Forest Research Review

September 2007

Seventeen-year-old loblolly pine planted at an initial density of 300 stems per acre on the Appomattox-Buckingham State Forest study of wide-spacing plantations.

In this issue...

VDOF Research Program

Welcome to the summer issue of the Virginia Department of Forestry (VDOF) Research Program Review. It's been a productive 2007 so far, and this issue will summarize some of our more interesting activities: an analysis of the value of planting improved loblolly pine seedlings; the latest data from our loblolly pine planting spacing study; a report on pre-commercial thinning studies; second-year results from our tree-of-heaven control test, and results from our statewide CREP hardwood planting survey.

Please let us know if you have any questions or comments, and be sure to visit our Web site at http://www.dof.virginia.gov/info/index-pubs-forest-res.shtml to browse through all the publications, fact sheets and analytical tools from the VDOF Research Program.

As always, please feel free to contact the research program staff with any questions or suggestions you may have:

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Recent Developments

1. With support from Chris Asaro and the Forest Health Program's Southern Pine Beetle prevention grant, we are collaborating with the Institute for Advanced Learning and Research in Danville, VA, to develop somatic embryogenesis techniques for mass-producing longleaf and loblolly pine. The work is in the horticulture and forestry lab of Dr. Barry Flinn, director of the Institute's Sustainable and Renewable Resources Program. A report of the results should be available this fall.
2. We completed installation in Essex County of a replicated study comparing the effects of biosolid application compared with traditional fertilizer on the growth of a loblolly pine stand. We will be collecting our first post-treatment data this winter.
3. We installed a comparison of the field performance of different sized hardwood seedlings. White oak, northern red oak, sawtooth oak and pin oak seedlings of varied root collar diameters were outplanted at the Augusta Forestry Center. We will check survival and growth this winter to see how it varies with initial seedling size.

On the Horizon

1. This fall, will see the beginning of the next cycle of progeny testing in our Tree Improvement Program. A number of trials will be planted in November at the Hockley Research Forest near West Point, VA.
2. In September, we will again collect the cone crop from our second-generation seed orchard in Milledgeville, GA. Like last year, we will collect seed individually from each of our top 20 or more families with the intent of making even better-performing seedling mixes available to Virginia landowners.
3. Work is beginning on an interpretive trail to demonstrate invasive species identification and control at the Charlottesville office complex. Grant funding has also been secured to help us expand this work to some of our state forests, where invasives are particularly problematic.
4. Over the next 12 months, we will be working on locating and installing plots in a large study of the combined effects of thinning and fertilization of a mid-rotation loblolly pine stand. The test is a collaborative effort with Virginia Tech and the Forest Nutrition Cooperative, and will include several intensities of thinning with and without fertilizer additions.
5. A conference, "Northern Limits – Restoring the Longleaf Pine in Ecosystem in Virginia," will be held at the Southeast 4-H Conference Center on Oct. 23-24, 2007 in Wakefield, VA. The conference is for landowners, scientists, government officials, foresters and students interested in learning more about the longleaf pine ecosystem in Virginia. The registration deadline is Oct. 1, 2007. More information about speakers, topics and registration can be found at http://www.pitcherplant.org/SpecialEvents.html or by contacting Phil Sheridan (804-633-4336, meadowview@pitcherplant.org).

Figure 1. VDOF research plot fertilizer application on a loblolly stand.

Genetics and Restoration

How Much Are Improved Seedlings Worth?

In the last issue of the Research Review, we summarized the 50-year history of the VDOF tree improvement effort. In it, we pointed out that while seedlings from the second generation of testing and selection grow an estimated 17 percent better in volume than unimproved "wild" seedlings, these gain estimates are the average of all open-pollinated seed in the orchard. Some individual parent trees have much higher volume gain while others are just average or even slightly below average. The individual families of loblolly pine are very stable and predictable in growth performance regardless of the site they are grown on, so the important question becomes "What is improved genetic material (i.e. seedlings) worth to landowners in Virginia?"

In recent years, industry nurseries have kept the best performing families from their orchards for their own land, and most state nurseries have sold seedlings only as mixtures of all families from their seed orchards. The VDOF collects seed of individual families in our second- and third-generation orchards separately, which will allow us to provide a range of value options to better match the reforestation objectives of individual landowners. The purpose of this analysis is to estimate what different mixes of seedlings might add in value over the life of a plantation.

