife habitat. Check with a qualified professional to see what species may grow best on your site.

Multi-function forest:

Is there any other reason besides timber that you wish to plant? Perhaps erosion needs to be controlled on one part of the site, a windbreak or privacy screen is needed, air quality improvement is desired, or wildlife enhancement is a driving factor. Consider species diversity for these alternate factors. Can any of the trees you want to plant serve a dual purpose?

Maintenance:

Are you willing to do any of the forest maintenance or do you wish to hire it out? Most plantations will need thinning and pruning and perhaps fertilization down the line. If you are willing to take on the work, develop a plan with a qualified professional as to which trees you need to thin and when, and find out any other maintenance needs. If you are planting hardwoods you will need to use tree shelters or fencing to protect your seedlings from deer browse. These both require a certain amount of maintenance to get the most effective protection.

Site preparation:

Many factors can contribute to early seedling mortality. Improper planting, dried out planting stock, planting too late in the spring, drought, rodents, and deer browsing can all cause planting failures. The leading cause of seedling mortality is the improper (or lack of) site preparation before planting. Many old fields have a dense cover of grasses and weeds or heavy sod. Site preparation is essential when planting hardwoods. Weeds and grass must be controlled prior to planting and control must be maintained for several years after planting. Cultivation may be necessary prior to planting on a new site, and weeds and vegetation may need to be controlled. Does your site need brush-hogged prior to cultivation? How and when will you apply herbicide to control the competing vegetation? Can you do the work yourself or will you need to hire it out? These questions need to be answered before nursery stock arrives at your door.

Order trees:

Nursery stock has been in high demand in the past several years. Order as early as possible before planting to make sure there are adequate supplies of the species desired. Find out where the seed stock for your seedlings originated. Seed harvested from trees outside your area may mature into trees with characteristics that are unfamiliar to your area. Seedlings grown from seed that has been harvested from your geographic area will grow and survive better. The twelve most common species planted in Pennsylvania are listed below.

Planting:

Learn when and how to plant stock properly. The second leading cause of seedling mortality is improper planting. Trees that are planted too shallow, too deep, J-rooted, or slanted are more susceptible to site and weather factors. You may feel that you can plant all your trees by yourself. If you're going to plant a large number of trees, rent a power auger. One man with an auger (8-10" bit) can plant almost double the number of trees without it. In fact, most plantings over 3,000 trees should be done with the help of a tree planting machine and crew. If you are planting several acres, chances are you won't be able to do it yourself and you may need to hire a tree-planter and crew. Ask a qualified professional for a list of planters in your area. There are tricks to every trade, and an experienced tree planter can improve your chances for success.

The following is a list of the most common species planted on Pennsylvania soils and their characteristics. **Trees in red print designate those species most successful in Northwest Pennsylvania.** Not all possible timber and wildlife species are covered, but you can ask a qualified professional for more alternatives. Trees designated with an asterisk (*) will need protection from deer browse in the form of tree shelters after planting.

Acer saccharum (Sugar Maple)*

The "Hard Maple" of the industry, Sugar maple is used for furniture, decorative purposes, flooring, and industrial use for its strong, heavy, and hard wood qualities. It grows best on well-drained loamy soils that are acidic to slightly alkaline. Sugar maple does not grow well on dry, shallow soils or boggy sites. It is tolerant to shade, but grows best if the area is cleared of competing vegetation to prevent any loss of moisture or nutrients to other trees.

Fraxinus americana and pennsylvanica (White and Green Ash)*

Both White ash and Green ash are sold as 'White Ash' in the woodworking trade. They both produce an excellent wood that is used for lumber and veneer, and famously, baseball bats. Encompassing a wide native range, ash is adaptable to a broad range of growing conditions. White ash does have demanding soil fertility and moisture requirements, preferring a soil content high in nitrogen and calcium, with a pH of 5.0-7.5. With proper growing conditions, it can reach a DBH of 12 inches and a height of 75 feet in 50 years. Ash also has a low shade tolerance. Ash growing in northwest Pennsylvania is also susceptible to a disease known as Ash 'yellows'. This fungal disease affects the tree in its pole stage and may not be detected until trees have fully occupied the growing site. The disease weakens the tree and can cause decline and death in white ash stands.

Prunus serotina (Black Cherry)*

Black cherry is an excellent and very valuable wood used for fine furniture, veneer, and woodworking. Native to the Eastern U.S., north to south, black cherry grows in a wide range of climatic conditions and soils. In all but the wettest and driest, growth will be very fast. Spacing should be tight for best results, because its intolerance to shade will keep side branching to a minimum as it reaches skyward.

