

First Year Post-plant Banded Over-the-top Herbaceous Weed Control in Old-field Planted Longleaf Stands in Georgia – The Laurens, Jenkins and Treutlen County Study Results and Recommendations – 8 year Results

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Background

There are numerous study results of 1st and 2nd year broadcast and banded herbaceous weed control (HWC) over loblolly pine (*Pinus taeda*) (Lauer and others 1993) and to a lesser degree for slash pine (*Pinus elliottii*). Little work has been reported using labeled herbicides over-the-top of longleaf pine (*Pinus palustris*) to control competing herbaceous vegetation. This paper focuses on banded (5 foot band) first year herbaceous weed control applied over containerized longleaf pine seedlings on old-field sites using various herbicides and two or three application timings in Laurens, Jenkins, and Treutlen Counties Georgia. Figure 1 is a map of Georgia with the longleaf HWC study location.

Lauer and others (1993) found that after 9 years loblolly pine basal area and volume per acre were significantly greater on 7 of 8 study areas with HWC versus no HWC. Volume/acre was an average 25% greater with HWC vs no HWC after 9 years. They also found that 1st + 2nd year HWC BA/ac and volume/acre were significantly greater than the 1st year only HWC on ½ the sites. Additionally, there was no significant difference in BA/ac or volume/acre after 9 years with a banded (5 foot band) versus a broadcast treatment on all the study sites. A 4, 5 or 6 foot band can also save money on herbicides since only 1/3 to ½ of the site is actually sprayed (assuming 10 or 12 foot rows). The first two or three feet either side of the newly planted seedling is the most critical area to keep weed free for as long as possible, especially the first ½ of the first growing season.

Longleaf HWC Studies in Georgia – The Laurens, Jenkins, and Treutlen County Sites

A HWC banded first year post-plant over-the-top application set of studies were installed in Laurens (2 sites), Jenkins and Treutlen County, Georgia in 2008. The study sites was all former old-field sites on well drained soils. All study areas were prepared with a glyphosate (100% foliar active, broad spectrum herbicide with no soil activity) treatment in the late summer or fall prior to planting. A scalp/rip treatment was performed on two of the four sites. Scalp/ripping is a mechanical treatment of displacing the topsoil (2-4 inches) to the sides of the planting row and a shank to subsoil to a depth of 9-16 inches in one pass months prior to planting. Containerized longleaf seedlings were planted in late September 2007 at the Treutlen County site (not scalped/ripped, machine planted), late January 2008 at the Dudley (Laurens County) site (September 2007 scalped/ripped and hand planted 6" offset of the rip), mid-February 2008 at the Lothair (Laurens County) site (not scalped/ripped, machine planted), and late-February 2008 at the Jenkins County site (September 2007 scalped/ripped, machine planted). All sites were planted at 600 tree/acre (TPA) at an approximate 12 x 6 feet spacing. Table 1 describes the treatments and timing at each site. All herbicide treatments were applied with a hand pump four gallon

backpack sprayer in a 5 foot band over the seedlings at the equivalent of 15 gallons/acre (GPA). Four rows of 20 seedlings in each row constituted the gross treated plot with the interior four rows of 13 seedlings/row being the measurement trees. All the seedlings in each plot other than the control had one of the herbicides applied over-the-top of the seedlings. The interior 52 seedlings/plot were followed for survival in year one (1/2 way through the growing season and at the end of the growing season), year 2, 3, and 5. Heights were measured in year 3, 5 and 8. Diameter at 4.5 feet above groundline (dbh = diameter at breast height) was measured at year 8. The interior two rows of 26 trees constituted a plot with the outer two treated rows in each plot serving as buffer between plots starting in year 8. There were three replications of each treatment at each site. The Jenkins County site was not followed after age 3-years due to low longleaf survival across all the treatments.

Study Results

Longleaf survival half way through the first growing season

As of late July 2008, approximately half way through the first growing season, longleaf survival across all treatments at the late September 2007 planted Treutlen County site was 97 percent. The late January 2008 planting averaged 89 percent at the Laurens County Dudley site. The mid-February 2008 planted Laurens County Lothair averaged 87 percent. However, the late February 2008 planting at the Jenkins County site averaged 74 percent (Figure 2).

Table 2 illustrates overall longleaf seedling survival as of late July in the first growing season at the earliest planted site (late September 2007; Treutlen County) and the latest planted site (late February 2008; Jenkins County). The early planted site had survival ranging from 93 to 100 percent while the latest planted site had a survival range of 51 to 85 percent (Table 2). Longleaf survival half way through the first growing season at the mid-February, non-scalped Laurens County site ranged from 70 to 98 percent (Table 3) and the scalped, late January Laurens County site had survival ranges of 65 to 97.5 percent (Table 3).

Note that on average a 25 percentage point lower survival (***bold in italics***) at the Jenkins and two Laurens County sites with the 10 oz/ac Oustar (all three sites) and the 4 oz/ac Arsenal treatments (two of three sites) when applied within two months of planting (Tables 2 and 3) compared to the same treatments applied one month later. Based on these findings at the January – February planted longleaf sites we do NOT recommend applying 10 or more oz/ac of Oustar or 4 oz/ac or more of Arsenal over longleaf until AT LEAST two months after planting. Dig up some seedlings (containerized or bareroot) and fluff off the soil and look for fine feeder roots (gray or white in color and very small diameter). If each of the healthy seedlings that were dug up look healthy and have 4 or more fine feeder roots at least 2-3 inches long then it is fine to apply the Oustar or Arsenal at these lower doses over the seedlings. Rainfall amounts the spring of the first growing season (2008) were close to historic averages for the period (Figure 3). Whereas July and September 2008 were rather dry months and some mortality occurred after the late July 2008 survival counts (Tables 2 and 3). In most years, the majority of mortality occurs by early July of the first growing season. Herbaceous vegetation that occupied the site the end of the first growing season by treatment and timing is presented in Table 4.

