



Five-Year Effects of Herbicide Tank Mixes and Surfactants for Loblolly Pine Release

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The Bottom Line...

Damage to the terminal shoot of two-year-old loblolly pines following herbicide release spraying was associated with the Arsenal (imazapyr) x Accord (glyphosate) tank mix – either with or without surfactants – and was temporary. Five-year pine growth was significantly better with release despite the damage and was correlated with hardwood competition control.

Abstract

A study was installed in 2005 at Appomattox-Buckingham State Forest to compare three common herbicide tank mixes [Arsenal (imazapyr) plus Accord (glyphosate), Arsenal plus Escort (metsulfuron), and Arsenal alone] and five surfactants (TimberSurf 90, Red River Forestry Oil, Entry II, Entrée 5735, or Brewer TA 35) for loblolly pine release. Pine damage and growth, and hardwood control were assessed for five years after treatment. Seven months after treatment, most of the plots showed evidence of damage to the terminal shoot of the planted pines. There was no evidence of more widespread effects on branches or lower parts of the crown. Three months later, all the damaged pines had recovered to the point that no damage could be seen, and normal height growth had resumed. The damage was associated with the Arsenal x Accord tank mix – either with or without surfactants. Five years after release, all the treatments had resulted in significantly greater pine height, diameter, and volume growth, and all had a significantly improved free-to-grow (FTG) rating. The treatments produced average gains in height, diameter, and volume of 7%, 18% and 23%, respectively.

Background

Hardwood competition is one of the most limiting factors affecting the long-term productivity of loblolly pine plantations. Herbicides are often applied either before planting (site preparation) or in the first one to two years after planting (release) to control competing hardwoods. Prior to 2005, the most common herbicide tank mix applied for pine release in Virginia had been Arsenal (active ingredient: imazapyr) plus Accord (active ingredient: glyphosate) plus Entry II surfactant (35% ethoxylated tallow amine).

In 2004, the manufacturer of Entry II withdrew it from the market, and in 2005, two alternate formulations of the same tallow-amine chemistry found in Entry II became available – EnTrée

5735 by Aquimix of Roanoke, VA, and TA-35 by Brewer International of Vero Beach, FL. Since the effects of the surfactant chemistry on crop pine tolerance to the Arsenal x Accord tank mix were potentially significant, it was important to test the alternatives to Entry II.

Methods

Test plots were installed on the Glover Tract (Stand AB-0505 of the Talbert Management Unit) at the Appomattox-Buckingham State Forest in September 2005. The site had been harvested in 2003 and planted with second-generation loblolly pine seedlings in March 2004 at a target planting density of 550 trees per acre.

The study compared 13 treatments including common herbicide release tank mixes: Arsenal alone at 12 oz./acre (AR); Arsenal at 12 oz./acre plus Accord at 32 oz./acre (AR/AC); and Arsenal at 12 oz./acre plus Escort XP at 1 oz./acre (AR/ES) with either no surfactant, TimberSurf 90 (TS), Red River Forestry Oil (RR), Entry II (EN), Entrée 5735 (ET), or Brewer TA 35 (TA) at 0.25% by volume. Plots were treated using a CO₂-pressurized backpack research pole sprayer simulating a helicopter application over a 30-foot spray swath along a 100-foot centerline (Figure 1). The treated plot size was 0.07 acre and each treatment was replicated three times in a randomized complete block experimental design to test for treatment effects on early pine damage and growth, and hardwood control.



Figure 1. Pole sprayer application of release treatments – September 2005.

Results

Pine Damage

In March 2006, damage to pine trees on all the plots was assessed. In addition to scattered damage due to tipmoth (*Rhyacionia frustrana*) and fusiform rust (*Cronartium quercuum* f. sp. *fusiforme*), most of the plots showed evidence of herbicide damage to the terminal shoot (3 to 6 inches of dead needles and stem – Figure 2). There was no evidence of more widespread effects on branches or lower parts of the crown. The average pine height was 3.8 ft. at the time of spraying, so this affected – on average – between 6% and 13% of the pine stem involved. By July 2006, all the damaged pines had recovered, no damage was detected, and normal height growth had resumed. A summary of those data indicate that the damage was mainly associated with the Arsenal x Accord tank mix – either with or without surfactants (Figure 3).

Hardwood Control

In July 2006, 10 months after treatment, competing hardwoods on the study plots were tallied and their densities compared to pretreatment levels. All the release treatments had significantly reduced hardwood densities while the untreated plots remained unchanged (Figure 4). Instead of the 2,000-2,500 hardwoods per acre present without treatment, pines on the treated plots had to compete for water, light, and nutrients with only 75-400 hardwoods per acre.

