Site Prep vs. Release for Woody Competition Control in Loblolly Pine: 15-Year Results

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The Bottom Line…

To maximize loblolly pine growth, earlier hardwood control is more advantageous than later control. After 15 years, pine productivity increased by 70% with the best site prep treatment and 40% with a second-year release. Ensuring that hardwood foliage is fully-developed improves the efficacy of herbicide treatments.

Abstract

A study of the effects on loblolly pine growth of seven herbicide alternatives for hardwood competition control (all with and without an additional year one herbaceous weed control (HWC) treatment) was installed at the Appomattox-Buckingham State Forest between July 2005 and August 2007. All chemical site preparation or release treatment applications reduced competing hardwood basal area compared to the untreated plots, with the later season (September 3 and October 1) applications averaging less competing vegetation basal area than either the July 23 application or the year-two release. This is generally reflected in individual pine tree volumes, with the September and October applications showing the greatest volumes. Application month was the most influential factor impacting treatment effectiveness. The effects of added first-year HWC were not consistent. Adding sulfometuron to the site prep mixtures resulted in an average decrease in hardwood control, no gains in individual pine volume, and a negative effect on per-acre volume at year 15. Across the study, pine volumes were negatively correlated to competition basal areas. The plots receiving site prep treatments applied in the optimum (September - October) time frame contained an average of 170 $ft.^2$/acre of basal area and 4,249 $ft.^3$/acre of total volume compared to 149 $ft.^2$/acre and 3,495 $ft.^3$/acre on plots released from competition after the second growing season, and 108 $ft.^2$/acre and 2,489 $ft.^3$/acre on untreated plots.

Background

In the summer 2005, VDOF collaborated with BASF Corporation's Market Development Specialist Harold Quicke (now with Bayer CropScience) and Dwight Lauer of Silvics Analytic on the installation of a test to compare the effects of various chemical weed control strategies on loblolly pine growth. In 2019, under the direction of his graduate advisor Dr. David Carter, Virginia Tech student Alexander Byers conducted intensive re-sampling of both loblolly pines and competing vegetation on the study plots. His resulting Master of Science project and thesis were

completed in the spring of 2021[1]. A final measurement of the pines occurred in the winter of 2020-2021, after 15 growing seasons.

Methods

A study of the effects on loblolly pine growth of seven herbicide alternatives for hardwood competition control (all with and without an additional year-1 herbaceous weed control treatment) was installed at the Appomattox-Buckingham State Forest between July 2005 and August 2007.

The study was installed in a complete randomized block, split-plot design with three replications per treatment. The eight whole-plot treatments included six chemical site preparation (SP) applications, a year-2 release, and an untreated check. The split-plot tested the effects of year-1 herbaceous vegetation control treatments. Second-generation orchard-mix loblolly pine seedlings from the VDOF Sussex Nursery were planted at an average density of approximately 476 trees per acre in March 2006.

The eight whole-plot treatments included:

- two herbicide SP tank mixes – one using imazapyr (Chopper at 40 oz./acre) alone and one with sulfometuron methyl (Sulfometuron Max at 3 oz./acre) added to the imazapyr – applied on three different dates (July 23, September 3, and October 1, 2005) – total of six treatments,
- one herbicide release treatment – imazapyr (Arsenal AC at 12 oz./acre) applied September 12, 2007, at the end of the second growing season after planting, and
- an untreated check.

The test site was burned *very* thoroughly on June 15, 2005. There was *very* little re-sprouted hardwood leaf area present at the first (July 23) application date.

In each replication, the eight treatment plots (including the check and release) were each split with one half receiving a year-1 HWC treatment of imazapyr (Arsenal AC at 4 oz./acre) plus sulfometuron methyl (Sulfometuron Max at 2 oz./acre) on April 19, 2006, and the other half receiving no additional treatment.

Pine survival, diameter at breast height (DBH) and height have been measured 3, 4, 5, 7, 10, 12, 13, 14 and 15 years after planting. Individual pine total volume outside bark was calculated using equations developed by Tasissa et al[2]. Competition basal area was measured in year 14.

[1] Byers, Alexander. 2021. Loblolly Pine Growth and Competition Response to Varied Chemical Site Preparation Treatments 14 Years after Establishment in the Piedmont of Virginia. M.S. Thesis. Virginia Tech.

[2] Tassissa, G., H. E. Burkhart & R. L. Amateis. 1997. Volume and Taper Equations for Thinned and Unthinned Loblolly Pine Trees in Cutover, Site-Prepared Plantations. South. J. Appl. For. 21(3):146-152.