Longleaf survival and heights in year 2 and 3 after treatments

Longleaf pine survival, percentage of seedlings out of the grass stage, and second and third year mean heights at the Laurens County Lothair site are presented in Table 5. Percent survival ranged from lows of 67 and 68 percent for the March Oustar and March Arsenal treatments (these two treatments were applied within two months of planting), respectively to highs of 94 and 96 percent for the April and May Oustar treatments (Table 5). The control had 87 percent survival and the early Oust (mid-March) and later (June) Arsenal treatment had 80 percent survival. The April and May Arsenal treatments had 91 and 86 percent survival, respectively. Mean height differences at the end of the second growing season were small, ranging from 0.50 feet for the April Arsenal treatment to 0.85 feet for the March Oust + June Arsenal treatment. Year three height differences started to diverge when comparing treatments. Year three mean heights ranged from 1.5 feet for the April Arsenal and 1.7 feet for the control to 2.7 and 2.9 feet for the April and May Oustar treatments, respectively (Table 5). The mean heights of the April and May Oustar treatments were 70 and 80 percent greater than the April and May Arsenal treatments.

The scalped, late January planted Laurens County Dudley site longleaf survival at the end of the third growing season, percentage of seedlings out of the grass stage, and second and third year mean heights are presented in Table 6. Percent survival ranged from lows of 57 and 73 percent for the March Oustar and March Arsenal treatments (these two treatments were applied within two months of planting), respectively to highs of 90 percent for the April and May Arsenal treatments and 91 percent for the control (Table 6). The March Oust + July Arsenal treatment had 83 percent survival. The April and May Oustar treatments had 84 and 80 percent survival, respectively. Mean height differences at the end of the second growing season ranged from 0.75 feet for the control, April and May Arsenal treatments to 1.4 and 1.5 feet for the May and April Oustar treatments, respectively (Table 6). Year three mean heights ranged from 1.3 feet for the March Arsenal and 1.7 feet for April and May Arsenal treatments (control mean height was 2.0 feet) to 3.0 and 3.8 feet for the May and April Oustar treatments, respectively (Table 5). April and May Oustar treatments mean heights were 87 and 114 percent greater than the April and May Arsenal treatment mean heights. Photos 5 through 8 illustrate the height differences between the treatments after three years.

Year five longleaf survival and height values by treatment, timing and site

Year five mean survival and heights for the two Laurens County and Treutlen County sites are in Tables 7, 8, and 9. The late January Laurens County planted site control plot longleaf trees had 83 percent survival and a mean height of 7.4 feet (Table 7). The March Oust + July Arsenal treatment had 80 percent survival and a mean height of 9.2 feet 24 percent greater than the control. The late March Arsenal and Oustar treatments had lower survival (73 and 58 percent, respectively) than the control (Table 7). The mid-April Arsenal mean height (6.7 feet) was lower than the control. The mid-April Oustar treatment had 83 percent survival and a mean height of 10.7 feet 3.3 feet (45 percent) greater than the control (Table 7). The mid-May Arsenal treatment had a longleaf mean survival of 87 percent and a mean height of 6.8 feet (0.6 feet shorter than the control). The mid-May Oustar treatment had 78 percent survival and a mean height of 10.7 feet (Table 7).

The trees in the mid-February planted Laurens County site control treatment had 81 percent survival and a mean height of 8.8 feet (Table 8). The March Oust + June Arsenal treatment also had 81 percent survival and a mean height of 9.5. The late March Arsenal and Oustar treatments had lower survival (68 and 62 percent, respectively) than the control (Table 8). The mid-April Arsenal mean height (8.8 feet) was the same as the control. The mid-April Oustar treatment had 95 percent survival and a mean height of 10.4 feet 1.6 feet greater than the control (Table 8). The mid-May Arsenal treatment had a longleaf mean survival of 86 percent and a mean height of 9.0 feet, slightly taller than the control. The mid-May Oustar treatment had 93 percent survival and a mean height of 10.4 feet 1.6 feet greater than the control (Table 8).

Tree survival averaged 86 percent in late September 2007 Treutlen County site control treatment and had a mean height of 11.2 feet (Table 9). Survival in the mid-April Oust and June Arsenal treatment averaged 94 percent and 13.1 feet mean height 1.9 feet greater than the control. The mid-April Arsenal treatment had a mean survival of 86 percent and a mean height of 11.0 feet which were slightly lower than the control. The mid-April Oustar treatment had 96 percent survival and a mean height of 13.9 feet 2.7 feet greater than the control (Table 9). The mid-May Arsenal treatment had a mean survival of 93 percent and a mean height of 11.2 feet (same as the control). The mid-May Oustar treatment had 97 percent survival and a mean height of 13.6 feet 2.4 feet greater than the control (Table 9).

Year eight longleaf survival, diameter, height, basal area and tons/acre values by treatment, timing, and site

Starting with the 8 year measurements, 26 trees in the interior two rows were tallied. This method was changed for the four rows totaling 52 trees (13 trees/row) that were tallied from study inception to avoid any root competition differences from adjacent trees. Therefore there may be some survival differences in year 8 compared to years 3 and 5.