Pine Growth Response

Pine growth attributes and free-to-grow status (0-4 scale with 0 being completely free to grow and 4 being completely suppressed) were assessed at pine age seven, five years after the release treatments were applied. All the release treatments had resulted in significantly greater pine height, diameter, and volume growth, and all had a significantly improved (i.e., lower) FTG rating (Table 1, Figure 5). There was no detectable difference among the three herbicide mixes, although there was a trend indicating that the Arsenal x Escort mixes are giving slightly less hardwood control and, probably as a result, slightly less diameter growth (Figures 6 and 7). Overall, the treatments produced average gains in pine height growth, diameter growth, and individual tree volume of 7%, 18% and 23%, respectively, and reduced FTG rating by 53% compared to the untreated plots.

Perhaps the most important conclusion from these data is illustrated in Figure 8: there is a clear relationship between hardwood competition and pine growth. The gain in diameter growth from the heaviest competition (untreated, FTG=1.56) to the best control treatment (Arsenal x Accord + TimberSurf 90, FTG=0.49) is 30%. Loblolly pine grows much better without hardwood competition.

The original plot size used in this study was not intended to allow long-term growth response data to be collected, so these were the final measurements from this trial.



Figure 2. Example of terminal damage associated with the Arsenal x Accord tank mix.

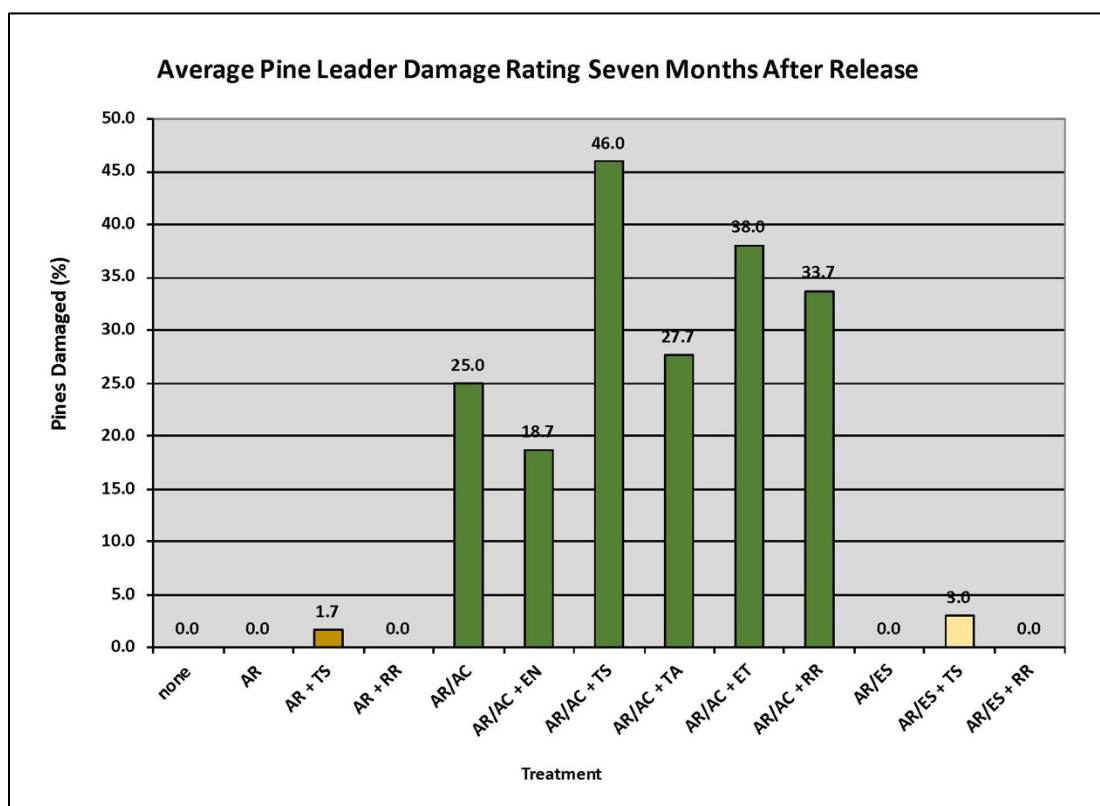


Figure 3. Pine leader damage on the 2005 loblolly pine release plots.