Liriodendron tulipifera (Tulip or Yellow Poplar)*

Used as a veneer and lumber for siding, trim work, cabinetry, and pulpwood, Tulip poplar is one of the chief commercial hardwoods. It has a straight grain with very good strength and stability. An eastern U.S. native, it grows under a wide variety of climate conditions and thrives in many soil types, with the exception of very dry or very wet sites. Its fast growth rate can produce a tree 45 feet tall in 20 years, and it will mature among the tallest of the Eastern broadleaf trees.

Pinus strobus (White Pine)

Producing a soft wood that is light and not considered strong, Eastern White pine is highly used as an easy working wood. It grows in cooler and humid areas in the northeast U.S. It will thrive in a vast range of soils, but to eliminate competition from larger hardwoods, plant on well-drained, medium textured, sandy soils where hardwoods won't grow. White pine is also susceptible to the white pine weevil. This insect will attack and kill the tops of white pine growing in direct sunlight. This causes one or more of the side branches to take over as the dominant top. The effect is that trees will grow with multiple stems and have a 'bushy' appearance.

Quercus rubra (Red Oak)*

The northernmost eastern oak, it is also one of the most important lumber species in Pennsylvania. Most are used for furniture, veneer, flooring, and millwork. One of the most rapidly growing oaks, it plants easily and endures a variety of growing conditions and soil types. It will grow best on moist, loamy, well-drained sites. Red oak is a major food source for the Gypsy moth. Severe defoliations will eventually weaken and may kill mature trees. Its fast rate of growth when planted with tree shelters makes it a prime candidate for many plantings.

Juglans nigra (Black walnut)*

One of the most coveted hardwoods, Black walnut is desired for its dark brown wood color and strength. Its primary uses are in fine woodwork and architectural construction. Growing best on deep, well-drained soils that are moist and fertile, Black walnut can grow 3-4 feet per year in optimal conditions. Its proximity to other desirable trees is important to consider, as walnut gives off a substance through both the leaves and roots called 'Juglone' that is toxic to other trees. Black walnut is also prone to Nectria canker. This canker begins to form on many trees in the 6-8 inch diameter range. By the time a tree is diagnosed with Nectria canker it is probably too late to use the tree for lumber purposes. Trees will survive with multiple cankers, but will never achieve 'lumber' grade status.

Populus tremuloides (Quaking Aspen)

Quaking (or Trembling) aspen is used for quick growth pulpwood and lumber. It has a soft, light wood, and is one of the most widely distributed trees in the U.S. It grows on a variety of soils including shallow, rocky, sandy, and heavy clay. Planting can be done on a cleared site without any thinning necessary. Most often it is planted and grown for early-succession wildlife food plots. Its seed catkins are highly prized by woodcock and grouse. It is also planted to reclaim sites that have been strip-mined or that have had heavy soil disturbance.

Pinus resinosa (Red Pine)

Red pine is one of the few softwood species in Pennsylvania that is still being harvested for a wood product. Its straight and fast growth makes it a prime candidate for use in the log home industry. It grows well on a variety of sites but likes well-drained sandy soils. It is used extensively in mixed planting with hardwoods. Its fast growth rate allows it to 'compete' with the hardwood crowns. This competition keeps the hardwood crowns confined and grows straighter taller hardwood trees. Mixed plantations should be thinned at about 25-40 years.

Larix decidua/Larix laricina (European or Eastern Larch)

One of the fastest growing conifers, Larch is often planted in conjunction with hardwood species in plantations. Its ability to compete with hardwood growth makes it a valuable asset in 'filling in' amongst the hardwoods. It prefers moist soils but will tolerate and often thrive in wet peaty, even bog-like soils. Mature trees are used most often for their lumber and, again, are used extensively in the construction of log homes. Its lumber has a distinct odor, texture, and appearance and is also extremely rot resistant. Larch is also one of the few deciduous conifer species. Its bright yellow foliage in the fall is one of its defining characteristics.

Picea abies and Picea glauca (Norway Spruce and White Spruce)

Two of the most abundant species of spruce, these two trees are widely planted throughout Pennsylvania. Norway spruce has been widely cultivated for ornamental, shade, and forest plantations. It prefers moist soils in humid, cool temperate climates. White spruce is one of the most important pulpwood species in Canada. It grows in many types of soil and climate conditions. It is sometimes planted in conjunction with hardwoods but does not have the fast growth potential to compete with hardwood species. Both Norway and White spruce are planted extensively for wildlife habitat. Grouped plantings of 10-25 trees provide shelter and thermal cover for wildlife. Various kinds of wildlife (including deer, rabbits, and grouse) browse spruce foliage in winter.