The Laurens County Dudley site control means were 82.7 percent survival, 4.5 inch dbh, 22.3 feet height, 54.6 ft² basal area per acre and 22.9 tons per acre of wood+bark (Table 10). The mid-March Oust + July Arsenal treatment means were 80 percent survival, 4.9 inch dbh, 24.1 feet height, 62.3 ft² basal area per acre and 24.6 tons per acre of wood+bark. The mid-March Arsenal treatment means were 70.7 percent survival, 4.4 inch dbh, 20.1 feet height, 45.1 ft² basal area per acre and 16.5 tons per acre of wood+bark. Treatment means for the mid-March Oustar were 60 percent survival, 5.4 inch dbh, 25.3 feet height, 56.6 ft² basal area per acre and 23.7 tons per acre of wood+bark.

The mid-March Arsenal and Oustar treatments, even using the low 4 and 10 oz/ac rates, were applied too soon after the late January longleaf planting, having 12 and 22.7 percentage points lower survival than the control and 23.3 and 28 percentage points lower than the corresponding mid-April Arsenal and Oustar treatments, applied one month later. The mid-March Arsenal treatment basal area and wood yield was 9.5 ft² per acre (17 percent) lower and 6.4 tons/acre (28 percent) lower than the control (Table 10). The early Oustar treatment basal area and wood yield values were similar to the control (54.6 ft² and 22.9 tons per acre for the control and 56.6 ft² per acre and 23.7 tons per acre, Table 10) but survival suffered.

The mid-April Arsenal treatment means were 84 percent survival, 4.5 inch dbh, 20.8 feet height, 55.3 ft² basal area per acre and 21.7 tons per acre of wood+bark. Means for the mid-April Oustar treatment were

88 percent survival, 5.2 inch dbh, 25.0 feet height, 78.1 ft² basal area and 33.4 tons per acre of wood+bark. The mid-April Oustar treatment basal area and wood yield were 23.5 ft² (43 percent) and 10.5 tons (46 percent) per acre, respectively and greater than the control (Table 10). The mid-April Arsenal treatment did not improve dbh, height or tons per acre production when compared to the control.

The means for the mid-May Arsenal treatment were 84 percent survival, 4.6 inch dbh, 21.4 feet height, 57.8 ft² basal area per acre and 24.1 tons per acre of wood+bark. The mid-May Oustar treatment means were as follows: survival was 83 percent, 5.4 inch dbh, 24.2 feet height, 69 ft² basal area and 29.5 tons per acre of wood+bark. There was a spray drift problem from the adjacent agricultural crop field in one of the three mid-May Oustar plots. As a result, survival was less than 50 percent in the first year, which affected overall treatment survival and basal area during later assessments (Table 10). The mid-May Oustar treatment basal area and wood yield were 23.5 ft² (43 percent) and 10.5 tons (46 percent) per acre greater than the control (Table 10) conservatively (included spray drift problem plot). The mid-April Arsenal treatment did not improve dbh, height or tons per acre production when compared to the control.

The Laurens County Lothair site control means were 87.7 percent survival, 4.4 inch dbh, 24.3 feet height, 53.7 ft² basal area and 24.4 tons per acre of wood+bark (Table 11). The mean mid-March Oust + June Arsenal treatment were 85.3 percent survival, 4.5 inch dbh, 24.7 feet height, 56.3 ft² basal area and 25.7 tons per acre of wood+bark. Survival was 68.0 percent, dbh was 4.5 inches, height was 25.2 feet, basal area per acre was 43.0 ft² per acre and wood yield was 18.6 tons per acre in the mid-March Arsenal treatment. The mid-March Oustar treatment means were 65.3 percent survival, 4.4 inch dbh, 24.5 feet height, 47.7 ft² basal area and 21.7 tons per acre of wood+bark.

The mid-March Arsenal and Oustar treatments, even using the low 4 and 10 oz/ac rates, were too soon after the late January longleaf planting, having 19.7 and 22.4 percent lower survival than the control and 22.7 and 25.4 percent lower survival than the corresponding mid-April Arsenal and Oustar treatments, applied one month later. The mid-March Arsenal treatment basal area and tons per acre were 10.7 ft² (20 percent) lower and 5.8 tons (24 percent) lower than the control (Table 11). The early Oustar treatment basal area and tons per acre were 13 and 11 percent lower than the control (53.7 ft² and 24.4 tons per acre for the control and 47.7 ft² and 21.7 tons per acre, Table 11), respectively along with poorer survival.

The mid-April Arsenal treatment means were 90.7 percent survival, 4.5 inch dbh, 25.1 feet height, 59.3 ft² basal area and 28.1 tons per acre of wood+bark. The mid-April Oustar treatment means were 90.7 percent survival, 4.6 inch dbh, 26.1 feet height, 63.3 ft² basal area and 30.0 tons per acre of wood+bark. The mid-April Oustar treatment basal area and wood yield were 9.7 ft² (18 percent) and 5.6 tons (23 percent) per acre, respectively greater than the control (Table 11). The mid-April Arsenal treatment dbh and height increases over the control were small while the basal area and tons per acre production were 5.6 ft² (10 percent) and 3.7 tons per acre (15 percent) greater than the control.

Means for the mid-May Arsenal treatment were 89.3 percent survival, 4.6 inch dbh, 24.4 feet tall, 60.3 ft² basal area and 27.8 tons per acre of wood+bark. The mid-May Oustar treatment means were as follows: survival was 86.7 percent, 4.7 inch dbh, 25.0 feet height, 59 ft² basal area and 28.2 tons per acre of wood+bark (Table 11). Basal area and wood yields were 10 to 12 percent and 14 to 16 percent greater than the control with the mid-May Arsenal and Oustar treatment (Table 11).