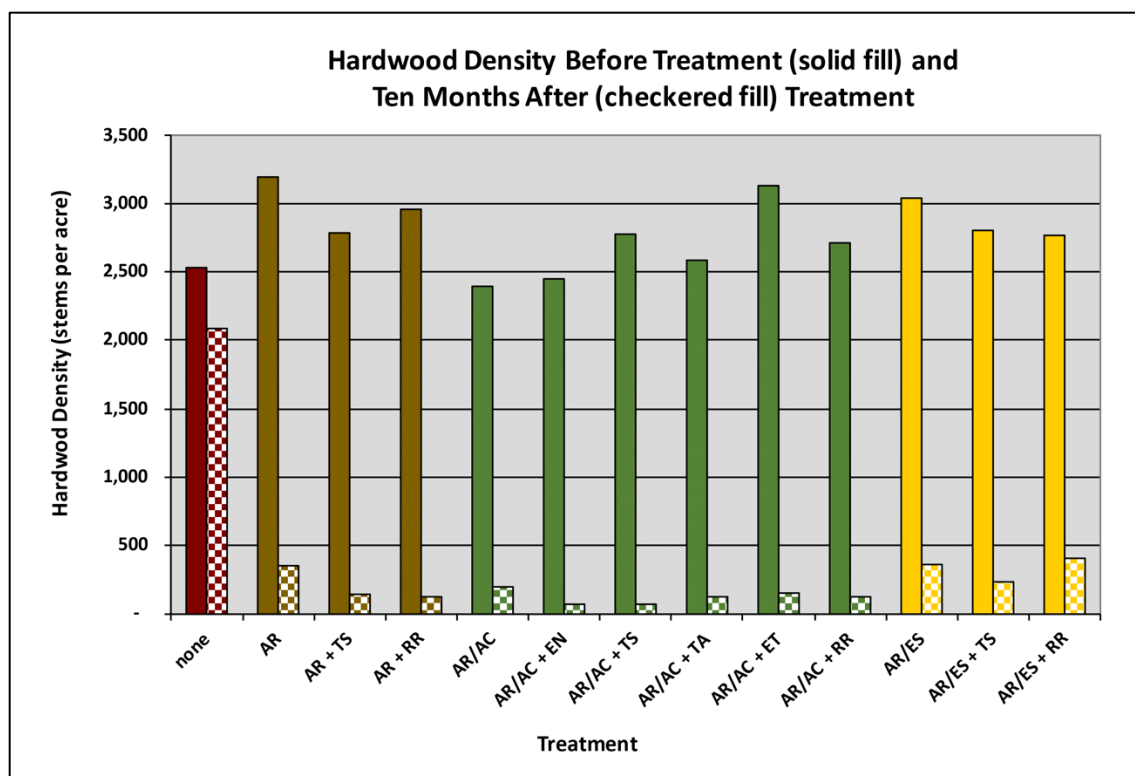


Figure 4. Hardwood density before treatment and 10 months after treatment on the 2005 loblolly pine release plots.

Table 1. Summary of loblolly pine growth five years after treatment in the 2005 release tank mix x surfactant study.

Treatment	Height (ft.)					DBH (in.)			Volume (ft. ³ /tree)	FTG
	Pre-Treat	Year 1	Year 2	Year 5	Growth	Year 2	Year 5	Growth	Year 5	Year 5
AR	3.7	6.6	10.2	17.5	13.7	1.47	3.40	1.93	7.65	0.77
AR + TS	3.7	6.4	10.6	18.6	14.8	1.55	3.50	1.95	8.65	0.67
AR + RR	3.7	6.2	10.0	17.4	13.6	1.45	3.22	1.77	7.17	0.84
AR/AC	3.8	6.4	10.1	17.4	13.5	1.51	3.43	1.93	7.64	0.63
AR/AC + En	3.4	5.4	9.0	16.5	12.9	1.24	2.99	1.75	6.39	0.76
AR/AC + TS	3.4	5.4	9.0	16.7	13.2	1.20	3.22	2.07	6.72	0.49
AR/AC + TA	4.0	6.4	10.2	18.0	13.8	1.46	3.43	1.96	8.05	0.69
AR/AC + ET	3.8	6.3	10.3	17.6	13.7	1.49	3.40	1.90	7.71	0.55
AR/AC + RR	3.6	5.8	9.5	17.4	13.7	1.38	3.36	1.97	7.51	0.54
AR/ES	3.7	6.3	10.0	17.5	13.7	1.48	3.18	1.69	7.16	1.05
AR/ES + TS	3.7	6.3	9.9	16.5	12.6	1.49	3.21	1.81	6.66	0.85
AR/ES + RR	4.2	6.9	10.7	17.9	13.7	1.60	3.38	1.77	7.93	1.00
Untreated	3.9	6.9	10.1	16.7	12.7	1.35	2.92	1.58	6.06	1.56
Treated Plot Average	3.7	6.2	10.0	17.4	13.6	1.44	3.31	1.88	7.44	0.74
Change vs Untreated (%)	-4	-10	-2	4	7	7	13	18	23	-53



Figure 5. Seven-year-old loblolly pines with no competition control treatment (left) compared to hardwood competition control using Aresenal at 12 oz./acre applied as a release treatment at age 2 (right).

