

**NATURAL RESOURCES CONSERVATION SERVICE
VIRGINIA TECHNICAL NOTE**

Forestry #3

TREE AND SHRUB ESTABLISHMENT GUIDELINES



INTRODUCTION

Establishing trees and shrubs successfully takes careful planning and consideration. Not all trees or shrubs can be planted using the same methods. Special attention is needed for woody plant establishment. The choice of what to plant depends on the purpose of the planting, the site and soil conditions and the availability of the seed, seedlings, or cuttings. There are many factors to consider before, during and after tree and shrub planting. A successful establishment depends on considering all these factors.

PLANTING ADAPTED SPECIES

Refer to Virginia Department of Forestry *Seedling Catalogue* for information about choosing and planting native trees and shrubs, plant characteristics and uses.

Some trees to plant and manage are listed in the Soil Survey Interpretations – Woodland Suitability for Individual Soil Series in Section II of the Virginia Field Office Technical Guide.

The NRCS *Plant Establishment Guide for Virginia* lists uses of native trees or shrubs for erosion control, wildlife and water quality.

The Virginia Department of Forestry and the Virginia Department of Game and Inland Fisheries as well as consultant or professional foresters can provide species recommendation for landowner's objectives.

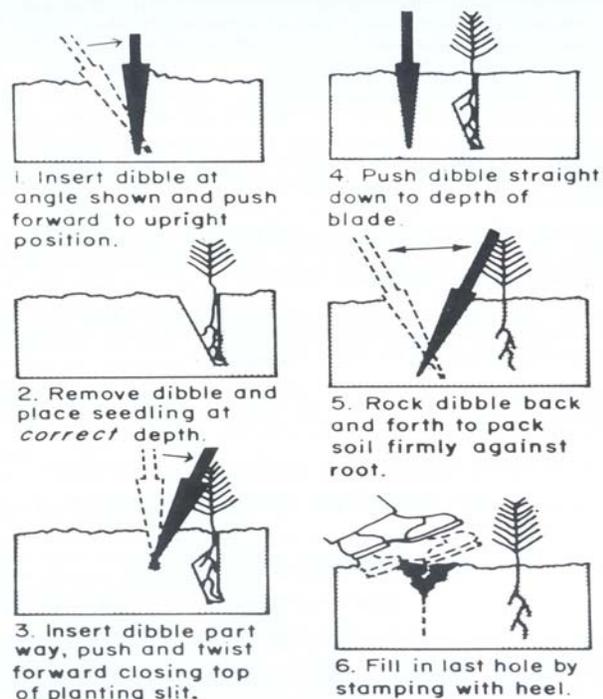
PLANTING SEEDLINGS

Seedlings may be planted by hand or with a machine transplanter. Machine transplanters are effective where logging debris or steepness of slope does not prohibit their operation. In some cases, planting is not needed at all since existing "seed trees" will provide the seedlings.

Hand Planting

Hand planting is used when the planting area is too small or the slope of the land is too steep to drive with a tractor. It is also used when there is too much debris on the ground and on wet sites. Refer to Figure 1 for procedures for hand planting. Planting is more efficient if a shoulder bag is used to hold the seedlings. If roots are too long for the planting hole, they can be trimmed to the length of the hole. Hand planting of pines is less tedious than hand planting hardwoods. Pines are less sensitive to errors in planting than hardwoods, therefore many more acres of pines can be hand planted in a day than hardwoods. Hardwood roots need more care in planting. Larger seedlings are used, at least 3/8-inch diameter at the root collar, and it is very important to keep the roots straight and not twisted or doubled over.

Figure 1. How to use a dibble to hand plant tree seedlings



Machine Planting

If the site is several acres or more in size and the ground is fairly even with no obstructions such as stumps, leave trees, or heavy brush, a machine planter will be the more efficient method. Refer to Figure 2 for an example of machine planting.

Figure 2. Machine planting tree seedlings.