The best post-plant herbicide treatment when compared to the control was the mid-April Oustar banded application improving wood+bark yield by 5.3 tons per acre or 23 percent (Table 11).

The Treutlen County control means were 81.3 percent survival, 5.1 inch dbh, 26.2 feet height, 68.0 ft² basal area and 32.8 tons per acre of wood+bark (Table 12). Means for the mid-April Oust + June Arsenal treatment were 90.7 percent survival, 5.3 inch dbh, 27.1 feet height, 84.5 ft² basal area and 42.1 tons per acre of wood+bark.

The mid-April Arsenal treatment means were 78.7 percent survival, 4.9 inch dbh, 25.3 feet height, 62.0 ft² basal area and 27.8 tons per acre of wood+bark. Means for the mid-April Oustar treatment were 85.3 percent survival, 5.3 inch dbh, 28.1 feet height, 79.9 ft² basal area and 39.0 tons per acre of wood+bark. The mid-April Oustar treatment pines' basal area and wood yield values were 11.9 ft² (18 percent) and 6.2 tons (19 percent) per acre greater than the control (Table 12). The mid-April Arsenal treatment dbh and height values were slightly lower than the control while the basal area and tons per acre production were 6.0 ft² (9 percent) and 5.0 tons per acre (15 percent) less than the control. The mid-April Oustar treatment basal area and wood+bark yield were 17.9 ft² (29%) and 11.2 tons per acre (40 percent) greater than the mid-April Arsenal treatment (Table 11).

The mid-May Arsenal treatment means were as follows: survival was 84.0 percent, 5.0 inch dbh, 25.4 feet height, 70.0 ft² basal area and 32.3 tons per acre of wood+bark. Means for the Oustar treatment that occurred in mid-May were 90.7 percent survival, 5.4 inch dbh, 28.3 feet height, 86.2 ft² basal area and 41.2 tons per acre of wood+bark (Table 12). The mid-May Arsenal treatment dbh, height and wood+bark yield values were slightly less than the control; 0.1 inch dbh, 0.8 feet height, 0.5 tons per acre, respectively. The mid-May Oustar treatment longleaf pines' basal area and wood yields were 18.2 ft² (26 percent) and 8.4 tons per acre (26 percent) greater than the control (Table 12). The mid-May Oustar treatment longleaf pines' basal area and wood+bark yields were 16.2 ft² (23 percent) and 8.9 tons per acre (28 percent) greater than the mid-May Arsenal treatment (Table 12).

Summary and Recommendations

We lost the Jenkins County, scalped, late February containerized longleaf old-field planted site to poor survival. In general, on well drained soils, late plantings tend to have poorer survival than early fall to mid-dormant season plantings as illustrated by Figure 1 survival rates half way through the first growing season.

Based on the three remaining sites we were able to measure through age 8 years the following can be surmised:

- (1) On well drained soils, early plantings (with containerized seedlings as early as late September), provided there is good soil moisture at time of planting, can improve survival (Figure 2) and early growth (Tables 7-9 and 10-12). This early planting rule also tends to be true even on soils with poorer drainage.
- (2) Do NOT apply labeled rates of Arsenal or Oustar within 2 months of planting longleaf seedlings. Containerized longleaf survival was reduced by 25 percentage points compared to the control and the one month later same treatments. Also dig up some planted longleaf seedlings and gently fluff off the soil around the roots or plug and look for 4 or more fine feeder roots (white or gray

and very small diameter) that are at least 2-3 inches long. If there are 4 or more visible 2-3 inch fine feeder roots then, generally, it is fine to apply these herbicides over the seedlings (2 months after planting). The early Oust and later Arsenal treatment did not increase or decrease longleaf survival compared to the control.

- (3) Apply the Oustar or Arsenal treatments at or below the labeled rate over longleaf in the Coastal Plain of Georgia by mid-April (assuming at least 2 months after planting) for best results year after year. April and May historically have been the 2 driest months of the year. An early treatment of Oustar or Arsenal can avoid growing season droughts that reduce the herbicide effectiveness.
- (4) The low dose of Oust (2 oz/ac) applied within two months of planting had no adverse effect on longleaf survival.
- (5) Across the three sites, the mid-April or mid-May 4 oz/ac Arsenal treatment did NOT appreciably improve longleaf growth (dbh, height, basal area or tons per acre) compared to the control.
- (6) Across all sites, mid-April 10 oz/ac Oustar treatment improved basal area and wood+bark yields by an average 15 ft² and 7.3 tons per acre (0.9 tons/acre/year) respectively, compared to the control and 13 ft² and 7.1 tons per acre (0.89 tons/acre/year) greater than the mid-April and mid-May averaged Arsenal treatments.
- (7) Do NOT use Oust or Oustar when soil pH is greater than 6.2 (former peanut fields, where poultry litter has been historically applied, or recent sites that had a large dose of lime applied). About all sites that have been in trees going back at least 25 years do not have pHs in the 6's. When in doubt, take several soil samples about every 8-10 acres in the top 6 inches of the soil and have the soil samples analyzed for pH.
- (8) Since Oust is a pre-emergence, soil active only herbicide (best to apply prior to the emergence of herbaceous vegetation for greatest control) and Velpar is an early post-emergence and soil and foliar active herbicide (best to apply soon after weeds emerge for best control), an early application of Oustar or Oust+Velpar works best in controlling most herbaceous vegetation. Once into May, many of the weeds present in old-fields and cut-over sites are well past the best time to apply Oustar or Oust+Velpar for the Coastal Plain of Georgia.