The data presented here are based on the results

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of tests of the individual families when planted on sites across the South and measured through at least age six. For each parent family, the measured percentage gain in height was used to adjust the site index on a "typical" site and then – based on that site index – the growth of an acre of those trees was modeled using the LobDSS model developed by the Forest Nutrition and Growth and Yield Cooperatives. This is a very conservative approach in that it completely ignores any added value from improved straightness, form, wood quality and disease resistance, which are also emphasized in the selection process.

Of course, there are many factors that affect how trees grow and what they are worth. So, for this exercise, assumptions had to be made as to what kind of forest and financial scenario we would simulate. The key assumptions are:

- Beginning site index (SI): 65 or 70
- Pulpwood minimum dbh: 5 inches
- Initial planting density: 436 trees per acre
- Chip-n-saw minimum dbh: 8 inches
- Rotation age: 30
- Sawtimber minimum dbh: 11 inches
- No fertilization or thinning
- Pulpwood top diameter: 4 inches
- Discount rate: 4 percent
- Chip-n-saw top diameter: 6 inches
- Chop and burn site preparation
- Sawtimber top diameter: 8 inches
- Hardwood basal area in stand: 5 percent
- Pulpwood price: $6 per ton
- Harvesting fixed cost: $5 per ton
- Chip-n-saw price: $18 per ton
- Harvesting variable cost: $12 per ton
- Sawtimber price: $35 per ton

A total of five potential mixes of seedlings were modeled: 1) the traditional seed orchard mix (SOM) of all families in the orchard; 2) a "third-tier" mix of six parent trees; 3) a "second-tier" mix of nine parent trees; 4) a "first-tier" mix of the top 10 parent trees; and 5) an "elite" mix of just the top two parents. The average percent height and volume gains at age six from the field tests for these mixes are listed in Table 1, along with the number of parents and individual trees available in the orchard for seed collection.

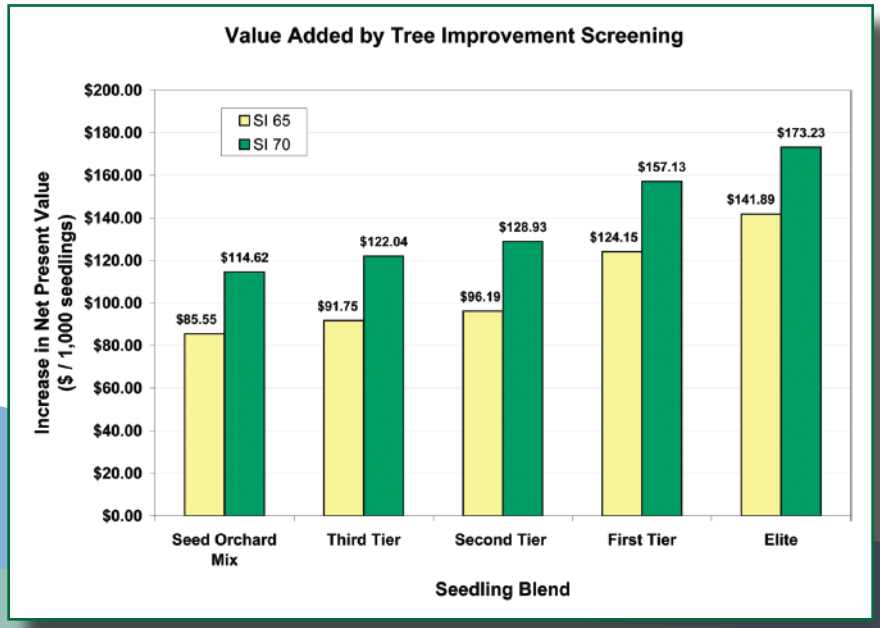
Table 1. Estimated gains and number of parents and trees for the five seedling mixes being compared.

Offering	Age 6		No. Parents	No. Individual Trees
	Height Gain (%)	Volume Gain (%)		
Seed Orchard Mix	6.9	17	51	2,437
Third Tier	7.4	17	6	473
Second Tier	7.7	24	9	657
First Tier	10.0	37	10	417
Elite	11.4	44	2	101

Table 2. Estimated added value (compared to unimproved seed) of one thousand seedlings of various improved seed mixes.