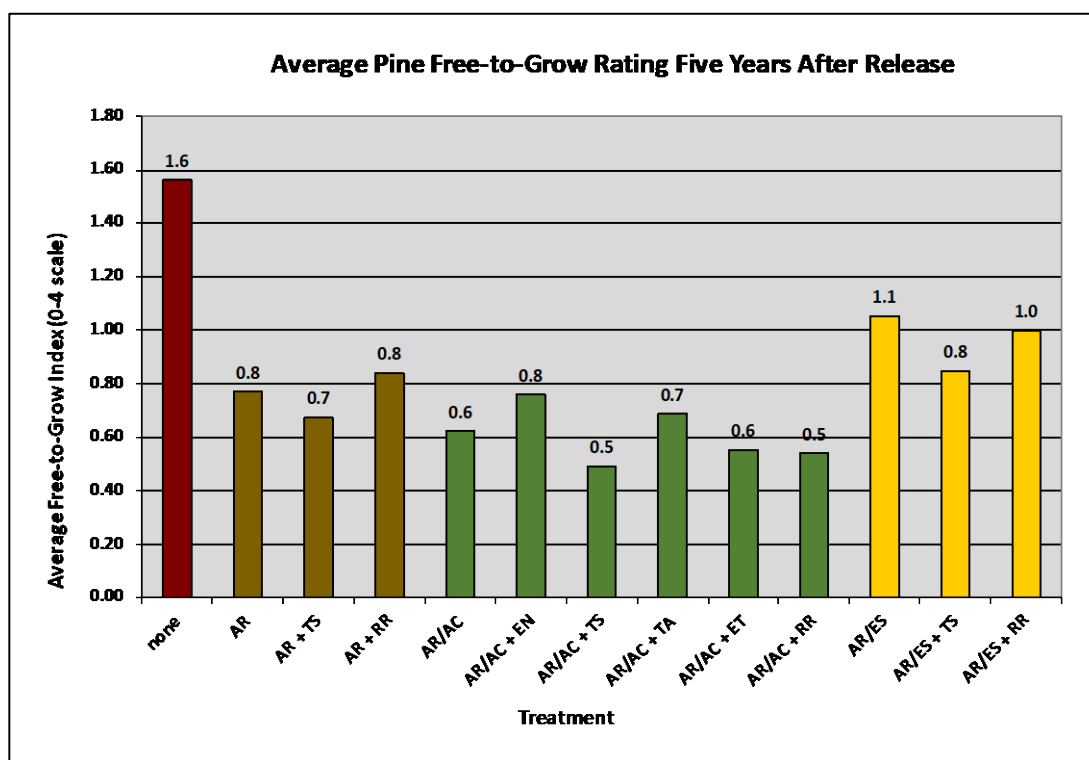


Figure 6. Average free-to-grow rating (using a modified 0-4 scale with 0 being no hardwoods anywhere and 4 being complete suppression) of loblolly pines on the 2005 release study.