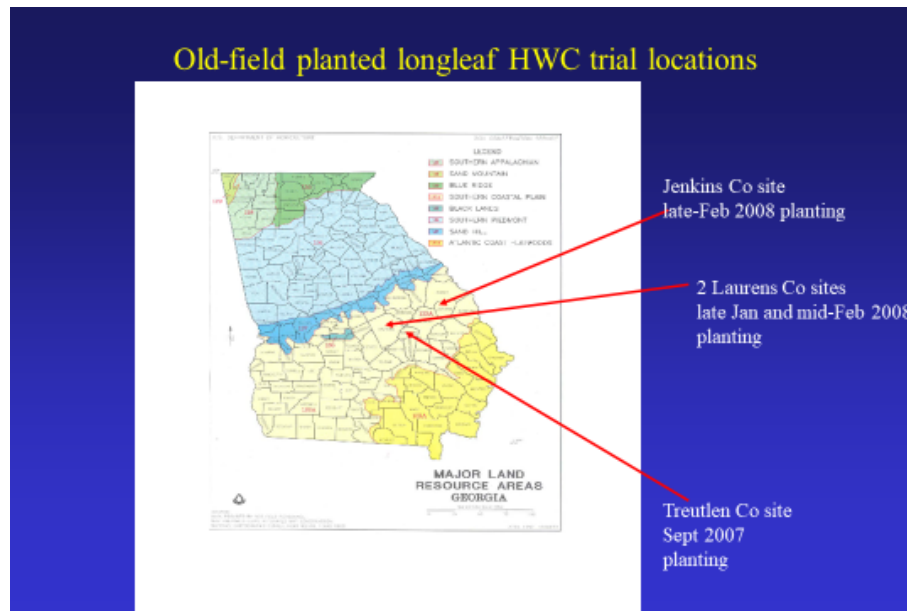


Figure 1. The longleaf 1st year post-plant over-the-top HWC study areas in Laurens (2 sites), Jenkins and Treutlen County, Georgia locations.

Table 1. First growing season (2008) treatments and timing at the old-field planted longleaf study areas on well drained soils in Laurens, Jenkins and Treutlen County, Georgia. All sites were planted with containerized seedlings at 6x12 feet spacing. Three replications of each treatment applied to each site.

Site	Treatment*	Timing
Treutlen Co.	control (no herbicide)	
Jenkins Co.	10 oz/ac Oustar	April 16
		May 13
	4 oz/ac Arsenal	April 16
		May 13
	2 oz/ac Oust +	April 16
	4 oz/ac Arsenal	June 15
Laurens Co. Dudley	control (no herbicide)	
Laurens Co. Lothair	10 oz/ac Oustar	March 21
		April 17
		May 16
	4 oz/ac Arsenal	March 21
		April 17
		May 16
	2 oz/ac Oust +	April 17
	4 oz/ac Arsenal	June 16 or 30 (Dudley)

*All treatments were applied over the top of the seedlings in a five foot band.

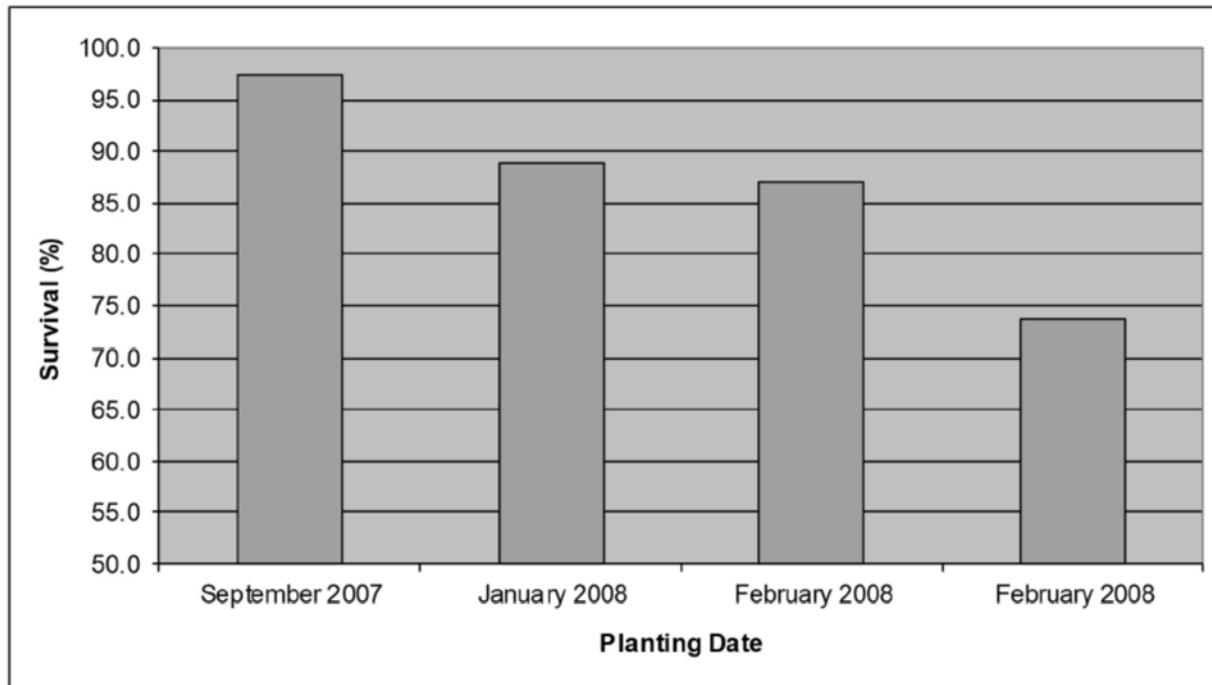


Figure 2. Longleaf seedling survival by study area across all treatments as of late July 2008.