Tsuga canadensis (Eastern Hemlock)

The Pennsylvania state tree, hemlock was once the major species in Pennsylvania. It is planted predominantly as an ornamental or for wildlife habitat. It must be fenced or protected after planting, as it is a preferred food species for whitetail deer. It prefers acidic soils in moist cool valleys and ravines of north-facing slopes. Extremely shade tolerant, it grows well under complete canopy. It is susceptible to the Hemlock woolly adelgid. This small insect will invade and attack the needles of the tree and strip them bare. Once defoliated, the tree quickly withers and dies. The insect is most prevalent in the southeastern counties of Pennsylvania and cases in northwestern PA are rare.

The rest of the information in this guide will expand on each of these areas. With proper care and planning, your tree planting will have the best chance for success. Read through the information carefully. If you have any questions call your local Service Forester or qualified professional.

PLANTING COSTS FOR HARDWOOD/CONIFER PLANTATIONS

(ALL COSTS ARE PER ACRE)

ALL CONIFER

8x8 SPACING	
680 TREES PER ACRE	
ALL CONIFER SPECIES	
COST OF SEEDLINGS (AVG)	\$150.00
COST OF HERBICIDE (PLUS APPLICATION)	\$25.00
COST OF PLANTING (HAND OR MECHANIZED)	\$170.00
TREE SHELTERS	N/A
TOTAL	\$345.00

CONIFER/HARDWOOD

8x8 SPACING	
680 TREES PER ACRE	
510 CONIFERS/ACRE 170 HARDWOODS/ACRE	
COST OF SEEDLINGS (AVG)	\$260.00
COST OF HERBICIDE (PLUS APPLICATION)	\$25.00
COST OF PLANTING (HAND OR MECHANIZED)	\$195.00
TREE SHELTERS (5 FOOT W/ STAKE)	\$833.00
TOTAL	\$1,313.00

10x10 SPACING	
440 TREES PER ACRE	
ALL CONIFER SPECIES	
COST OF SEEDLINGS (AVG)	\$95.00
COST OF HERBICIDE (PLUS APPLICATION)	\$25.00
COST OF PLANTING (HAND OR MECHANIZED)	\$110.00
TREE SHELTERS	N/A
TOTAL	\$230.00

10x10 SPACING	
440 TREES PER ACRE	
330 CONIFERS/ACRE 110 HARDWOODS/ACRE	
COST OF SEEDLINGS (AVG)	\$175.00
COST OF HERBICIDE (PLUS APPLICATION)	\$25.00
COST OF PLANTING (HAND OR MECHANIZED)	\$125.00
TREE SHELTERS (5 FOOT W/ STAKE)	\$540.00
TOTAL	\$865.00

ALL COSTS LISTED HERE ARE AVERAGES. YOU MAY RUN INTO LOWER OR HIGHER COSTS DEPENDING ON THE PLANTING SITE AND THE SPECIES YOU ARE PLANTING. PLANTING MAY BE DONE BY HAND OR MECHANIZED TREE PLANTER. HERBICIDE MAY BE APPLIED BY TRACTOR OR HAND SPRAYER. SEE YOUR LOCAL SERVICE FORESTER FOR DETAILS ON SPECIES AND SITE SELECTION.

Tree Planting Timeline

1. July of the year before planting.

A successful tree-planting project begins approximately nine months before tree seedlings arrive in the spring. Plan now to accomplish the following steps, so that they are completed in a timely manner.

2. September of the year before planting.

Begin Site Preparation by spraying or tilling to control existing vegetation, and prepare the site for spring planting. A critical step for successful tree planting is to provide a planting bed free of competition from weeds.

3. October/November of the year before planting.

Plan to order tree seedlings five to six months in advance. Popular hardwoods like oaks will often be sold out by November. State nurseries and private nurseries in Pennsylvania grow tree seedlings adapted to our climate. Other mid-western or Lake States nurseries also produce stock that will grow well, but avoid ordering from nurseries more than 100 miles south or west of the state line.

4. April/May of planting year.

Plant tree and shrub seedlings in April or early May. Install tree shelters on ALL hardwoods immediately after planting. Seedlings maybe planted by hand using a power auger or with a tree-planting machine. Check with the DCNR Service Forester in your county to find out if a planting machine is available to use. Many rental companies carry power augers with an 8-10”bit. This can be a most useful tool in tree planting. Some counties have planting machines that they rent out for a reasonable fee. Renters must usually provide the tractor and crew to do the planting. With a little experience, people can plant about 5,000 trees (10 acres worth) a day with a planting machine. **To be practical, plan on a maximum of 400 trees per day per person for hand planting crews.** If you do not want to plant trees yourself, check with your DCNR Service Forester for a list of custom tree planting services. Custom tree planters can do the entire job for you, including the site preparation, planting and follow up care.

5. June - August of planting year.

Mow or spray to manage weeds and other competing vegetation.

6. After planting year.

Don't expect to walk away from the seedlings once they are in the ground. Plantings will need mowing and/or spraying to control competing vegetation for at least 2 years. Tree shelters will have to be checked and maintained. Sometimes additional animal control measures are needed. Insects and diseases may become a problem in plantations.

Site Preparation

The single most important part of planting trees is protecting the small bare-root seedlings from existing, competitive vegetation. This cannot be over-emphasized. Not only do these plants compete for light and water, many grasses produce natural chemicals, which suppress tree and shrub growth. If not managed, competition from weeds, grasses, and shrubs will choke out the planting in short order. Sites may be prepared for planting using mechanical means, chemical means or a combination of the two.

Mechanical Site Preparation

Reduce the competition from a thick grass sod by moldboard plowing and/or disking in 6-foot wide strips. Leave undisturbed sod between the strips. By minimizing the amount of soil that is disturbed, the threat of water erosion and weed seed invasion by such things as Canada thistle is reduced. Till on the contour in order to further reduce erosion. Spring plowing is not generally recommended, as it will introduce air into the soil that can dry the roots of newly planted stock. If residual cover is relatively small, a rotary or sickle-bar mower can be used to cut competing vegetation as close to the ground as possible. On land that is greater than a 6% slope or when planting large areas consider using banded herbicides.

Chemical Site Preparation

Weedy or grassy competition can be controlled with selective herbicide use.

Effective control depends on four factors:

- timing of application
- herbicide selected
- weather conditions
- application rate

Heavy sod can be controlled by a fall application of herbicide in the year prior to planting.

Alternatively, a pre-emergent herbicide can be applied in the spring just after the trees are planted and before the existing grass cover has "greened up". Herbicides should not be allowed to come in contact with the tree roots. Banding of herbicides controls weeds yet minimizes the impacts on erosion. Very dry conditions will limit the effectiveness of most herbicides. Be sure to follow label directions for application rates, as rates differ depending on soil type and herbicide. Consult with your local DCNR Service Forester for specific herbicide recommendations. ***NOTE: All herbicides must be applied in accordance with label recommendations and their registered use.***

Controlling Grasses and Broadleaf Weeds

Glyphosate (Accord), dicamba (Banvel) and 2, 4-D should be applied before trees are planted or as hand directed sprays during the growing season. They should not be applied over the top of actively growing tree seedlings. Glyphosate controls grasses as well as broadleaf weeds; 2, 4-D and Banvel kill only broadleaf weeds. With Banvel and 2,4-D, fall treatments are highly preferable to spring treatments; these growth hormone products prevent the plants from becoming cold hardy, and even if the herbicide fails to kill all the plants by first snowfall, the cold winter temperatures kill the remaining plants.

Brushy Weed Control

Unwanted trees and shrubs, such as elm or box elder, should be removed prior to planting. Most Pennsylvania deciduous trees and shrubs are prolific sprouters and in one year can grow 3-5 feet from cut stumps. To prevent sprouting, treat the stump with a recommended herbicide.

Planting Procedures

Hand Planting

When planting by hand be sure to:

- Keep seedlings shaded and cool until planting
- Minimize handling of the seedlings.
- Carry seedlings in a bucket or planting bag along with wet burlap to keep seedlings moist.
- Never carry seedling exposed to the air or immersed in water.
- Seedling roots should hang freely and just touch the bottom of the hole.
- Long anchor roots may need to be pruned back.
- The new soil line should be just above the old soil line.
- Pack the soil after planting.

A rough estimate is that an inexperienced, but physically fit, tree planter can plant 500 seedlings by hand per day.

Machine Planting

Mechanical planting is suitable for especially large orders to be planted on even terrain. Generally a 30-50 horsepower tractor and a crew of three are sufficient. The principles of seedling protection listed above certainly apply. Experience in operation of tree planters comes quickly and a crew can usually plant 5000 seedlings a day.

April is tree-planting time in Pennsylvania. Plant after the frost has left the ground (late March), but before bud break and shoot elongation (late May).

Bareroot Hardwood Stock

Trees purchased as bare root hardwood stock are generally between 1 and 3 year old trees and are either seedlings or transplants. A designation such as 2-0 means the tree spent two years in the same seedbed, while a designation of 2-1 means the tree spent 2 years in a seedbed and 1 year in a transplant bed (transplanting improves root development).

1. Handle seedlings carefully. Keeping them healthy requires minimizing physical damage and keeping them at a constant low (33-40 degrees) temperature with a high relative humidity. They must remain in a state of dormancy from the time of lifting to the time of planting.
2. To prevent desiccation, plant seedlings as soon as possible. If root hairs become damaged, they will never properly uptake water and nutrients. *Root hairs that remain dry for only 30 seconds will kill a seedling.*
3. Seedlings are often packaged and shipped in plastic-lined boxes that provide both physical and moisture protection for the seedlings. Bags are used for smaller quantities of seedlings. They do not protect seedlings from physical damage.