Natural Regeneration

Seeding a site can also be accomplished through natural regeneration. This method works best with native pines, cottonwoods, and yellow poplar (tulip poplar) and most hardwoods, if fire and grazing are eliminated. Before considering this method, inventory the site to ensure that an adequate seed source, called seed trees, is present. Because the growing seedlings will be severely over-stocked, it will be necessary to release the young trees from competing vegetation and undesirable species. See Virginia Conservation Practice Standard *Forest Stand Improvement (Code 666)* for more information about tree release.

Table 1. Minimum Recommended Number of Seed Trees/Acre for Pines in Virginia

DBH*	Shortleaf Pine	Loblolly Pine	Longleaf Pine	White Pine
10	20	12	55	12
12	14	9	38	9
14	12	6	28	6
16+	12	4	21	4

*DBH is Diameter at Breast Height

DIRECT SEEDING

Seed Quality

Seed should be ordered from a reliable commercial seed dealer. Lots should contain no more than 10% cull by number and moisture content should be 10% or less. Impurities should be 2% or less by weight.

Seed Treatment

Seed stratification and repellent coating are essential for all pines except longleaf. Stratification will hasten germination after sowing, which in turn will reduce the period of exposure to predators and the elements. After stratification, the seed must be coated with a chemical repellent.

The repellent coating is the same for all Southern pine species. It usually consists of one chemical to repel birds and another to repel rodents and many insects. It also includes a substance that sticks the repellent to the seed, plus an aluminum powder to lubricate the seed so they flow through a seeding machine.

Timing and Rates

Seed should be sown about the time of the last killing frost. However, if longleaf seeds are used, November or February are the preferred seeding times.

For broadcasting, the rate for most species, both pines and hardwoods, should be 10,000 to 15,000 seed per acre. In terms of weight, used often for pines, the following pounds per acre are recommended:

Longleaf	3.0
Loblolly	1.0
Shortleaf	0.4
Virginia	0.3
White	0.6

With the hand-operated cyclone seeder, about 15 acres can be sown per man-day. This machine is efficient on tracts of up to several hundred acres.

Leaf litter must be burned if it is deep enough to prevent seed from reaching mineral soil. If the tract cannot be burned, use the spot sowing method as follows:

Using a hoe, rake leaves from a spot about one-foot square and drop six seeds on the exposed soil. Press them lightly into the soil. The leaves should be scattered, rather than piled, around the edge so they won't blow back over the bare spot and smother seedlings. Seedling 1,000 spots per acre, one man can cover 2 to 4 acres daily.

Release Seedlings

One advantage of direct seeding is that overtopping hardwoods do not hamper the operation; they offer shade to the seed during germination time and while the seedlings are getting established. The hardwoods should be killed by the middle of the following summer. Otherwise, they will compete for moisture and growing space. Direct seeding should not be used on slopes which are steep and eroded because seed can easily be washed away. Also deep, sandy soils should be avoided because they dry out too fast for good seed germination. For direct seeding to work on such sites, the seed have to be covered with ½ inch of soil – a very time-consuming operation.

PLANTING CONIFER SEEDLINGS

Seedling Quality

A quality seedling is disease-free, root collar diameter no less than one-eighth inch, stiff and woody, with secondary needles present, maximum top length 14 inches and a root system no less than five inches nor more than 9 inches long.

Seed Treatment

Seed stratification and repellent coating are essential for all pines except longleaf. Stratification will hasten germination after sowing, which in turn will reduce the period of exposure to predators and the elements. After stratification, the seed must be coated with a chemical repellent.

This coating is the same for all Southern pine species. It usually consists of one chemical to repel birds and another to repel rodents and many insects. It also includes a substance that sticks the repellent to the seed, plus an aluminum powder to lubricate the seed so they flow through a seeding machine.

Care of Seedlings

Seedling roots must be kept moist at all times. Seedlings (especially the roots) should not be exposed to the sun, wind, heating, drying, or freezing at any time from lifting at the nursery plantbeds until planted. No roots should be exposed to the sun or wind for more than 10 minutes. If cold storage is not available, keep seedlings packed in bales after delivery. They should not be stored in bales longer than 2 weeks.