Table 2. The late September 2007 planted Treutlen County site and the late February 2008 Jenkins County site percent survival by treatment as of late July 2008, approximately half way through the first growing season.

Treatment (timing)	-----Site-----	
	Treutlen Co, non-scalped late Sept 2007 planting	Jenkins Co, scalped, late Feb 2008 planting
	----- percent survival -----	
Control (no herbicide)	93	85
Oust + Arsenal (April+June)	100	82
Arsenal (April)	95	57
Oustar (April)	100	51
Arsenal (May)	97	85
Oustar (May)	99	83

Table 3. The mid-February (non-scalped) Lothair and late January (scalped) Laurens County Dudley site percent survival by treatment as of late July 2008, approximately half way through the first growing season.

Treatment (timing)	-----Site-----	
	Laurens Co., non-scalped mid-Feb. 2008 planting	Laurens Co., scalped, late Jan. 2008 planting
	----- percent survival -----	
Control (no herbicide)	86	95
Oust + Arsenal (March+June)	87	91
Arsenal (March)	73	96
Oustar (March)	70	66
Arsenal (April)	94	97
Oustar (April)	98	85
Arsenal (May)	91	98
Oustar (May)	98	84

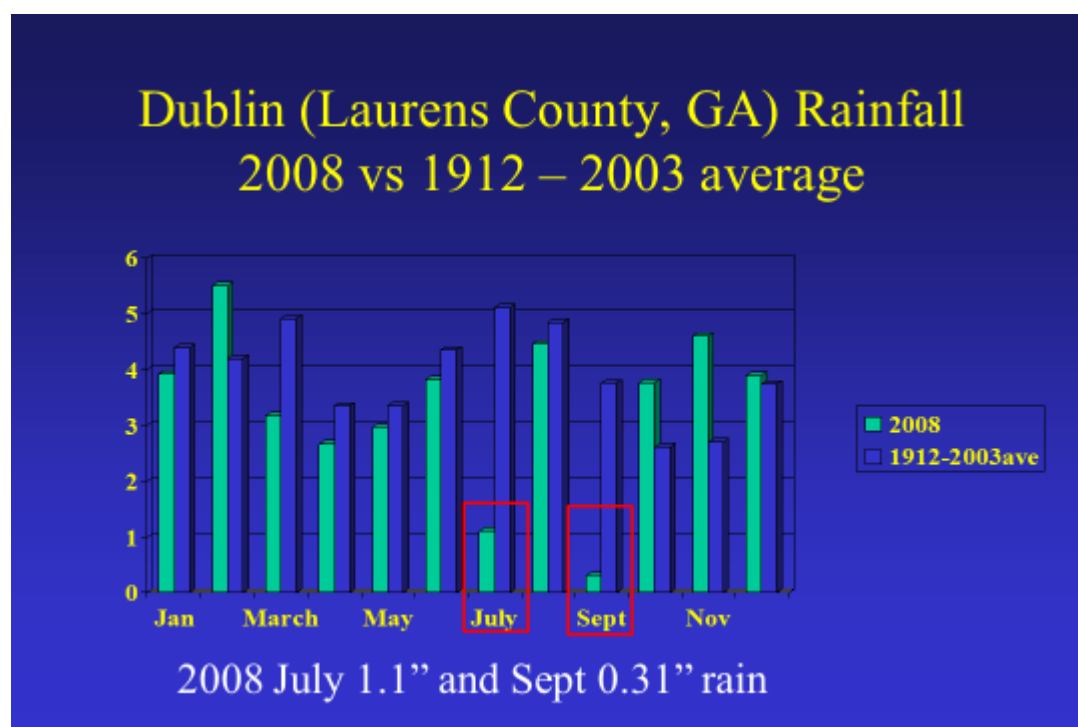
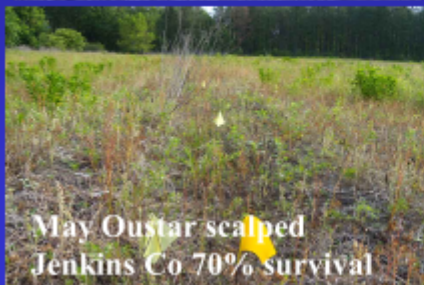


Figure 3. Dublin weather station monthly 2008 and 50 year average rainfall. Note that July and September rainfall totals were well below the historical averages for those two months.

April-May 2009 photos of old-field planted longleaf (Sept 2007 – Feb 2008)



Photos 1-4. Pictures of each of the four study areas in the spring of the second growing season.

Table 4. Herbaceous weeds present in the plots by treatment and timing towards the end of the first growing season (September 2008).

Treatment: / timing	Oust + Arsenal	Oustar	Arsenal
March		croton, minor camphorweed, minor TX panicum	croton, TX panicum, dogfennel, minor camphorweed
April		croton, minor camphorweed, minor TX panicum	croton, TX panicum, dogfennel, minor camphorweed
May		croton, minor FL pursley, coffeeweed	croton, TX panicum, dogfennel
Mar or April & June/July	Bermudagrass, minor TX panicum, coffeeweed		

Table 5. Third year survival, percentage of seedlings out of the grass stage, and second and third year mean heights by treatment and timing at the Laurens County Lothair non-scalped site (planted mid-February 2008).