Offering	Dollars per Thousand Seedlings			
	Added Value		Gain Over Seed Orchard Mix	
	Site Index 65	Site Index 70	Site Index 65	Site Index 70
Seed Orchard Mix	$85.55	$114.62	—	—
Third Tier	$91.75	$122.04	$6.20	$7.42
Second Tier	$96.19	$128.93	$10.64	$14.31
First Tier	$124.15	$157.13	$38.60	$42.51
Elite	$141.89	$173.23	$56.34	$58.61

Figure 2. Estimated added value (compared to unimproved seed) of one thousand seedlings of various improved seed mixes.



The value of these observed gains for one-acre planted with each family and grown to rotation, was estimated from the model output in terms of net present value (NPV), and then all the family values in a given mix were weighted by the number of individual trees in the orchard to derive an average value added for the mix. Since seedlings are sold in bundles of one thousand, the values were then converted to dollars per thousand seedlings. The results are summarized in Table 2 and Figure 2.

Under the financial and silvicultural assumptions used in this exercise, the data indicate that the seed orchard mix alone is worth $85-115 per thousand compared to unimproved seed. Individually, the selected mixes are worth $92-173 per thousand and add between $6 and $59 per thousand in value above that from the SOM. The net present value is related to site index, with higher site quality (site index) leading to higher returns by around $30 per thousand. The value of improved seedlings increases as site productivity increases – either due to inherent site characteristics or to intensive silvicultural treatments, such as competition control or fertilization.

This analysis is not intended to suggest that seedlings should actually be sold at these prices or in these mixes. There are too many factors that vary with site and landowner objective to be able to generalize. But it does serve as a good example of the kind of value landowners can expect to receive on average sites under fairly typical plantation conditions.

Pine Silviculture

Loblolly Pine Planting Density Study

How many trees per acre should be planted when establishing a new loblolly pine stand? Like most forestry questions, the answer depends to some extent on site conditions and objectives. But it's an important decision because the choice affects timing of crown closure and rates of stand volume growth, individual tree diameter growth and natural pruning. Lower planting densities result in faster individual tree diameter growth, but slower total stand volume growth and slower natural pruning. As a result, planting density has a large impact upon the timing of thinning, the intensity of thinning and the products removed in thinning.

Twenty years ago, planting densities of 700 or more trees per acre were common, and as many as 1,200 per acre were planted on some sites – often in anticipation of heavy early mortality that would reduce early densities by 30-50 percent or more in some cases. In recent years, the improved growth, survival and uniformity of selected families on intensely managed sites has made mortality less of a concern, and with the cost of the best improved seedlings rising, planting densities have fallen. It is now common across much of the industry land in the South to plant between 400 and 450 trees per acre. Even lower densities, in the 200-400 trees per acre range, may be of interest to landowners who wish to maximize diameter growth, obtain sawtimber as soon as possible, delay crown closure, or forego thinning of their stands.

In the springs of 1990, 1992 and 1993, plantings of 100%-genetically-improved first generation loblolly seedlings from the Virginia Department of Forestry tree nurseries were planted on tracts located in the Appomattox-Buckingham State Forest in the Piedmont of Virginia. Each year, three replications were planted on a single tract. The spacing and number of seedlings were varied in three plots per replication to obtain densities of 200, 300 and 400 trees per acre (TPA – see Figure 3 below).

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Figure 3. Study plots on the Rinehart location of the planting density study at age 17.

With the measurements made after the 2006 growing season, age 14 through 17 results are available and are summarized in Table 3. Survival has been good to excellent at all three sites, and – along with height - is unaffected by planting density. DBH and basal area follow expected trends: individual tree dbh is greater at lower densities while stand basal area is greatest at higher densities. Both findings are statistically significant. By age 17, individual trees average nearly 10 inches on the 200 tpa plots while basal area on the 400 tpa plot is approaching 140 ft.^{2}/acre. Total stand volume tends to be higher at the 400 tpa density, but the differences are only marginally significant, statistically. From the chart in Figure 4, it is evident that volume is continuing to accumulate rapidly on all of the plots, although differences between densities are not increasing in all cases. At the age 17 Rinehart location, there is little difference between 300 and 400 tpa.

This study continues to show that relatively low density plantings of genetically improved loblolly pine seedlings can result in well-stocked stands with high-quality crop trees with mean diameters approaching 10 inches by age 17, and the 300 and 400 trees per acre density stands could support a merchantable thinning now. The 300 tpa stand may prove to yield as much as the 400 tpa stand, and will likely have greater stand vigor, residual crop tree diameter, and ability to regain wind and ice-firmness quicker after thinning. Planting densities in the 300-400 tpa range may be good for single-thinning management regimes where thinning cannot be done until after 17 or 18 years of age. The 200 trees per acre stand may be a better choice for areas where intermediate harvests are not practical.

Table 3. Current survival (percent), height (feet), dbh (inches), basal area (ft.^{2}/acre), and total stem volume (ft.^{3}/acre, inside bark) on the DOF loblolly pine planting spacing study at three locations: a) Talbert, b) Abbitt, and c) Rinehart.

a) Talbert Tract	Density			Treatment Pr>F*
Age 14	200 tpa	300 tpa	400 tpa	
Survival (%)	88%	83%	88%	.9984
Height (ft.)	42	40	42	.1294
DBH (in.)	8.8	7.9	7.6	.0027
Basal Area (ft.^{2}/acre)	91	92	113	.0102
Total Volume (ft.^{3}/acre ib)	1,392	1,337	1,715	.0132

b) Abbitt Tract	Density			Treatment Pr>F*
Age 15	200 tpa	300 tpa	400 tpa	
Survival (%)	97%	92%	92%	.9949
Height (ft.)	48	47	47	.8264
DBH (in.)	9.6	8.9	8.5	.0041
Basal Area (ft.^{2}/acre)	98	120	147	.0337
Total Volume (ft.^{3}/acre ib)	1,700	2,056	2,480	.1322

a) Rinehart Tract	Density			Treatment Pr>F*
Age 17	200 tpa	300 tpa	400 tpa	
Survival (%)	93%	93%	93%	.9999
Height (ft.)	51	52	50	.6299
DBH (in.)	9.5	8.9	8.2	.0016
Basal Area (ft.^{2}/acre)	113	129	139	.0052
Total Volume (ft.^{3}/acre ib)	2,100	2,411	2,524	.0913

*Treatment Pr>F indicates the statistical probability of a greater F statistic in the analysis of variance – the higher the number the more likely it is that the observed differences are not due to the treatment. A Pr>F less than .05 is generally regarded as strong evidence that the treatment has caused the observed differences.

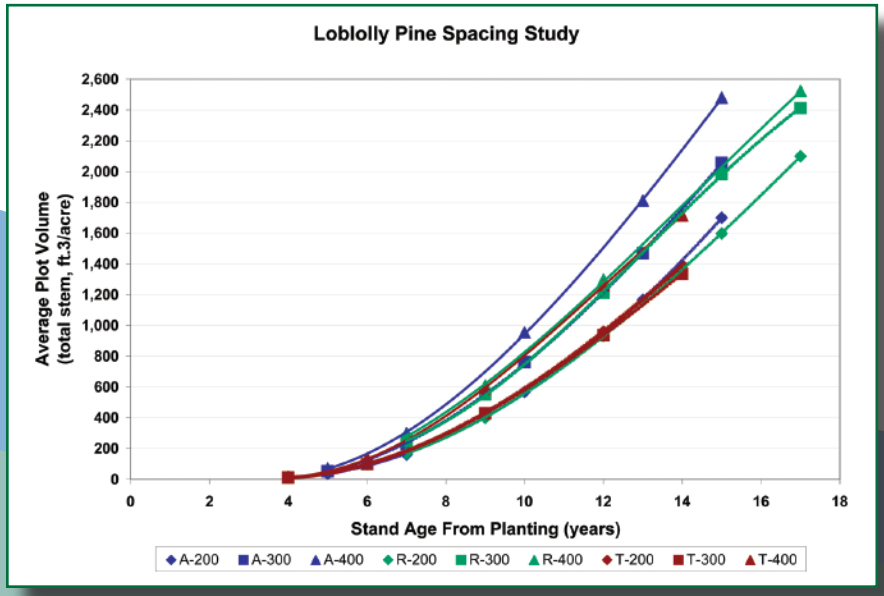

Figure 4. Total stem volume (ft.^{3}/acre, inside bark) on the DOF loblolly pine planting spacing study at three locations (Talbert = T, Rinehart = R, and Abbitt = A) and three planting spacings (200, 300 and 400 trees per acre) through the most recent remeasurement.

White Pine Establishment Study – Second Year Results

On Feb. 17, 2005, 2-0 eastern white pine seedlings were randomly selected from the Virginia Department of Forestry's Augusta Nursery operational lifting. They were transferred immediately to the grading building where they were graded as rapidly as possible and then either transferred directly to the storage cooler or left exposed on the grading table for 30, 60 or 240 minutes after grading before being placed in the cooler.

On March 18-21, 2005 and again April 18-19, 2005, additional seedlings were lifted and, along with those stored since February 17 – transported to the planting locations. On May 17-18, 2005, recently-lifted (within two weeks) seedlings from the operational program were retrieved from coolers at Augusta, Salem and Galax.

Test plots were installed at three locations: in Augusta County (at the Augusta Forestry Center); in Floyd County (near Burkes Fork Creek); and in Grayson County (on the Matthews State Forest). All three locations were on flat to gently sloping old field sites with an established grass/sod cover. Seedlings for each of the 18 treatments (see Table 4) were planted in 15-tree rows replicated three times in a randomized complete block experimental design at each location. Planting dates were March 18-21, April 18-19 and May 17-18, 2005.

The first-year results were summarized in the March 2006 issue of the Research Review and in Occasional Report 125. The plots were measured for the second (and final) time after the 2006 growing season. The survival summary is presented in Table 4 and Figure 5. The overriding site factor determining the survival of these seedlings after two years has been competition. Survival ranges from 7.5 percent at the Floyd location to

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Figure 5. Percent of planted eastern white pine seedlings surviving at the end of the second (2006) growing season.

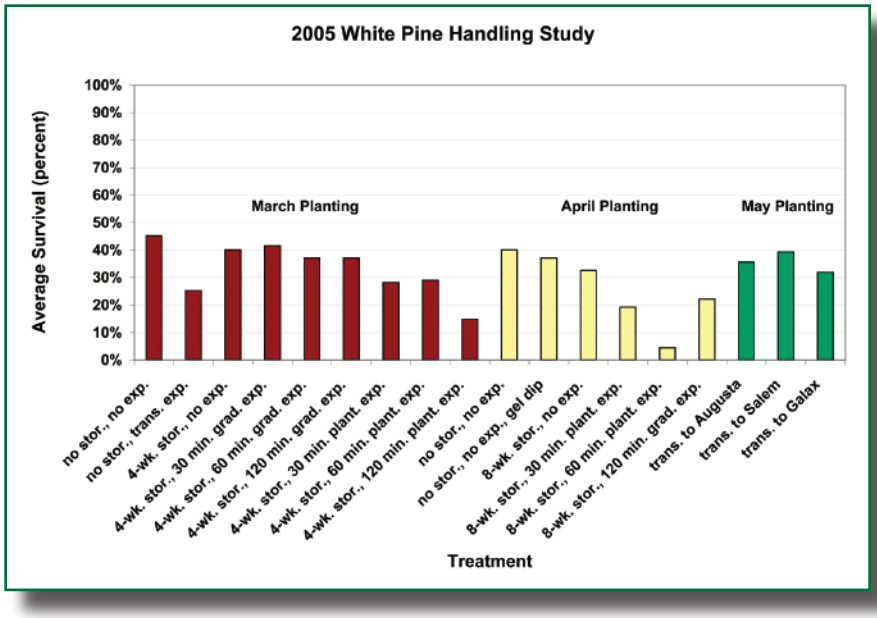

Table 4. Percent of planted eastern white pine seedlings surviving at the end of the second (2006) growing season. Overall means are ranked in descending order.

No.	Treatment	Augusta	Floyd	Grayson	Average
1	no storage, no exposure	37.8	24.4	73.3	45.2
4	4 wk. storage, 30 min. grading exposure	33.3	13.3	77.8	41.5
3	4 wk. storage, no exposure	40.0	6.7	73.3	40.0
10	no storage, no exposure	35.6	13.3	71.1	40.0
17	Transport to storage at Salem	44.4	0	73.3	39.3
6	4 wk. storage, 120 min. grading exposure	20.0	11.1	80.0	37.0
5	4 wk. storage, 60 min. grading exposure	24.4	13.3	73.3	37.0
11	No storage, no exposure, gel dip	37.8	4.4	68.9	37.0
16	Transport to storage at Augusta	28.9	0	77.8	35.6
12	8 wk. storage, no exposure	40.0	8.9	48.9	32.6
18	Transport to storage at Galax	26.7	0	68.9	31.9
8	4 wk. storage, 60 min. planting exposure	33.3	11.1	42.2	28.9
7	4 wk. storage, 30 min. planting exposure	28.9	8.9	46.7	28.1
2	No storage, transport exposure	24.4	8.9	42.2	25.2
15	8 wk. storage, 120 min. grading exposure	11.1	2.2	53.3	22.2
13	8 wk. storage, 30 min. planting exposure	22.2	2.2	33.3	19.3
9	4 wk. storage, 120 min. planting exposure	22.2	6.7	15.6	14.8
14	8 wk. storage, 60 min. planting exposure	2.2	0	11.1	4.4
	Average for this location	28.5	7.5	57.3	31.1
	Planted March, 2005 (treatments 1-9)				
	Planted April, 2005 (treatments 10-15)				
	Planted May, 2005 (treatments 16-18)				

Pine Silviculture, continued

57.3% at the Grayson site. Despite the heavy stress from competing vegetation, trends in the treatment effects observed after one year still are apparent. Survival was lowest for treatments imparting stress due to either 1) cold storage for 8 weeks before planting, 2) exposure during planting, or 3) exposure during transport.

Pre-Commercial Thinning of Loblolly Pine Stands

By John Scrivani, director, Resource Information Division

Natural regeneration of loblolly pine in either planted or naturally-regenerated stands can result in thousands, or even tens of thousands, of seedlings per acre (Figure 6). While natural stands will self-thin and some crop trees will assert dominance, a pre-commercial thinning can be used to increase both the number of crop trees and their rate of growth (Figure 7).

In the early 1990s, Tom Dierauf and I established seven pre-commercial thinning study locations in the coastal plain of Virginia – three in plantations and four in naturally-regenerated stands. Thinnings were implemented by cutting with chainsaws or brush saws. Also, at each location, an area was left un-thinned as a control. From one to three $^{1}/_{10}$-acre plots were established in the thinned areas at each location. Because of the high stocking, smaller plots of $^{1}/_{100}$-acre were established in the control areas.

Figure 6. View of an unthinned loblolly pine stand (edge in background) with 20,700 stems per acre.

Figure 7. View of a thinned loblolly pine stand (same as in Figure 6) after thinning to 690 stems per acre.

Each of these locations has been measured three times since establishment. The final stand measurements, ranging in stand age at measurement from 15 to 21, are presented in Table 5. The thinned stands had stocking of 140 to 550 crop trees per acre. In every case, a significant increase in diameter (1 to 5) inches was observed due to thinning.

In three of the thinned stands (thinned at age, 3, 4 and 5) significant "re-sprouting" of cut stems was observed. Loblolly pine is not capable of producing sprouts, but if one live limb is left on the stump it can take over as the leader and give the appearance of a sprout. In two of the stands, these "sprouts" are mostly suppressed and are starting to drop out of the stand. On one tract, however, about 10 "sprouts" per acre have become crop trees. These results, combined with the good results of the two stands thinned at ages 6 and 7, suggest that waiting to stand age 6 or 7 may be a way to minimize recruitment of "cut" stems into the stand. More careful cutting or chemical thinning treatments could be effective at earlier ages.

The results are most dramatic for the natural stands (# 1-4). Average diameter was increased by 3.2 inches to 4.0 inches when compared to the control. Competition induced mortality in the un-thinned controls has reduced stocking from the tens of thousands to the range of 1,000 to 2,000. In all but one case, basal area in the control stand is below that of the thinned stand. The high overstocking also reduced dominant height growth of the controls relative to the thinned, as shown in Table 6. Dominant height reductions of 5 feet to 10 feet were observed. Crown ratios are also consistently higher in the thinned areas. Nevertheless, in each natural stand control area some trees have expressed dominance and qualify as crop trees, although they are fewer and smaller than crop trees in the thinned stands.

Table 5. Third measurement results.

Stand No.	Initial Condition		Current Conditions						
	Age	Stems/Acre	Age	Stems/Acre		Basal Area (ft.^{2}/acre)		DBH (in.)	
				Thinned	Control	Thinned	Control	Thinned	Control
1	7	10,700	21	485	1,000	202	168	8.6	5.4
2	6	34,783	21	350	950	170	178	9.4	5.6
3	5	62,400	17	550	2,000	147	99	6.8	2.8
4	3	25,800	16	540	1,150	144	61	6.8	3.0
5	5	540	18	280	500	165	194	10.3	8.3
6	5	670	18	140	630	103	166	11.6	6.8
7	4	1,480	15	440	1,100	132	220	7.2	5.9

Table 6. Natural stand height and crown development with and without thinning.

Stand No.	Height (ft.) of Dominants		Crown Ratio (%)	
	Thinned	Control	Thinned	Control
1	69	60	44	40
2	55	50	49	41
3	46	36	47	38
4	44	34	50	31

Since the planted stands had pre-thinned stocking well below the natural stands, even counting volunteers, dominant height growth was not affected over the long term. Table 7 shows no significant difference in dominant heights 11-15 years after thinning. Thinning of planted stands with less than 2,000 stems per acre also tended to reduce stocking. As can be seen in Table 2, each thinned planted stand had lower basal area relative to the control. Also notice that, as would be expected, the lower the post-thinning stocking, the greater the increase in diameter.

Table 7. Height of planted stands with and without thinning.

Stand No.	Height (ft.) of Dominants	
	Thinned	Control
5	57	56
6	53	53
7	42	42

In summary, pre-commercial thinning of natural stands can increase the number, diameter and height of crop trees without decreasing overall stocking. For overstocked planted stands, pre-commercial thinning can increase the diameter of crop trees, while dominant height is generally not affected. Pre-commercial thinning of both types of stands increases stand vigor and can be helpful in reducing the risk of insect losses and storm damage.

Success of Riparian Restoration Projects in the Ridge & Valley, Piedmont, and Coastal Plain Regions of Virginia

By Benjamin N. Bradburn, VDOF watershed project leader

Forested riparian buffers are a Best Management Practice (BMP) for protection of water quality and wildlife habitat. Since the 1990s, conservation agencies in Virginia have been involved in establishment of riparian buffers under the auspices of programs, such as the Conservation Reserve Enhancement Program (CREP). Although CREP was established for the protection of water quality, little monitoring has evaluated the success of establishment efforts. In summer 2006, a team from Virginia Tech (Benjamin N. Bradburn, W. Michael Aust, Matthew B. Carroll) evaluated 63 CREP sites distributed across the Coastal Plain, Piedmont, and Ridge and Valley regions. The goal of this project was to examine restoration plantings to determine which species were more prevalent and whether the plantings were adequately stocked. The study sites were selected randomly from the VDOF conservation programs database. County VDOF foresters provided information from landowner files pertaining to the selected sites visited in the study. Field data at each site were collected using fixed area plots.

The Coastal Plain region had the highest stocking of planted trees with a mean 115 trees per acre and the highest mean naturally regenerated species of 3,162 per acre. The Piedmont had a mean 99 trees per acre of planted trees and a mean 1,082 trees per acre of volunteers, while the Ridge and Valley produced means of 85 and 185 trees per acre, respectively. The mean percent stocking for the Coastal Plain, Piedmont, and Ridge and Valley were 100 percent, 90 precent and 77 percent, respectively. The percent stocking is based on the Natural Resources Conservation Service (NRCS) field guidelines of having an initial 110 trees per acre (TPA) planted on site. In combination with the planted stems, the Coastal Plain and Piedmont sites are very well stocked and should provide good composition throughout the establishment and growth of the stand. However, the Ridge and Valley region generally had poor stocking and efforts need to be applied to provide better survival and stocking rates. One characteristic attributing to this region's lack of stocking is the lack of a volunteer seed source. Many of the sites planted in the Ridge and Valley were in the middle of large pastures where trees, especially the pioneer species, were absent.