Additional details regarding study location and plot configurations are contained in VDOF Occasional Report Number 130 (https://dof.virginia.gov/wp-content/uploads/RR-130.pdf), which summarized the results through age 10. A very detailed summary and analysis is contained in the aforementioned Alexander Byers Master of Science thesis.

Results

The results (Table 1) underscore the importance of hardwood competition as a limiting factor for loblolly pine growth. The effectiveness of chemical SP applications varied depending on when they were applied, but September 3 and October 1 applications were effective at both controlling competition into year 15 and increasing pine volume productivity relative to the check and the year-2 release (Figure 1). The July 23 applications were effective at controlling competition and increasing pine volumes compared to the check but did not show significant differences from the year-2 release. Their effectiveness was likely dampened by the intensity of the site preparation burn and the short time between burn and herbicide application.

The best plots in the test (those with SP using imazapyr alone applied October 1) have trees that average 8.2 inches in DBH and 56 feet in height at age 15 contrasted with trees on the untreated check plots that average 6.8 inches in DBH and 48 feet in height. The plots receiving imazapyr-alone SP applied in the September 3 to October 1 time frame contain an average of 170 $ft.^2$/acre of basal area and 4,249 $ft.^3$/acre of total volume compared to 149 $ft.^2$/acre and 3,495 $ft.^3$/acre on plots released from competition after the second growing season and 108 $ft.^2$/acre and 2,489 $ft.^3$/acre on untreated plots. The herbicide release at age 2 increased volume productivity by 40% compared to no treatment, but the SP occurred 2 years earlier and increased volume growth by 53% (July 23 application) to 75% (October) compared to no treatment. October SP generated 25% more volume growth than the age 2 release.

Adding sulfometuron methyl to the SP mixture did not generate significant increases in individual tree pine volume by year 15 and showed significantly higher average competition basal area than treatments without it. Possibly as a result of the heavier competition, the per-acre pine volumes were consistently lower on plots that received the additional sulfometuron in the imazapyr site prep tank mix (Figure 2).

The effects of added year-1 HWC were not consistent. Adding the treatment to the July 23 site prep application reduced competition in year 14 and increased pine volumes. Conversely, the July 23 application that did not receive HWC consistently showed the lowest individual tree volume across all measurements. The October 1 application that received first-year HWC showed the greatest individual tree volume across all measurements. The October and September applications maintained greater individual tree volumes over both July applications, regardless of the inclusion of HWC.

At age 14, all treatment combinations had significantly reduced competition basal area compared to the untreated plots. All treatment combinations, except for the July 23 applications without HWC, also show significant reductions in competition basal area compared to the year-2 release with HWC. The October 1 and September 3 applications show significant reductions in competition basal area compared to all other treatments. There was an inverse relationship of

competition level and pine volume: the higher the hardwood basal area the lower the pine volume produced.

Table 1. Summary of loblolly pine data 15 years after treatment in the 2005 chemical site preparation vs. release study.

Hardwood Control Treatment	Year One HWC	Height (ft.)	DBH (in.)	Survival (%)	Basal Area ($ft.^2$/acre)	Total Volume ($ft.^3$/tree)	Total Volume ($ft.^3$/acre)
Untreated	No	47.6	6.77	91.5%	121.1	6.5	2,828
	Yes	48.3	6.83	74.5%	94.8	6.1	2,150
	Average	47.9	6.80	82.7%	107.9	6.3	2,489
August 2007 Release	No	50.3	7.65	90.7%	142.9	7.7	3,307
	Yes	52.0	7.78	95.8%	155.7	8.1	3,683
	Average	51.1	7.71	93.1%	149.3	7.9	3,495
July 2005 SP	No	53.9	7.87	90.4%	149.3	8.4	3,627
	Yes	53.9	8.01	94.4%	161.9	8.9	3,995
	Average	53.9	7.94	92.5%	155.6	8.7	3,811
July 2005 SP + sulfometuron	No	51.6	7.33	90.4%	131.4	7.4	3,172
	Yes	54.7	7.95	94.4%	159.6	8.8	3,986
	Average	53.2	7.66	92.5%	145.5	8.1	3,579
September 2005 SP	No	54.8	8.30	96.0%	174.9	9.4	4,316
	Yes	54.0	8.16	92.2%	162.2	9.0	3,966
	Average	54.4	8.23	94.1%	168.5	9.2	4,141
September 2005 SP + sulfometuron	No	54.0	8.09	92.3%	162.6	9.2	4,033
	Yes	55.7	8.21	86.5%	154.9	9.5	3,924
	Average	54.8	8.15	89.4%	158.8	9.4	3,979
October 2005 SP	No	55.7	8.32	90.7%	167.4	9.8	4,246
	Yes	55.6	8.19	100.0%	177.6	9.4	4,469
	Average	55.6	8.25	95.3%	172.5	9.6	4,358
October 2005 SP + sulfometuron	No	53.4	8.01	94.2%	160.5	8.7	3,902
	Yes	54.6	8.40	93.8%	174.7	9.7	4,291
	Average	54.0	8.20	94.0%	167.6	9.2	4,097

