



Improving Survival Rates For Hardwood Plantings

Summary

This report summarizes the results of a two-year effort conducted between 2006 and 2008 to evaluate hardwood planting sites in Virginia. Nearly 40 percent of the 300 sites inspected had acceptable survival of 80 percent. Nearly 74 percent of the sites inspected had survival rates of more than 50 percent. These field observations indicate that tree survival and stand establishment is closely related to the following factors:

- Species appropriate for site
- Seedling health and vigor (1/4 inch or larger root collar diameter)
- Seedling storage, handling, and planting quality
- Site preparation to remove competing vegetation
- Use of appropriate, safe herbicides
- Scalping the sod from the planting spot when planting
- Appropriate use and installation of tree shelters, white oak or treated pine stakes, and mats
- Landowner education regarding planting and maintaining hardwoods
- Exclusion of livestock

The Virginia Department of Forestry Hardwood Planting Guidelines addresses these factors, and if followed, a survival of 80 percent or better can be obtained.

Methods

From September 2006 to September 2008, 200 hardwood planting sites, one to eight years old were evaluated for survival and growth, and 100 sites, less than six months old, were evaluated for planting quality. Most of the tracts were planted as part of the Conservation Reserve Enhancement Program, Conservation Reserve Program, or Environmental Quality Incentives Program; were on pasture or hay land; and were in the piedmont and mountains of Virginia. To evaluate cultivated field planting, 32 tracts in southeastern Virginia were evaluated. Between 30 and 150, one-hundredth acre (radius: 11' 9") plots were taken on each tract.



Fig. 1 Successful Planting

Results and Discussion

Planting survival on the first 148 tracts can be broken down as follows:

- 58 tracts or 38 percent of all tracts had better than 80 percent survival
- 112 tracts or 74 percent of all tracts had better than 50 percent survival
- 9 tracts or 6 percent of all tracts had a survival of less than 20 percent
- Due to differences in planting contractors, survival rates varied by physiographic region, Table 1

A Good Plan Ensures Success

Table 1 Overall Survival by Physiographic Region

Coastal Plain	70 %
Northern Piedmont	70 %
Northern Mountains	65 %
Southern Piedmont pine tree planters	59 %
Southern Mountains landowner & pine tree planters	56 %

A successful planting project starts with a **plan** to identify which **species** are to be planted and where. A written plan was found in less than 10 percent of the counties visited. Often decisions were left to the planting contractor. More than 11 percent of the tracts had areas with few surviving trees due to the wrong tree species being planted for the site conditions. These usually were upland species being planted in soils which were wet at least several months of the year. Shade-intolerant species were planted in the shade on portions of 27 percent of the tracts, resulting in few surviving trees under existing overstory. A plan should cover measures to

avoid the problems listed above.

Use 1/4 Inch Seedlings

Seedlings less than **1/4 inch diameter**, as shown in Figure 2, was another common problem. Over the past eight years approximately half the trees planted did not meet this standard. Some seedlings observed, that are still less than 1/4 inch diameter, had not grown after three years. It is impossible to determine what percentage of trees had died due to small size, since by the third year, many small seedlings had simply disappeared. Research indicates that trees less than 1/4 inch may have initial survival similar to larger trees but will be slower growing. Numerous small, chlorotic seedlings and dead seedlings were observed under grass and weeds. The small seedlings were often covered up and shaded out by grass and weeds.



Fig. 2 Small Seedling

Prepare The Site

Effective **site preparation** had not been conducted on more than 90 percent of the tracts. The most common site preparation was mowing. A few tracts were burned or were treated with herbicide. Mowing or burning gives no long-term benefits. Fescue remains a competitor on pasture and hay land except where repeated herbicide treatment was used.

Maintenance

Repeated **annual mowing** was believed to enhance survival and growth, but measurements showed less than a one percent difference in survival or growth between mowed and un-mowed areas. Areas which were not mowed had, on average, 112 natural trees per acre, compared to no natural seedlings on the mowed areas.

Protect Seedlings



Fig. 3 Tree Shelter

Removing the grass roots where the seedling was to be planted was also a factor. Small seedlings cannot compete with the grass that fills the tree shelter where the **sod had not been scalped**. Grass, usually fescue, inside the tree shelter contributed to an average mortality of 50 percent of the seedlings on seven percent of the tracts.

Tree shelters were used on 98 percent of the planting sites, see Figure 3. In checking cultivated fields in Greenville and Southampton counties that were planted without tree shelters, only 12 percent survival was found. In these two counties, the tracts planted with four-foot tree shelters, buried two inches deep, were found to have a 74 percent survival rate after four years.

A comparison of brand and type of shelter and height indicated:

- Very poor survival without a shelter, even on cultivated fields.
- Average height doubled from 2 foot Tubex to 4 foot Tubex.
- Average height increased 20 percent from a 3 foot Tubex to a 4 foot Tubex.
- Average height for the 4 foot Tubex was 20 percent greater than for the 4 foot Miracle.
- The difference in percent survival was not significant between the Tubex and Miracle shelter.
- The Blue shelter height growth was close to the 4 foot Tubex but the survival was 21 percent less.