Spacing of planted seedlings

Proper spacing of seedlings ensures a high survival rate, maximum growth and efficient use of space. Spacing controls competition between the seedlings and takes into account future operations such as thinning, release and harvest. Spacing recommendations are highly dependent on site characteristics and landowner's objectives. For instance, in Virginia, to be considered for Land Use Assessment for tax relief a minimum of 400 trees per acre is required. Table 2 lists the most important pine species for Virginia. Consult with a forestry professional for specific spacing recommendations.

Table 2: Recommended Conifer Species for Reforestation and Aforestation by Region*

Species	Coastal Plain	Lower Piedmont	Upper Piedmont	Mountains
Loblolly Pine	X ¹	X	X	
Longleaf Pine	X ²			
Shortleaf Pine ³	X ¹	X	X	X ⁴
Virginia Pine ⁵			X	X
Eastern Redcedar	X	X	X	
Eastern White Pine ⁶			X	X
Frasier Fir ⁷				X
Red Spruce ⁷				X

- 1 Not recommended on sands over 30" in depth.
2. Best species for sands over 30" in depth.
3. Adapted to dry, infertile soils.
4. Recommended up to 2,500 feet elevation.
5. Adapted to severely eroded soils and disturbed sites.
6. Should not be planted on heavy clay soils or wet sites.
7. No lower than 2,000 ft elevation, preferably above 4,500 ft elevation.

NATURAL SEEDING

Site preparation measures to encourage natural seeding should be employed only with light-seeding intolerant species whose seed are wind disseminated. This includes the native pines, cottonwood and yellow poplar (tulip popular). Most of the heavy seeded, tolerant hardwoods will reproduce satisfactorily with fire and grazing excluded. After establishment, desirable seedlings should be released, where necessary, from competing vegetation and undesirable species. Refer to Virginia Conservation Practice Standard *Forest Stand Improvement* (Code 666) for more information about releasing trees.

PLANTING HARDWOOD AND SHRUB SEEDLINGS

Care of hardwood and shrub seedlings are similar to conifer seedlings with the following additions:

- Seedlings must be large, at least 3/8" root collar diameter, and healthy. Small or weak seedlings result in planting failures.
- Seedlings must be of correct geographic source.
- The species must be adapted to the site.
- Logging and site preparation must be such that the soil is not eroded or compacted. Organic soil is desired when planting hardwood seedlings. Also, compaction and puddling occurs when equipment is run over wet soils. These conditions result in planting failure. As a general guide, the site should have a pine site index of 90 feet or more at 50 years if hardwood plantations are to be considered as a satisfactory crop.
- The newly planted seedlings need to grow without severe competition. This requires intensive site preparation and proper follow-up to control competing vegetation.
- Tubes, mats and shelters are necessary to protect the seedlings from browsing by deer, mice and other animals; they also protect the seedling from weed competition, excessive winds and sunscald.
- Plantations must be carefully monitored. Hardwoods and shrubs are killed or injured by light fires; grazing cattle and deer can destroy them, and they are sensitive to herbicides.
- Site characteristics for important hardwood and shrub species in Virginia are displayed in Table 3.

PLANTING WITH CUTTINGS

Cottonwoods, Alders, Willows and Sycamores

Cottonwood and willow cuttings are easily and quickly planted. A pointed steel rod, approximately 3/4" in diameter and of convenient length (36"- 42"), may be used. The rod is inserted vertically in the soil to a depth of approximately 12". The rod is withdrawn, a cottonwood cutting 20" long is placed in a hole to a depth of 15", and the soil is then firmed around the cutting. Cottonwood cuttings of various lengths up to 40" may be planted. In such cases, the cuttings are planted to depths, which will permit 4" to 5" to extend above the surface of the ground. Alders, and sycamores can be planted in this way also.