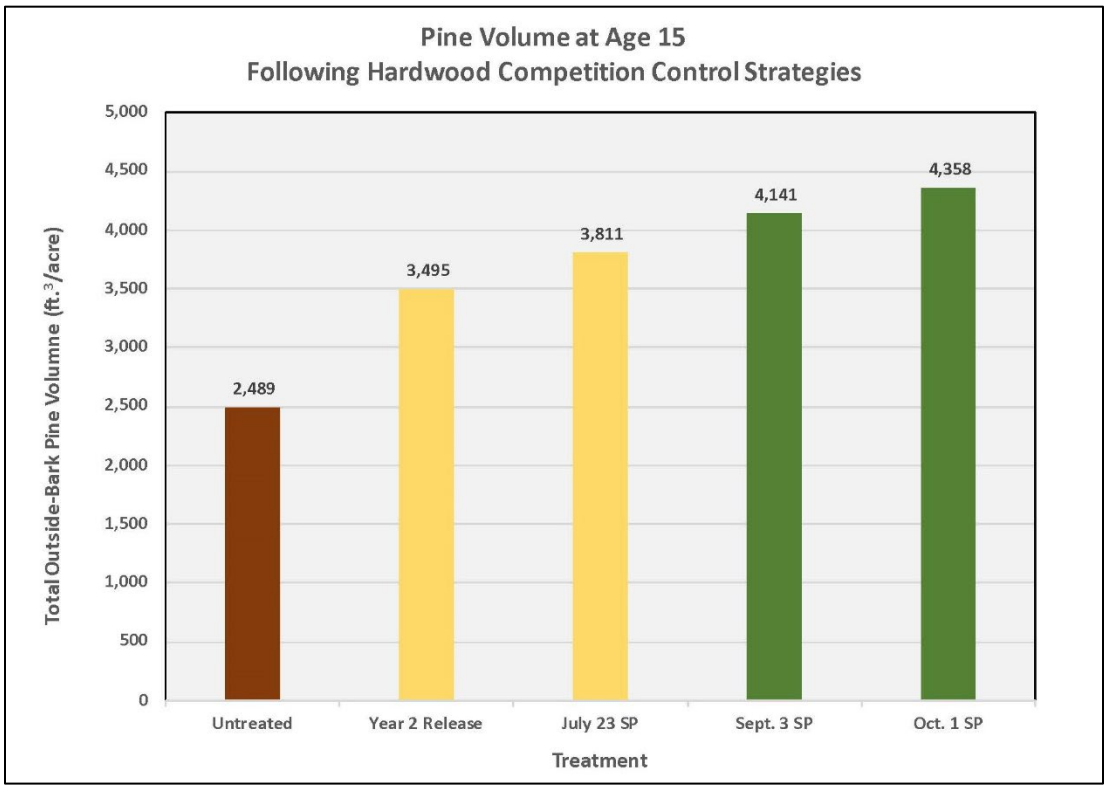

Figure 1. Total pine volume at age 15 following different hardwood completion control strategies in the 2005 chemical site preparation vs. release study.