Table 2 Correlation of different tree shelters, average height growth, and average survival

Shelter Height	# Tracts	Overall Average Height 1998-2006	Average Survival
No shelter	5 Cultivated fields	1.8'	12.4 %
2-foot (Tubex)	25 tracts	2.5'	65 %
3-foot (Blue)	10 tracts	4.9'	53 %
3-foot (Tubex)	15 tracts	4.0'	67 %
4-foot (Miracle)	13 tracts	4.1'	71 %
4-foot (Tubex)	67 tracts	5.1'	74 %

Using inferior stakes or shelters to save a few dollars usually results in significantly reduced survival. The "Blue" shelter does not hold together to give adequate protection. In every case, the Tubex photodegradable shelters were found to split off as the tree grew. Photodegradable Shelters also save the extra expense of cutting them off, when the tree fills the shelter.

The Miracle Shelter and Jump Start brands are non-photodegradable and the Miracle web site recommends leaving the shelter in place until the tree is three inches in diameter, to protect against buck rub. Then, cut it off since it will not split. It will take 10 years for most of the trees to reach three inches in diameter, in which time most planted areas will grow up in a thicket of briars, vines and brush. Only time will tell how many non-photodegradable shelters will be cut off and how many will be left to girdle and kill the tree inside.

Properly Install Shelters

Improper installation of tree shelters; use of improper stakes; two- or three-foot tubes, or flimsy tubes, significantly reduced survival on many tracts. Tree shelters have proven effective in reducing damage to the seedling and, in some cases, increases growth. Prior to the 2008 planting season most tree shelters in the southern mountains and southern piedmont were not buried two to three inches and gave no protection from mice and voles. This resulted in low seedling survival on many tracts.

Provide Protection From Pests

In the northern piedmont and northern mountains most, but not all, contractors **buried the tree shelter two inches** which gave protection from voles and mice even where vole populations were high. VDOF research found height growth has been much greater with tubes (increased 1.4 ft) than without (decreased due to browse -0.6 ft), and seedlings in tubes have survived well (90 percent) and those not in tubes have not (20 percent). Both of these results are largely due to browse damage of the unprotected seedlings by rabbits and rodents. As vegetation increases during the second and third years, often vole and mice populations and damage increases, unless the shelters are buried.

In some areas of the mountains, two- or three-foot shelters have been commonly used to save money. However, on many of these sites, some eight years old, most of the oak trees are still at the top of the shelter, due to deer browse.

Use Durable Tree Tubes

Another problem occasionally found, was the use of flat sheets that are rolled to make a tube, or flimsy “blue” tubes which did not stand up to strong wind or deer rubbing.

The **white oak stake (except for chestnut oak) or treated pine stake** has proven to last on the eight-year-old evaluated tracts. On tracts over four years old, up to 20 percent of the stakes had rotted off. These turned out to be red or chestnut oak, or other hardwoods. Rebar was found on four tracts. The cable ties used to hold the shelter to the rebar or bamboo slip around on the rebar or bamboo, as the wind blows, contributing to deterioration of the shelter, and after a few years, rebar pose a safety hazard. Bamboo had not held up on the few tracts where it was used.

Control Weeds

Weed mats were used on most tracts. Weed mats or herbicide use for several years, adjacent to the shelter, appear to significantly reduce grass and weed competition.

Protect Birds

Bird nets were used on most of the tracts with four-foot shelters. Where bird nets were not used, in most cases, less than one dead bird per acre was found. In a few cases where bird populations were high, more dead birds were found. The net should be used if the landowner has a concern for song birds, especially blue birds.

Minimize Livestock Damage



Fig. 4 Livestock Damage

Significant **livestock damage**, Figure 4, was evident on 15 percent of the tracts—half or seven percent appeared to be due to “flash grazing.” Survival on tracts with livestock damage was 45 percent compared to 76 percent survival on tracts without livestock damage.

Mowing between the rows also resulted in a few shelters being clipped on most tracts. Insects and beavers caused only minor damage. Only a few tracts had significant damage from flooding. About 13 percent of the tracts were planted by the landowners, most being just a few acres or less. Landowners were seldom well informed about planting guidelines and very few did a good job of planting and installing shelters.

Follow DOF Planting Guidelines

Planting quality checks in the spring of 2006 indicated that approximately half of the tracts did not meet the standard of 80 percent of the trees being planted correctly according to “**VDOF Hardwood Planting Guidelines.**” In 2008, planting contractors and some landowners were informed of the need to make corrections. As the 2008 planting season progressed, planting contractors improved. Planting quality checks were made on 46 tracts in the spring of 2008. Planting contractors planted 35 tracts, of which 29 tracts or 83 percent had 80 percent of the trees planted correctly. Landowners planted 11 of the tracts, and only four tracts, or 36 percent, had 80 percent of the trees planted correctly.

Another inspection in the late summer of 2008 on tracts planted in the spring of 2007 indicated most contractor-planted tracts had survival of 90 percent or better. Two tracts on very rocky land had survival of 67 percent. Two tracts had reduced survival due to soil active herbicide, Oust and 2,4-D, with survival of 22 percent and 50 percent, respectively.

DOF Website

For Planting Guidelines go to <http://www.dof.virginia.gov/mgt/hwd-planting-guide.shtml>

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