Timing	Treatment	3 rd yr survival	3 rd yr seedling % out of grass stage	2 nd yr mean ht. (ft.)	3 rd yr mean ht. (ft.)
	Control	87	100	.53	1.7
March+ June	Oust+Arsenal	80	100	.85	2.4
late March	Arsenal	68	100	.56	1.9
late March	Oustar	67	100	.65	1.8
mid-April	Arsenal	91	100	.50	1.5
mid-April	Oustar	94	100	.68	2.7
mid-May	Arsenal	86	100	.62	2.1
mid-May	Oustar	96	100	.74	2.9

Table 6. Third year survival, percentage of seedlings out of the grass stage, and second and third year mean heights and cumulative heights (adding up the heights of each surviving tree) by treatment and timing at the Laurens County Dudley scalped site (planted late January 2008).

	Treatment	3 rd yr survival	3 rd yr seedling % out of grass stage	2 nd yr mean ht. (ft.)	3 rd yr mean ht. (ft.)
	Control	91	80	.75	2.0
March+ June	Oust+Arsenal	83	97	.98	2.6
late March	Arsenal	73	69	.88	1.3
late March	Oustar	57	88	1.2	2.8
mid-April	Arsenal	90	76	.75	1.7
mid-April	Oustar	84	99	1.5	3.8
mid-May	Arsenal	90	89	.75	1.7
mid-May	Oustar	80	99	1.4	3.0

3rd year height differences at the scalped Laurens Co site



Oust+Arsenal (L) vs
April Arsenal (Rt)



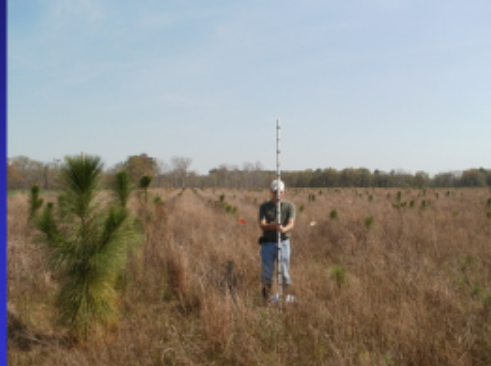
May Oustar (L) vs
April Arsenal (Rt)

Photos 5 and 6. Three year height differences between the March Oust + July Arsenal and the April Arsenal treatments (left photo) and the May Oustar and April Arsenal treatments (right photo) at the scalped, late January planted Laurens County site. Raymond Joyce, Laurens County Agent, is holding the height pole.

3rd year height differences at the scalped Laurens Co site



Scalp only (L) vs May
Oustar (Rt)



April Oustar (L) vs
May Arsenal (Rt)

Photos 7 and 8. Three year height differences between the scalp+rip only and the May Oustar treatments (left photo) and the April Oustar and May Arsenal treatments (right photo) at the scalped, late January planted Laurens County site. Raymond Joyce, Laurens County Agent, is holding the height pole.

Table 7. The old-field scalped, late January 2008 containerized longleaf seedling Laurens County Dudley site five year mean survival and height for the HWC treatments and timing.

Timing	Treatment	% survival	height (ft)
	Control (C)	83	7.4
March + June	Oust + Arsenal	80	9.2
late-March	Arsenal	73	5.6
	Oustar	58	9.2
mid-April	Arsenal	86	6.7
	Oustar	83	10.7
mid-May	Arsenal	87	6.8
	Oustar	78	10.7

Table 8. The old-field non-scalped, mid-February 2008 containerized longleaf seedling Laurens County Lothair site five year mean survival and height for the HWC treatments and timing.

Timing	Treatment	% survival	height (ft)
	Control (C)	81	8.8
March + June	Oust + Arsenal	81	9.5
late-March	Arsenal	68	8.5
	Oustar	62	9.6
mid-April	Arsenal	86	8.8
	Oustar	95	10.4
mid-May	Arsenal	86	9.0
	Oustar	93	10.4

Table 9. The old-field non-scalped, late September 2007 containerized longleaf planted Treutlen County site five year mean survival and height for the April and May Oustar and Arsenal HWC treatments

Timing	Treatment	% survival	height (ft.)
	Control	86	11.2
April - June	Oust + Arsenal	94	13.1
mid-April	Arsenal	86	11.0
	Oustar	96	13.9
mid-May	Arsenal	93	11.2
	Oustar	97	13.6

Table 10. The old-field scalped, late January 2008 containerized longleaf seedling Laurens County Dudley site eight year mean survival, dbh, height, basal area and tons per acre for the HWC treatments and timing.

Laurens Co, old-field, scalped, late January 2008 hand planted containerized longleaf - 8 yr results								
Treatment	color	rep	plot #	% survival	dbh (in)	height (ft)	BA/ac (ft2)	Tons/acre
Control	white	1	1	88	4.52	20.3	58.9	24.5
		2	10	84	4.14	20.55	47	20.6
		3	19	76	4.82	26.1	57.8	23.7
		means		82.7	4.5	22.3	54.6	22.9
Oust+Arsenal	blue	1	2	80	4.8	24.4	60.3	23.1
		2	9	92	4.68	24	66	26.8
		3	17	68	5.21	24	60.5	24
		means		80	4.9	24.1	62.3	24.6
Mar Arsenal	yellow	1	4	76	4.12	20.1	42.2	17.4
		2	14	72	4.68	20.1	51.5	18
		3	20	64	4.45	20	41.5	14
		means		70.7	4.4	20.1	45.1	16.5
Mar Oustar	pink	1	3	60	5.57	24.8	54.4	22.2
		2	15	60	5.26	24.9	52.4	22.8
		3	18	60	5.3	26.1	63.1	26.2
		means		60	5.4	25.3	56.6	23.7
Apr Arsenal	green	1	5	92	4.38	20.1	58	22.6
		2	11	80	4.57	21.1	54.6	21.2
		3	22	80	4.51	21.3	53.3	21.2
		means		84	4.5	20.8	55.3	21.7
Apr Oustar	orange	1	6	84	5.4	24.8	80	31.2
		2	16	96	5.2	26.4	84.8	39.5
		3	24	84	5.03	23.7	69.4	29.5
		means		88	5.2	25	78.1	33.4
May Arsenal	lime	1	7	68	4.37	21.2	42.6	18.3
		2	13	96	4.82	22.3	72.9	30.1
		3	21	88	4.49	20.7	57.9	23.9
		means		84	4.6	21.4	57.8	24.1
May Oustar	red	1	3*	68	5.25	23.4	42.6	27.4
		2	15	96	5.16	24.64	86.9	30.1
		3	18	84	5.67	24.6	77.2	31.1
		means		83 / 90	5.4	24.2	69 / 82	29.5 / 30.6
*Plot #3 had 2 rows by adjacent field with <50% survival in first yr due to spray drift of a defoliant meaning row 1 of the interior measurement rows had low survival. % survival, BA/ac, and tons/ac values are with and without plot #3 means								

Table 11. The old-field non-scalped, mid-February 2008 containerized longleaf Laurens County Lothair site eight year mean survival, dbh, height, basal area and tons per acre for the HWC treatments and timing.

Laurens Co, non-scalped, mid-February old-field planted longleaf stand - 8 yr results							
Trt	plot #	Rep #	% surv	dbh (in)	ht(ft)	BA/ac	tons/ac
Control	1	1	92	4.2	25.6	51	24.3
	13	2	83	4.5	24.1	55	23.7
	22	3	88	4.36	23.3	55	25.2
		means	87.7	4.4	24.3	53.7	24.4
Oust+Arsenal	2	1	80	4.4	24.4	50	23.2
	11	2	88	4.7	26.2	64	30.5
	21	3	88	4.38	23.45	55	23.5
		means	85.3	4.5	24.7	56.3	25.7
Mar Arsenal	6	1	68	4.4	24.9	34	15.1
	16	2	76	4.55	24.3	49	19.9
	23	3	60	4.67	26.5	46	20.9
		means	68	4.5	25.2	43	18.6
Mar Oustar	8	1	76	3.9	22.3	53	24.5
	15	2	64	4.4	24.6	50	22.6
	20	3	56	4.85	26.5	40	18
		means	65.3	4.4	24.5	47.7	21.7
Apr Arsenal	5	1	92	4.6	26.3	64	30.9
	10	2	88	4.7	25	63	29.2
	24	3	92	4.13	24	51	24.1
		means	90.7	4.5	25.1	59.3	28.1
Apr Oustar	6	1	92	4.8	26.8	69	33.1
	16	2	92	4.5	25.2	61	28.1
	18	3	88	4.58	26.2	60	28.8
		means	90.7	4.6	26.1	63.3	30
May Arsenal	7	1	88	4.6	25.5	60	28.8
	12	2	96	4.56	25.6	65	31.1
	19	3	84	4.5	22.1	56	23.4
		means	89.3	4.6	24.4	60.3	27.8
May Oustar	3	1	80	4.6	25.9	51	24.2
	14	2	84	4.9	25.9	57	26.8
	17	3	96	4.7	23.1	69	33.7
		means	86.7	4.7	25	59	28.2

Table 12. The old-field non-scalped, late September 2007 containerized longleaf planted Treutlen County site eight year mean survival, dbh, height, basal area and tons per acre for the HWC treatments and timing.

Treutlen Co 8yr results by treatment in a late Sept 2007 non-scalped old-field planted longleaf pine stand								
Treatment	color	plot #	rep	% surv	dbh (in)	ht (ft)	BA/ac(ft2)	Tons/ac
Control	white	1	1	72	5.14	26	62.4	29
		9	2	80	4.87	25.2	62	29.5
		19	3	92	5.14	27.3	79.5	39.9
				81.3	5.05	26.2	68	32.8
Oust+Arsenal	blue	2	1	88	5.1	26.3	75	35.1
		8	2	92	5.58	28.4	93.7	50.4
		15	3	92	5.31	26.7	84.8	40.8
				90.7	5.3	27.1	84.5	42.1
Apr Arsenal	green	4	1	88	5.03	26.3	72.8	32.5
		11	2	72	4.81	24.8	54.5	24.9
		17	3	76	4.85	24.8	58.8	26.1
				78.7	4.9	25.3	62	27.8
Apr Oustar	orange	3	1	84	5.13	27.7	72.3	33.9
		7	2	88	5.57	29.7	89.3	46.1
		13	3	84	5.33	26.9	78.1	36.9
				85.3	5.3	28.1	79.9	39
May Arsenal	yellow	5	1	92	5.03	26.1	76	34.9
		12	2	80	4.86	24.2	61.7	29
		16	3	80	5.24	25.8	72	32.9
				84	5	25.4	70	32.3
May Oustar	red	6	1	92	5.57	28.8	93.5	45.5
		10	2	92	5.54	29	92.4	44.8
		14	3	88	5.04	26.9	72.6	33.4
				90.7	5.4	28.2	86.2	41.2

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