Table 3. Suggested Hardwood and Shrub Species for Reforestation and Aforestation by Region and Soil Characteristics*

Coastal Plain Characteristics

Species	Well Drained Deep, Rich (River Terrace)	Heavy, Somewhat Wet Soils (Mineral Soils)	Very Poorly Drained Permanently Wet Soils w/ Clay Base Muck or Peat	Shallow, Sandy Loamy Soils Over Clay Base (>6" Topsoil)
Ash				
Black Ash				X
Green Ash	X	X		X
White Ash	X			
Bald Cypress		X	X	X
Beech	X			
Black Gum (Tupelo)		X	X	
Black Walnut	X			
Black Willow		X	X	
Cedar				
Atlantic White Cedar			X	
Chokecherry		X	X	
Common Buttonbush	X	X		
Cottonwood	X			
Dogwoods	X			
Hazel Alder	X	X		
Hickories				
Mockernut	X	X		
Pignut				
Indigobush	X	X		X
Oaks				
Red				
Black Oak	X	X		
Northern Red Oak	X			
Cherrybark	X			
Pin Oak		X	X	
White				
Overcup Oak	X	X	X	X
Water Oak	X	X		
White Oak	X	X		
Willow Oak	X	X		
Persimmon	X			
Red Maple	X	X	X	
Red Mulberry	X			
River Birch	X	X		
Service-berry		X	X	X
Sweetgum	X	X		
Swamp Tupelo				X
Sycamore	X			X
Waxmyrtle (Bayberry)		X	X	
Yellow Poplar	X	X		

Table 3 Continued
Piedmont Characteristics

Species	Loamy, Clayey, Red, Droughty, (Eroded)	Upland Slopes & Ridges; Deep, Loamy Soil (Little Erosion)	Small Stream Bottom (Variable)	Major River Bottoms (River Terraces)
Ash				
Green Ash			X	X
White Ash		X		X
Beech			X	
Black Gum (Tupelo)			X	
Black Walnut		X		
Black Willow			X	X
Common Apple		X		
Common Buttonbush			X	X
Cottonwood			X	X
Dogwoods		X		
Eastern Redbud		X	X	
Eastern Red Cedar	X	X		
Hackberry			X	
Hazel Alder			X	X
Hazelnut			X	X
Hawthorne		X	X	
Hickories				
Mockernut	X	X		
Pignut	X	X	X	
Indigobush	X		X	
Oaks				
Red				
Black Oak	X	X		X
Cherrybark Oak			X	
Chestnut	X			
Northern Red Oak		X		
Pin Oak			X	X
Southern Red Oak		X		
White				
Overcup Oak			X	X
Water Oak			X	X
White Oak		X	X	X
Willow Oak			X	X
Persimmon	X	X	X	
Red Maple	X	X	X	X
Red Mulberry			X	
River Birch			X	X
Service-berry			X	X
Sweetgum		X	X	X
Sycamore		X	X	X
VA-70 Lespedeza	X			
Yellow Poplar		X	X	

Table 3 Continued
High Piedmont & Lower Mountains Characteristics

Species	Upland Ridges, Rocky, Eroded (Less than 3" topsoil)	Upland Ridges, Deep Soil (less than 50% Rocks)	Coves, Valleys	High Plateau
Beech			X	
Black Gum (Tupelo)			X	
Black Locust		X	X	
Black Walnut			X	
Black Willow			X	
Cherry		X	X	
Common Apple		X		X
Cottonwood			X	
Crab Apple			X	
Dogwoods			X	
Eastern Redbud	X	X		
Eastern Red Cedar	X			X
Hackberry			X	
Hazelnut			X	
Hawthorne			X	
Hickories Mockernut Pignut	X	X	X X	X
Indigobush	X		X	
Oaks Red Bear Oak Black Oak Chestnut Oak Northern Red Oak White Bur Oak White Oak	X X X	 X X	 X X	 X
Persimmon	X			
Red Maple	X	X	X	
Red Mulberry			X	
Sycamore			X	
VA-70 Lespedeza	X			X
White Ash			X	
White Walnut (Butternut)		X	X	
Yellow Poplar		X	X	

SPACING GUIDELINES FOR HARDWOODS AND SHRUBS

Spacing for special purpose plantings such as program requirements, wildlife, beautification, aesthetics, and sound and visual barriers, carbon sequestration or waste treatment will be done in consultation with an appropriate forestry specialist or from the Virginia Department of Forestry, Virginia Department of Game and Inland Fisheries, consultant forester or professional forester.