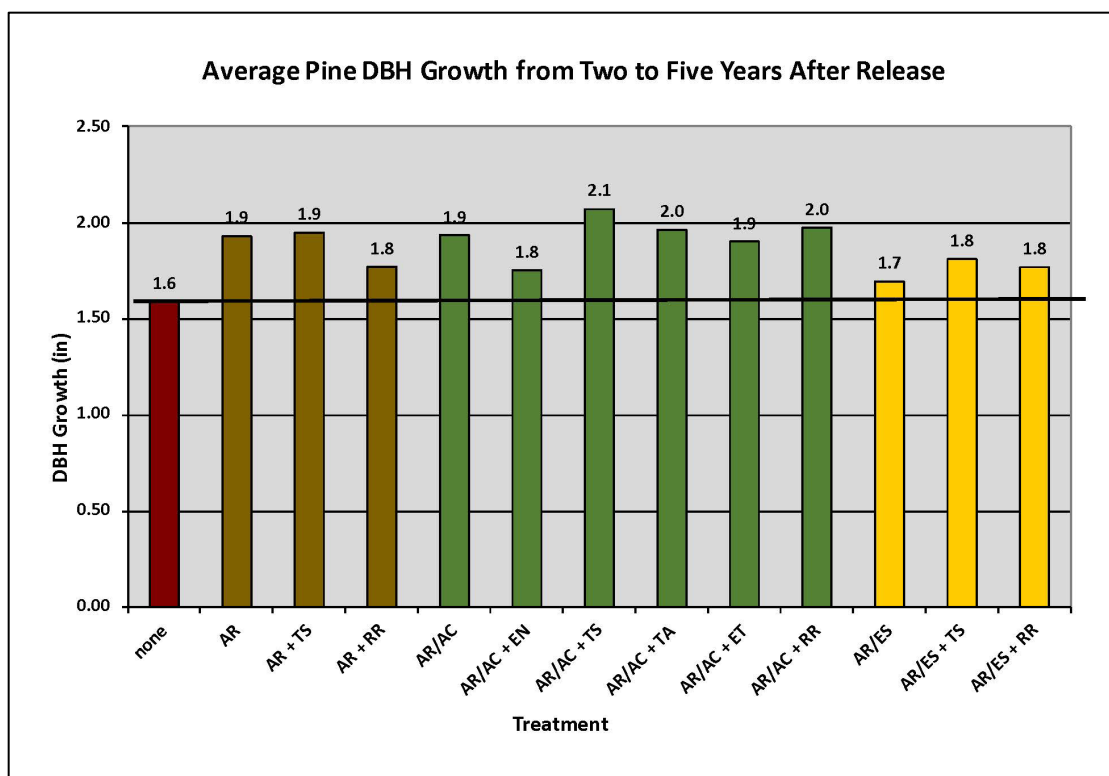


Figure 7. Average diameter (dbh) growth during the first five years after treatment on the 2005 release study.

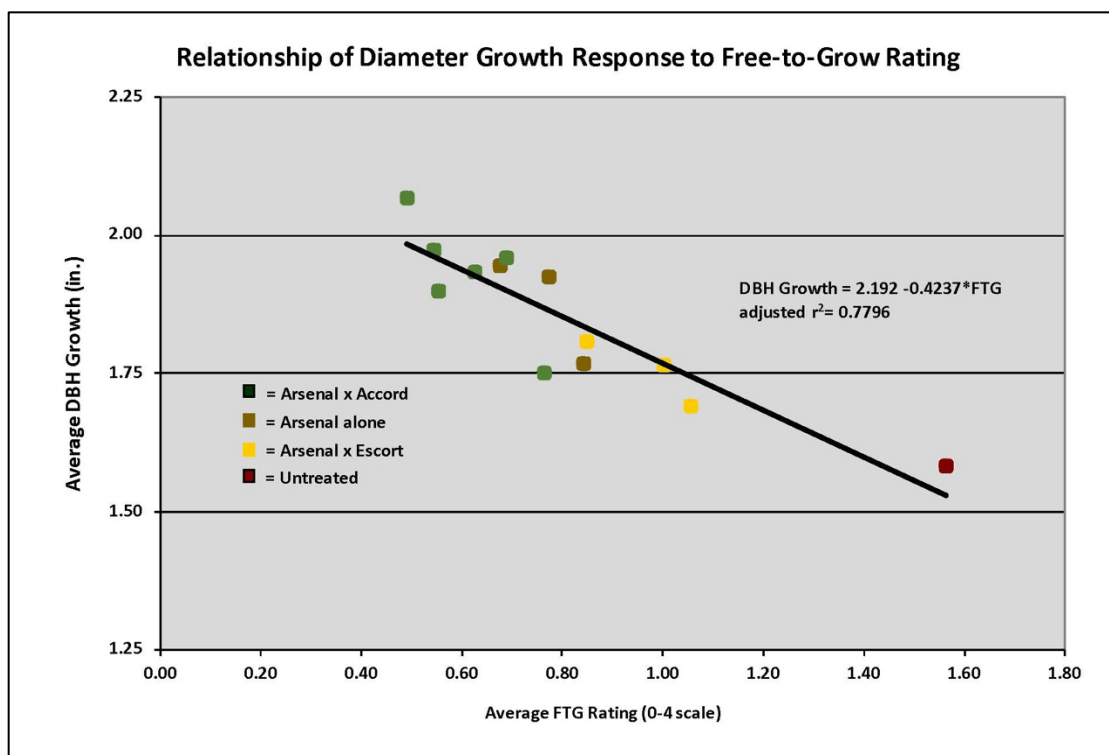


Figure 8. Relationship of diameter growth response to FTG rating (higher FTG rating means heavier hardwood competition).