4. Until you are ready to plant, do not handle your seedlings individually. Leave them in their packaging to minimize physical damage.

5. Transportation is a vital consideration for all sizes of orders. For large orders (over 1000 seedlings) a refrigerated truck is optimal. If one is not available the following steps should be taken with a pickup truck:

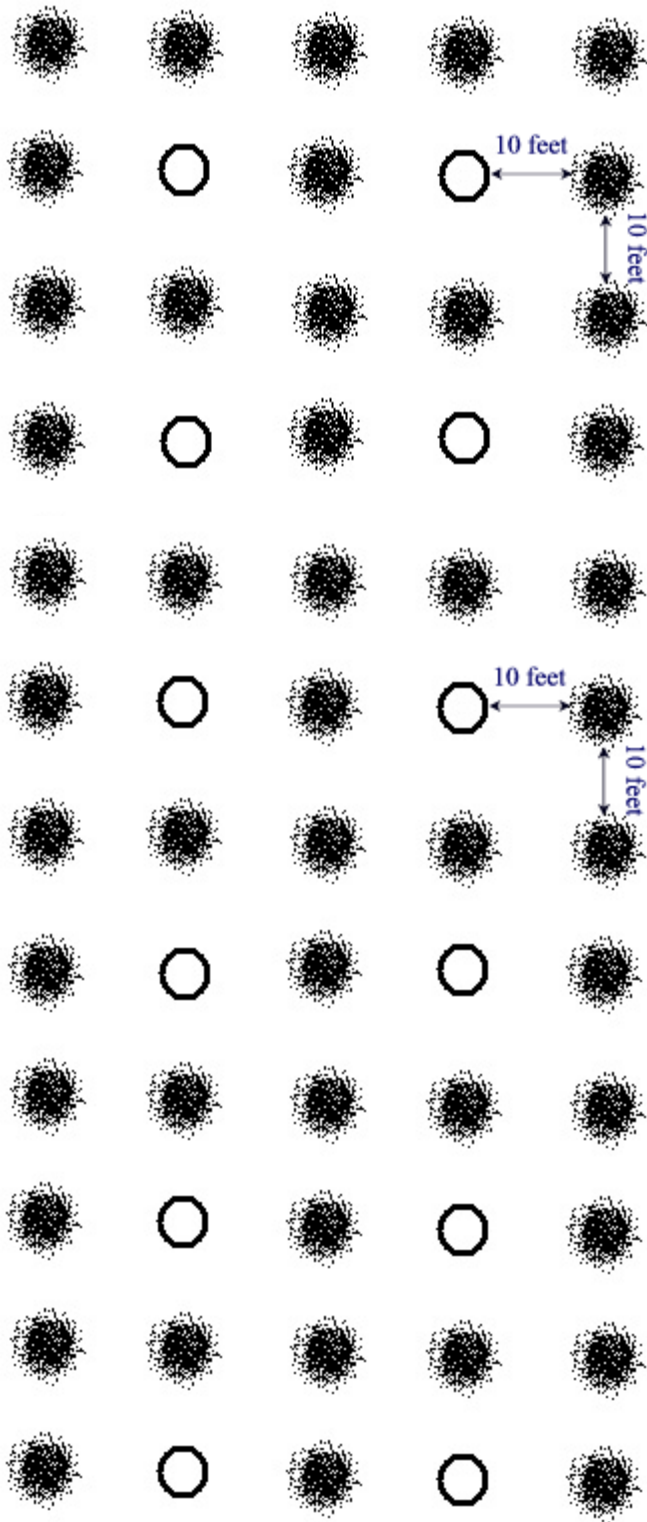
- Place foam sheets on the bed and spacer boards between the foam and the boxes for ventilation.
- With bags, or bales, build a frame to allow for airflow about the packages.
- Cover packages with a damp canvas tarp.
- Cover the canvas tarp with a solar-reflective tarp
- Fasten the load securely.

** If the order is small, a refrigerated van is still the best way to go. If this is not possible, and the packages fit into your car, air conditioning on maximum along with insulation and ice packs is advised. Only a few minutes in a hot trunk can damage seedlings permanently. If you suspect that the seedlings have not been kept cool since leaving the nursery, you may want to open the package and sprinkle the roots with water.*

6. Seedlings should **not** be 'heeled-in', nor planted in shallow soil pits for long-term storage. Do not immerse seedlings in water as this can drown root hairs. Do not delay planting while waiting for optimal soil conditions. Since most people do not have adequate long-term storage, seedlings are better off in the ground. If the planting job is large, consider receiving staggered seedling shipments to minimize storage time. The less time the seedlings spend out of ideal storage, the more vigorous they will be.