In general, a minimum of 300 trees per acre for hardwoods is recommended for timber production, 110 per acre for wildlife habitat establishment. However, since spacing is dependent on soil characteristics, site conditions and landowner's objectives, it is best to consult with a professional forester to determine species and spacing.

Table 4 illustrates the connection between different spacing patterns and the number of trees per acre required to fill the area. These spacing patterns are used mostly for poles, pulpwood, lumber and veneer objectives.

Table 4: Number of Trees Required Per Acre at Various Spacings

5' x 5' = 1,742	6' x 9' = 800	8' x 8' = 675	10' x 10' = 435
6' x 6' = 1,225	6' x 10' = 728	8' x 10' = 545	12' x 12' = 300
6' x 8' = 870	7' x 10' = 622	8' x 12' = 450	20' x 20' = 110

*From 400 to 500 well-distributed trees/shrubs per acre is an adequate stand for trees of minimum pulpwood size (5 or 6 inches diameter at breast height, dbh). From 1,000 to 1,200 trees/shrubs per acre is an adequate stand for 5-foot to 8-foot high Christmas trees. About 110 trees or shrubs per acre are recommended for wildlife planting.

PLANTING FOLLOW-UP FOR ALL TREES AND SHRUBS

Seedling stocking and survival can be determined a year after planting by taking 1/100 acre randomly sampled plots in the plantation. The radius of a 1/100-acre plot is 11.75'. Sufficient plots are needed to give a good representation. As a rule, if 300 or more well-established seedlings survive per acre, it will not pay to replant. Replacement plantings should be made within 2 years after the original planting.

GENERAL INSTRUCTIONS

Successful plantations depend so much on the care of planting stock that every effort should be made to keep it in good condition. Experience has shown that stock can be kept in better condition in bales/bags as it comes from the nursery than in field heel-in beds. This is particularly true where the stock will be planted in two to three weeks.

The following additional precautions should be taken in storing bales/bags:

- Keep in a cool place. Avoid heated rooms.
- Protect bales/bags from freezing.
- Water at least once each week to keep roots and packing moss moist.
- Stack bales/bags on sloping racks to ensure air circulation, easy watering, and drainage of excess water.

Stock must be kept cool and protected from "heating". Heating is a condition where seedlings break dormancy thereby using up stored water and energy resources. The survival rate for seedlings planted after heating is very low. Stock that is well watered, protected from direct sunlight, and properly aerated usually will not heat. Seedlings that have been subjected to heating should not be planted.

It should be remembered that the sooner seedlings are planted after being lifted from nursery beds, the better the chances for survival and normal growth. Loose seedlings, those not baled or bagged, should be “heeled in” immediately upon arrival.

While planting, take the following precautions:

- Water, wet moss, or wet burlap should be kept around the seedling roots.
- When hand planting, one seedling should be selected at a time and immediately planted.
- At the end of each day, “heel in” the loose seedlings or repack them in wet moss and wrap tightly with waterproof paper.

HEELING

To ensure adequate survival of seedlings, it is imperative to keep the roots of the seedlings moist. Seedlings should not be allowed to dry out from the moment they are lifted from the seedbed at the nursery to the time they are planted. Seedlings should be planted the day they are delivered. If this is not possible, protect the seedlings by “heeling” them in.

Heeling Instructions:

1. Select a well-drained and slightly sloping spot with some shade.
2. Dig the trench 2 to 4 inches deeper than the seedlings’ roots are long. One side of the trench should be smooth and slightly sloping.
3. Place a shallow layer (less than 3 inches) of seedlings against the sloping side of the trench and cover the roots and 1 or 2 inches of the stem with soil.
4. Water the soil thoroughly and repeat as necessary in order to keep the soil moist at all times.
5. Keep seedlings covered while hauling and protect them from the sun and wind prior to planting.