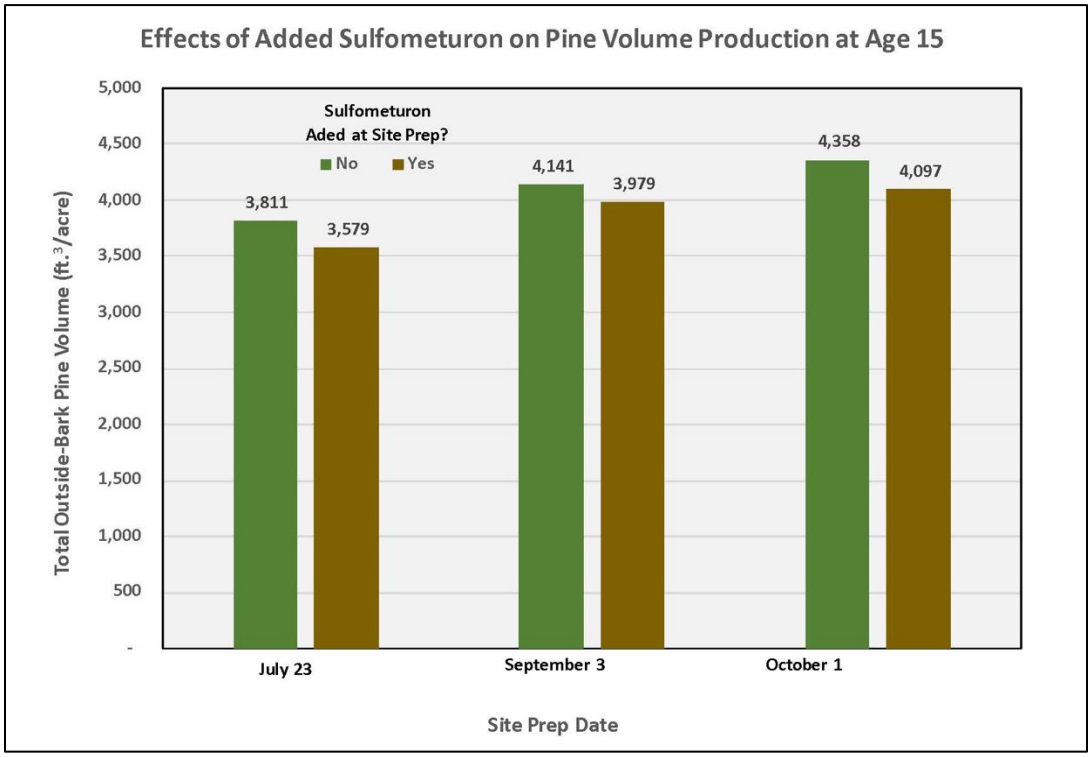

Figure 2. Effects of added sulfometuron on pine volume production at age fifteen in the 2005 chemical site preparation vs release study.

The average volume growth between ages five and 15 is plotted in Figure 3. There are three groups: the untreated trees, the release and early (July 23) site prep plots and the September 3 and October 1 SP plots. The early site prep plots may lag behind the later application dates because of minimal leaf area development at the time of treatment.

Effectively controlling hardwood competition is essential to maximizing pine productivity. Doing so with a pre-plant site preparation treatment increases the hardwood control and resulting pine production compared to waiting until age two to apply a release treatment. Chemical site preparation treatments would likely be effective throughout the application season, but should be given time between any prescribed fire or mechanical control.

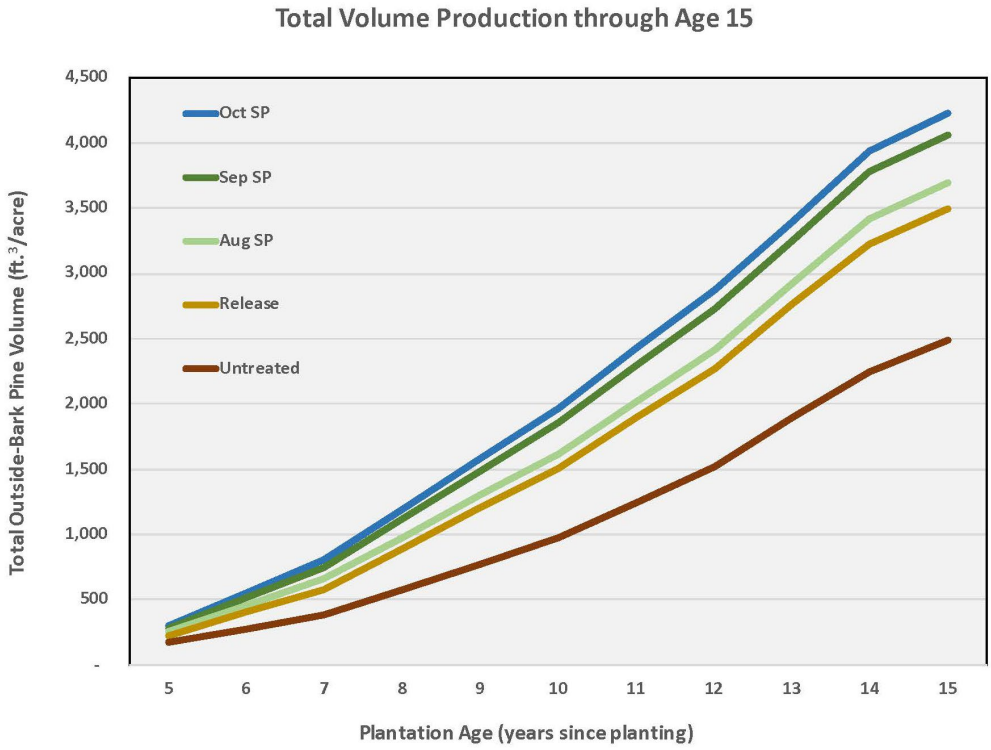

Figure 3. Total volume production through age 15 in the 2005 chemical site preparation vs release study.