7. A key to survival of hardwood seedlings is to plant as large and vigorous a root system as possible. Do not root prune unless absolutely necessary. Root prune seedlings only if the length of the root system is longer than the depth of planting. If necessary, trim the roots so that the length from the root collar to the tip of the root is between 8-10 inches. Lateral roots can be pruned at 4 inches in length from the main taproot. Root pruning should be done in a controlled environment where the seedling root system will not be exposed to the drying effects of the sun and wind, where water is available to re-moisten the seedlings and the ambient air temperature is relatively cool (e.g. 40-50 degrees Fahrenheit). The worst place to do root pruning of seedlings is on the tree-planting site itself.

A Few Things You Should Know About Hardwood/Conifer Plantations



Trees should be planted 10 feet apart.

This 10'x 10' spacing amounts to 440 trees/acre.
330 conifers
110 hardwoods

The first row to be planted should be all conifers.

The second row planted should alternate between conifers and hardwoods.

Keep following this schematic the whole way across your planting (see diagram at left).

A power auger should be used to plant all hardwood seedlings. Conifers may also be planted using an auger.
(Refer to planting guidelines in handouts.)

End product should be each hardwood seedling surrounded by conifers.

Install tree shelters on all hardwood seedlings.

Tree shelters are not needed or recommended for conifer seedlings.

You can plant more hardwoods in the plantation. This will, however, significantly increase the cost of planting.

Make sure that weed control (herbicide) is accomplished before or immediately after planting.
(Ask your forester how to accomplish this.)

If applying herbicide after planting, make sure you **DON'T SPRAY THE SEEDLING.**

Maintenance on tree shelters **WILL** be necessary.

Pruning hardwoods and/or conifers may also be necessary.



**Hardwood Seedling w/
4-foot Tree Shelter**



**Conifer Seedling
pref. Red Pine or Jap. Larch
No Shelter Needed**



COMPARISON OF



HARDWOODS (Deciduous)

vs.

CONIFERS (Coniferous)

- Intolerant of shade.
(Need direct sunlight.)
 - Need site preparation before planting.
 - Need post-planting vegetation control for 3-5 years.
 - Preferred deer browse.
 - Need corrective pruning to maintain central leader.
 - Sporadic insect problems.
Gypsy moth on oaks.
Target canker on walnut.
Ash yellows on white ash.
 - Produce more wildlife food (mast).
 - Higher sawtimber value.
 - Longer time period to harvest sawtimber – 60 years (minimum).
 - Better firewood.
- Red pine and Larch are intolerant.
White pine is mid-tolerant.
Spruce is shade tolerant.
 - Site preparation helpful but NOT necessary.
 - Vegetation control helpful.
(Necessary for quality Christmas trees.)
 - Secondary deer browse.
(Spruce/larch NOT preferred.)
 - Strong central leader if not browsed or attacked by insects.
 - White pine weevil.
Spruce gall adelgid.
 - Produce more wildlife cover.
 - Lower sawtimber value.
 - Shorter time period to harvest sawtimber – 40 years (minimum).
 - Better windbreak.

SEEDLING SOURCES

(partial list)

Conservation Districts provide seedlings in smaller quantities than commercial nurseries.

CRAWFORD COUNTY CONS. DISTRICT

Woodcock Creek Nature Center
21742 German Road
Meadville, PA 16335
(814) 763-5269

MERCER COUNTY CONS. DISTRICT

747 Greenville Road
Mercer, PA 16137
(724) 662-2242

ERIE COUNTY CONS. DISTRICT

1927 Wager Road
Erie, PA 16509
(814) 825-6403

FOREST COUNTY CONS. DISTRICT

Courthouse Annex, P.O. Box 456
Tionesta, PA 16353
(814) 755-3450

VENANGO COUNTY CONS. DISTRICT

471 Beach Road
Franklin, PA 16323
(814) 676-2832

WARREN COUNTY CONS. DISTRICT

609 Rouse Ave., Suite 203
Youngsville, PA 16371
(814) 563-3117

PRIVATE NURSERIES

Provide seedlings in larger quantities. Order at least 5-6 months before planting season.

For a listing of other private nurseries in PA contact:

PA Nurserymen's Association
1924 N. Second Street
Harrisburg, PA 17102
(717) 238-1673

ABRACZINSKAS NURSERIES, INC.

RR #1, Box 6
Catawissa, PA 17820
(717) 356-2323
www.sunlink.net/abs

CANALE'S NURSERY

Box 51
Shelocta, PA 15774
(724) 354-2801
(724) 354-2500

***CARINO NURSERY**

Box 538
Indiana, PA 15701
(724) 463-3350
(724) 463-7480
www.carinonurseries.com

FLINCKINGERS NURSERY

Sagamore, PA 16250
(800) 368-7381

JOHNSTON NURSERIES

RD #1 Box 100
Creekside, PA 15732
(724) 463-8456
seedlings@hotmail.com

MAPLE HILL FARMS

P.O. Box 648
Lewisburg, PA 17837
(717) 524-0791

***MUSSEY FORESTS, INC.**

P.O. Box S-90M
Indiana, PA 15701
(724) 465-5685

***PIKE'S PEAK NURSERY**

P.O. Box 75 RD #1
Penn Run, PA 15765
(724) 463-7747

PINE GROVE NURSERY, INC.

RD #3 Box 146
Clearfield, PA 16830
(814) 765-2363

STRATHMEYER FORESTS, INC.

P.O. Box 70
Dover, PA 17315
(717) 292-5683

DEER AND RODENT REPELLENTS (CHEMICAL)

<u>PRODUCT NAME</u>	<u>ACTIVE INGREDIENT</u>	<u>USE NUMBER</u>	<u>EPA REG. NO.</u>	<u>MANUFACTURER</u>
ROPEL	Benzylmethyl Ammonium Saccharide 0.065%	B, C (taste)	45735-2	Burlington Scientific 91 Carolyn Blvd. Farmingdale, NY 11735 (516) 694-9000
HINDER	Ammonium Soap of Higher Fatty Acids 15.0%	A, B, C (odor)	1148-13	Unioyal Chemical 74 Amity Bethany, CT 06525 (203) 393-3630
HOT SAUCE ANIMAL REPELLENT	Capaicin 2.5%	A, B, C (taste)	72-574	Millie Chemical & Fertilizer P. O. Box 333 Hanover, PA 17331 (717) 632-8920
MAGIC CIRCLE DEER REPELLENT	Bone Tar Oil 93.75%	A, B, C (odor)	47043	J. C. Ehrlich Chemical Co. P. O. Box 5106 Reading, PA 19612 (215) 921-0641
MAGIC CIRCLE RABBIT REPELLENT	Thiram 20.0%	A, B, C (taste)	47042	J. C. Ehrlich Chemical Co. (Same as Above)
REPEL	Thiram 21.0%	A, B, C (taste)	5719-93	Chacon Chemical Corp. 2600 Yates Ave. City of Commerce, CA 90040 (213) 721-5031
RABBIT-DEER REPELLENT AND BULB SAVER	Thiram 11.0%	A, B, C (taste)	4136	Bonide Chemical Co., Inc. 2 Wurz Ave. Yorkville, NY (315) 736-8231
CHAPERONE DEER REPELLENT	Thiram 7.0%	B, C (taste)	731-14	Sudbury Laboratories, Inc. 6 October Hill Road Holliston, MA 01746 (617) 429-7900

Protecting Your Seedlings from Deer and Rabbits

Deer and Rabbits are a king size headache for nurserymen, golf courses, and homeowners. Both animals will browse through your tree plantings like a shopper at Wal-Mart, stopping to take a little taste of each plant until he finds one he likes. When he gets to a tree or a shrub he likes at the first taste, and will stay and eat until he is satisfied. He'll come back again when he is hungry. Being small, rabbits eat close to the ground, girdling the plants. Deer being larger animals can browse up to 4 1/2 feet from the ground.

A plant transfers water and nutrients from the roots to the foliage just under the bark of the plant. There is a layer of tissue just below the bark known as the cambium layer. This is the life support system for a plant. When the bark and cambium layer are eaten away the plant can no longer nourish itself, and will die.

Browsing by deer can usually be identified by browsed twig ends that have a ragged appearance, while twigs browsed by rabbits, porcupines, and other rodents have a neat, clipped appearance. This is because deer lack upper incisors and canine teeth, and cannot nip off twigs. Instead they must press foods between their hard upper palates and their bottom teeth, and jerk their heads up to tear it free.

There are several 'solutions' to deer and rabbit browsing. Several are listed here in order of effectiveness.