Tree and shrub establishment can be highly successful when done correctly. By paying attention to the purpose of planting the trees, carefully considering the species, and deciding whether to hand or machine plant, will ensure that seedling survival will be high and a healthy forest will be established.

INTERPLANTING

Interplanting is used when a stand failure has occurred in an original planting. New seedlings are interplanted in between the surviving seedlings. It is important to remove or control trees, shrubs, and vegetation of unwanted species that overtop or compete with interplanted seedlings and trees already established. Use the best-suited method described in the Virginia Conservation Practice Standard *Forest Stand Improvement (Code 666)* to release the surviving trees. This release work should be done in the spring to assure better survival and faster growth. Then plant new seedlings where the failures occurred. The objective of interplanting young stands is to attain an average stocking of at least 300 well distributed trees per acre by the time the trees are 5 to 6 inches dbh (diameter at breast height). The average distance between the trees should be 10 to 12 feet apart.

CULTIVATION

Cultural Practices

Ordinarily, pine plantations do not require cultivation. However, cultivation of pine seedlings planted on old fields, abandoned farms, and pastures has resulted in appreciable increase in early growth as compared to normal growth of seedlings on untreated areas. The “cost versus benefit ratio” may help the landowner make his decision in this matter. If cultivation is needed, a light disking to reduce grass competition during the first year usually will suffice.

Cultivation of cottonwood plantations is essential to survival and may be accomplished by disking, cross-plowing, or hoeing. Field plantations of other hardwood species such as sycamore and yellow poplar will also benefit from these cultural measures.

Release from Overtopping Vegetation

Planted seedlings or cuttings should be released from any overtopping vegetation not later than 2 years after planting. Consult the specifications for Virginia Conservation Practice Standard *Forest Stand Improvement (Code 666)* for applicable methods of treating overtopping vegetation. The “Foliage Spraying” methods should not be used on areas planted to hardwood species.

SITE PREPARATION

Before planting, most sites need site preparation treatment. Refer to the Virginia Conservation Practice Standard Site Preparation (Code 490) for more complete information about site preparation.

Site preparation will vary according to the species to be planted, type of ground cover, soil type, slope, degree of erosion, and other site factors. The objective is to reduce competition without removing or destroying topsoil and organic matter. Many areas will not require site preparation where pine species are being planted

Some special considerations for site preparation are as follows:

- **Heavy Brush or Shrubs**

Apply foliage spray, disk, or plow according to the size and type of undesirable brush or shrubs. Refer to *The Virginia Cooperative Extension Pest Management Guide*,

Horticultural & Forest Crops for more information on using chemicals for site preparation. On slopes exceeding 9 percent, disking or plowing should be done on approximate contours on strips 3 to 4 feet wide, leaving alternate strips undisturbed. Kudzu or honeysuckle can be controlled according to methods described in the Virginia Conservation Practice Standard *Forest Stand Improvement (Code 666)* or *Pest Management (Code 590)*.

- **Chemicals**

Chemicals can be used for individual stem treatment or applied to extensive areas. Refer to the Virginia Conservation Practice Standard *Forest Stand Improvement (Code 666)*.

- **Prescribed Burn**

Prescribed fire should be specified where needed and is a valuable supplement to some forms of mechanical or chemical control of competing vegetation. Drum chopping and fire, used in combination, is one of the most effective and least destructive methods of intensive site preparation. Other benefits are improved access and visibility that increase efficiency and safety of planting operations. Refer to Virginia Conservation Practice Standard *Prescribed Burning (Code 338)*.

- **Critical Areas with Severe Sheet Erosion, Gullies, or with Topsoil Removed**

Treat these areas by planting cover crops, fertilizing, and mulching prior to planting. For further details, consult the specifications for Virginia Conservation Practice Standard *Critical Area Planting (Code 342)*.

OTHER CONSIDERATIONS FOR PLANTING TREES OR SHRUBS

Site Improvement

Water control and fertilizer often can improve growth on wet and other low quality sites.