The list of the three most prevalent species in each region included white oak and pin oak in every case. They were joined in the top three by black oak and willow oak (a tie) in the Coastal Plain; southern red oak in the Piedmont, and northern red oak in the Ridge and Valley.

Restoration of riparian forest vegetation via plantings is generally successful in situations having a combination of good fencing, proper species selection, and the proper installation and maintenance of planting aids (Figure 8). The Coastal Plain and Piedmont efforts are working primarily due to the fencing out of livestock and the abundance of volunteer growth. Efforts in the Ridge and

Figure 8. A well-maintained hardwood CREP planting in the Ridge and Valley region.

Valley need to be focused more on the control of invasive species (Figure 9) so the desired vegetative cover is achieved. Having had few sites with site preparation techniques applied, it may be appropriate to look more closely into better site preparation techniques to more sufficiently establish the initial seedlings' growth. The majority of the damaging issues involved the planting shelters affecting the seedlings' growth; to address these problems, some amount of inspection and maintenance should be conducted on the planted sites. Landowners and/or agency officials should routinely observe the plantings to confirm that the survival and stocking is adequate and the fencing is keeping the livestock out. These key factors are the determinants to the projects' success or failure. An extra effort to educate landowners about invasive weed control, mowing, planting, maintenance and site surveillance by VDOF and NRCS could help improve the success of these plantings.

Figure 9. Invasive species, such as this thistle (9 feet tall) in the Ridge and Valley can seriously impede the development of riparian plantings.

Tree of Heaven (Ailanthus) Control Methods – Second Year Results

Although there are many invasive, non-native plants to contend with in Virginia, tree of heaven (Ailanthus) is considered the most serious woody invasive. It is occupying interior forest habitat where canopy gaps occur and is now the 46th most abundant tree out of a list of 104 tree species for the Commonwealth. In a collaborative effort with Chris Asaro (forest health specialist) and Charlie Becker (forest utilization and marketing specialist), a study was initiated in early 2006 to (a) evaluate the effectiveness of herbicide treatment in combination with different harvesting strategies and (b) assess the market value of the resulting tree of heaven wood. The following summarizes the results of the control phase (a) of the study.

All herbicide treatments in the test involved a tank mix of Garlon 4 (triclopyr) in JLB Oil Plus carrier at a ratio of 1:3 Garlon:oil applied using a Solo backpack sprayer. Three herbicide application strategies – basal stem spray followed by chainsaw harvest one week later; basal stem spray followed by chainsaw harvest four weeks later, and chainsaw harvest followed immediately by a cut-stump treatment - were compared to harvesting with no herbicide treatment in a completely randomized design at each location. Each of these four treatments was applied to five stems in each of three dbh size categories (<4 inches, 4-10 inches, and >10 inches) at each location. This resulted in a total of 10 Ailanthus stems (5 at each location) in each treatment x size class category - a total of 120 stems in the study. The diameter breast height of treated trees ranged from 1 to 16 inches.

The pre-harvest herbicide treatments were applied on June 5-6, 2006. These stems were then harvested either one week later (June 12-14, 2006) or four weeks later (July 5-6, 2006). Also on July 5-6, 2006, the stems receiving the cut-stump treatment and those left unsprayed were harvested.

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Tree of Heaven (Ailanthus) Control, continued

The number of stump sprouts arising from all harvested stems in the study was tallied on Sept. 25, 2006. All of the herbicide treatments had worked well to that point; fewer than 10 percent of the original stems receiving the treatments had resprouted, compared to nearly 70 percent of those left unsprayed. Sprouting was evaluated again in July 2007 after allowing time for any living stumps to initiate growth. The earlier results appear to be holding, as only those stumps that did not receive the herbicide treatment have sprouted. Unlike the first assessment, the results here seem to indicate that the largest trees have the most stump sprouts (see Figure 10). These results show that a mixture of Garlon 4 herbicide in an oil-based carrier applied as a basal or cut-stump spray shortly after leaf development in the spring is a good treatment for removing tree of heaven up to 16 inches in diameter.

Figure 10. Typical treated and untreated tree-of-heaven stumps in July of the growing season after treatment.

Stump from stem treated with Garlon 4 basal spray one week prior to cutting.

Prolific stump sprouting one year after cutting without herbicide application.

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