Mini-Barriers

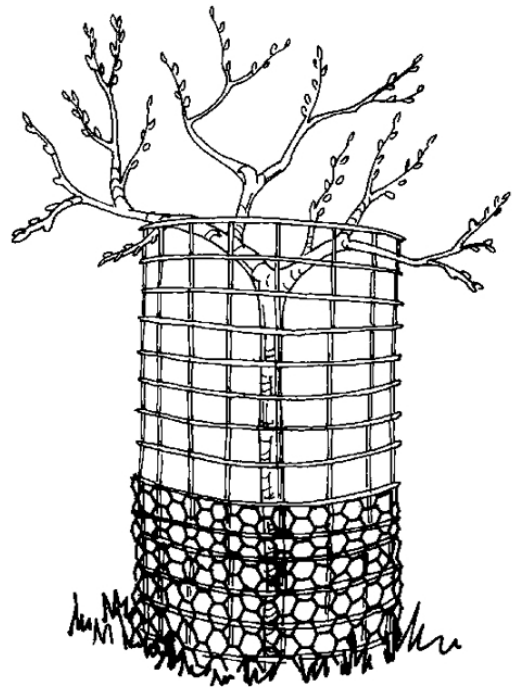
Barriers to protect small areas, individual plants, or vulnerable parts of plants can be purchased or made at home. These have the advantage of being less expensive and obtrusive than full fences, allowing deer access to surrounding food plants while protecting others. They can also protect plants from bucks rubbing their antlers, which breaks branches and strips bark off trunks.

A mini deer fence should be at least 4 feet high, placed far enough out from the plant to prevent deer from accessing the plant and causing damage, and be firmly staked to the ground. Prior to installation, remove all grass and weeds within the barrier by spraying with herbicide. To get a cage of the right size, simply unroll a 10-foot length of fence. Firmly fasten the ends together. This will give you a 3-foot cage. A 2-foot high band of chicken wire can be added to the bottom to exclude rabbits. Use wooden or metal stakes to hold the cage upright and use tent stakes to firmly fasten the cage to the ground.

This is especially effective for fruit and nut trees. These producing trees have a branching structure not well suited to tree shelters. This technique can also be used for shrubs and conifer plants.

Commercially available tree guards protect trees from damage done to the bark from deer antlers and gnawing from other wildlife. They can be wrapped around nearly any size tree, cut to different heights, and expand as the tree grows. Be sure to remove them if the tree shows signs of disease.

Tree shelters have been used successfully to protect small transplants and growing tree tips. For small plants, use tubes that match the plant's height and allow room for growth. Be sure to hold the tube upright with a wood or metal stake. Tree shelters are applicable for trees with an upright branching structure. Oaks, maples, black cherry, and other hardwood species can all be protected from deer and rabbits by using tree shelters.



Repellents

Deer repellents use a disagreeable odor or taste, or a combination of both, to dissuade deer from eating the treated plant. They are easy to apply and homemade solutions are inexpensive.

Numerous odor and taste repellents have been developed to reduce deer damage, and new products are continually becoming available. There have been numerous studies to test the effectiveness of these repellents, often producing conflicting results. No repellent eliminates deer damage entirely.

Before you apply: Most repellents function by reducing the palatability of the treated plant to a level below other available plants. Hence, repellent effectiveness depends upon the availability of wild deer food. Repellents are more appropriate for short-term rather than long-term problems and are the most practical for non commercial users experiencing low to moderate deer damage.

Repellents work best if applied before the deer develop a routine feeding pattern. This means applying repellents before leaves or flower buds emerge and as new growth appears. It's easier and more effective to prevent a feeding habit from forming than to try to break an established one.

Repellent facts:

- Spray-on repellents need to be applied frequently to protect the new plant growth, and will need to be reapplied after rain and long exposure to hot, dry, or windy weather.
- Deer may become accustomed to the same repellent over time, and eventually ignore it. Alternating repellents may help keep deer confused and more wary of eating your plants.
- Repellents that are applied to plant surfaces are generally more effective than capsules containing garlic oil, bags of hair, or other devices that produce an odor intended to protect a specific area.
- Finally, before putting complete faith in a repellent, first try it on a small area. Always use commercial repellents according to the manufacturer's directions.

Scare Tactics

Like most animals, deer are neophobic (fearful of novel objects), and many scare tactics take advantage of this behavior. However, deer soon get accustomed to new things and damage resumes after they realize no actual harm will come to them. As with repellents, a given tactic will work on some deer, but no single one seems to work on all of them. If the animals are already used to feeding in the area, scare tactics will last an even shorter length of time.

Scare tactics can be visual (scarecrows, bright lights, spare blankets), auditory (noisemaking devices such as exploders, whistles, etc.), or olfactory (predator urine or droppings).

One recent innovation is a motion sensor combined with a sprinkler that attaches to a hose. When a deer comes into its adjustable, motion-detecting range, a sharp burst of water is sprayed at the animal. This device appears to be effective by combining a physical sensation with a startling stimulus. Similar in approach but less effective are radios and lights hooked up to a motion detector.

A dog can help keep deer away, especially if it is large and awake. To keep the dog at home while simultaneously repelling deer from your property, use a "dog trolley" or an invisible (buried electric) fence, where practical. Avoid tethering a dog near stairways and fences, and provide at least 15 feet of cleared space for it to move around in. Do not use a choke chain, and remove all debris that could tangle or injure your dog. Provide shade, water, and shelter for the dog at all times.