Water control should be designed to maintain optimum water table. In the bottomlands, pines grow best when the water table is at least 18 inches but less than 36 inches below the surface.

Bedding is used to improve drainage and make planting easier. It has improved survival and initial growth of loblolly pine, but may increase future logging costs. Pines planted on beds in wet areas benefit from improved nutrition and soil aeration.

Fertilization is generally not used when planting trees. Contact the Virginia Department of Forestry for more information.

Size of openings

Openings within established stands of trees should not be planted unless they are wide enough to permit direct sunlight to reach the ground for several hours each day. The openings should be at least twice as wide as the height of the surrounding trees.

Spacing

Trees should be spaced so that they will make normal growth until the time of the first cutting, which is usually a commercial thinning. Refer to Tables 1,2 and 3 for spacing guidelines.

Time to plant

Plant during the dormant season. (The season can be extended from two to four weeks by placing dormant seedlings in cold storage.) Avoid planting when ground is frozen or dry or excessively wet and sticky. Planting when soil is in poor condition results in low survival, poor planting production, misplanted seedlings, and poor growth.

Planting depth

Plant seedlings slightly deeper (1" to 2") than they grew in the nursery in all soils except deep sands where they should be planted 2 to 4 inches deeper than they grew in the nursery, exercising due care not to cover the terminal bud. An exception is longleaf pine which should be planted with the terminal bud at ground level after the soil has settled.

Root condition

Roots must be planted straight down, not twisted, balled or U-shaped. The opening (slit, hole, or furrow) should be large and deep enough to accommodate the root system in its normal position.

Firming the soil

Soil must be packed firmly around the planted seedlings with no air pockets around roots. For pines, test firmness by grasping 4 or 5 needle tips and pull. If seedling comes out of the ground, the trees have not been packed firmly. If the needles come loose, it is packed too firmly.

INSECT, DISEASE AND OTHER PROBLEMS

- Pales weevil is the most serious insect pest for pine seedlings on recently cutover pinelands. In susceptible areas, use chemically treated seedlings. Another preventive measure is to delay planting for one season following harvest cutting. The greater the volume of slash and number of stumps, the higher the population of pales weevil will be.
- Fusiform rust is the most important disease of loblolly pines. In localities where fusiform rust incidence is high, consider planting rust resistant stock or species less susceptible to rust (longleaf, shortleaf, and white pine).
- Damping off disease is caused by many types of fungi but is especially associated with *Rhizoctonia sola*, and species of *Pythium*, *Fusarium*, and *Phytophthora*. Both pines and hardwoods are affected. This disease is common in nurseries and infected seedlings can be delivered to planting sites. The fungi are more active in sites that are excessively wet and the pH is above 5.5. It is best to avoid sites that have these conditions or wait until the site is drier.
- Problems other than insects and diseases can hamper tree and shrub establishment. Deer, mice, voles, and other mammals chew on the seedlings often killing them. Acres of hardwoods can be damaged from these animals. To combat this destruction, tree shelters, stakes and mats are used to protect the trees. Figure 3 shows a planting protected from animal damage with tubes. Refer to the publication "Hardwood Planting Guidelines" from the Virginia Department of Forestry for more information.

Figure 3. Seedlings protected with 4-foot tubes.



SAFETY TIPS FOR TREE PLANTERS

Wear protective gloves and use care when handling seedlings treated with chemicals. Wash hands thoroughly and change clothes if they become soiled with chemicals.

Provide first aid kit and see that tree planters wear proper work clothing.

REFERENCES

1. NRCS, *Virginia Field Office Technical Guide*, Sections II and IV.
2. "Forestry Best Management Practices for Water Quality" in NRCS, *Virginia Field Office Technical Guide*.
3. Virginia Department of Forestry *Seedling Catalog, Virginia Trees for Virginia's Landowners*.
4. NRCS, *Plant Establishment Guide for Virginia*.
5. Burns, Russell M., and Barbara H. Honkala, tech. coords. 1990. *Silvics of North America: 1. Conifers; 2. Hardwoods*. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. vol.2, 877 p. These volumes can be accessed at:
http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm