



OLD-FIELD LONGLEAF PINE HERBICIDES APPLICATION TIMING AND PRODUCTS STUDY - ONE, TWO AND SIX-YEAR RESULTS

David Dickens- Forest Productivity Professor, David Clabo – Extension Silviculture Assistant Professor, Stephen Kinane – Silviculture Assistant Professor, David Moorhead – Emeritus Silviculture Professor, *UGA Warnell School of Forestry and Natural Resources*

STUDY SUMMARY

A first growing season longleaf trial was installed on an upland, well drained old-field site in April-May 2000. April and May of 2000 were very droughty. The early April overtop banded treatment of Oust XP+Velpar L VU greatly improved first year survival and growth over nine individual early May overtop banded herbicide treatments and an untreated control (no herbicide overtop treatment). April and May have historically been the driest two months of the first half of each year in most of Georgia. Applying overtop labeled herbicides prior to the onset of a droughty spring can improve longleaf survival and growth on upland moderately well to excessively drained soils.

RECOMMENDATIONS

1. Overtop longleaf pine herbicide applications should be completed by mid-April in the Georgia Coastal Plain on upland well to excessively drained soils due to the findings of this study and the fact that April and May have been the two driest months of the first half of the year. By early May, herbaceous weeds are well-developed, harder to control and planted rows are harder to find, making overtop herbicide applications more difficult.
2. States north of Georgia in the native range of longleaf may consider getting first year longleaf herbicide applications done when herbaceous weeds are no more than 6 to 12 inches tall and before the onset of their driest spring months period.
3. The most effective herbicides in this and other cases (Clabo and Dickens 2022) to improve longleaf pine survival and growth are the combination of Oust XP (sulfometuron methyl) and Velpar L VU (hexazinone) which are pre- and early post emergence herbicides, respectively, applied by mid-April in the Georgia Coastal Plain on upland well to excessively drained soils. These two tank mixable herbicides control herbaceous weeds exclusively (Oust XP) or primarily (Velpar) through soil activity, making rain and good soil moisture a prerequisite for good to excellent herbaceous weed control.
4. Oust XP should not be used when surface soil pH is greater than 6.0-6.2 and Velpar L VU rates are soil texture dependent, with course textures (loamy sands, sandy loams, sands) soils requiring less while medium (loam, silt loam, clay loam, sandy clay loam) and fine (silty clay loam, clay loam, sandy clay, silty clay, clay) require more.
5. Studies (Lauer and others 1993, Clabo and Dickens 2023) have found that first year HWC with the right herbicides and proper timing at the right dosage can improve survival and growth in droughty springs/summers. With normal to above normal spring into early summer rainfall, HWC will not significantly improve survival but will significantly improve growth.
6. A low dose (4 oz/ac) of Arsenal (Imazapyr 54% a.e.) and a low dose of Oust XP (1.6 oz/ac) + Velpar L VU DF (8.6 oz/ac) should not be applied overtop of longleaf within two months of planting. A 22 to 25 percentage point drop of longleaf survival at the end of the first year occurred when these two treatments were applied within two months of planting compared to the control (no herbicide treatment) or the same treatments overtop 2.5 and 3.5 months after planting (Clabo and Dickens 2022).



ABSTRACT

A study area in Emanuel County, Georgia was installed to discern the effectiveness of various herbicides over newly planted (December 1999) longleaf pine (*Pinus palustris* Mill.) seedlings on an old-field site. Survival and height growth data after herbicide treatments indicate that the early (7 April 2000) Oust XP+Velpar L VU herbicide treatment gave greater initial survival and height growth compared to nine later herbicide treatments (9 May 2000) or an untreated control. First year survival ranged from 90 percent with the April Oust XP + Velpar L VU treatment to 40 to 63 percent with the May herbicide treatments. All dead seedling spots that were flagged and numbered were replanted during December 2000 in the May treatments and control plots. After six growing seasons, mean longleaf survival, d.b.h., height, and green weight per acre were greater with the April application. Sixth year survival ranged from 79 percent in the April application, 53 to 67 percent for the May herbicide treatments, and 41 percent for the control. In the May treatments, originally planted trees had significantly larger heights and diameters than the replanted trees. Original planted trees had an average diameter of 3.4 inches and height of 16 feet. Replanted trees had an average diameter of 1.9 inches and height of 9 feet. During the spring of 2000, rainfall patterns were well below normal. It appears that the early April herbicide treatment allowed for the seedlings to survive this critical dry period. These results indicate that substantial longleaf establishment costs can be saved with an earlier herbicide application under severe spring drought conditions on upland well drained soils.

OBJECTIVES AND METHODS

The BASF Corporation was interested in testing various post-plant herbicides, individually and in combinations, over longleaf pine seedlings planted on an old-field site to determine herbicide effects on early survival and growth. The herbicides used were intended to control grasses and broadleaf weeds that were present on the site or expected to germinate on the site. The study area was a former 15-acre cotton field with the dominant soil being Tifton soil series (fine-loamy, well drained Plinthic Kandiudults) in Emanuel County, Georgia. Surface (0 to 6 inches) soil pH and available phosphorus over the study area ranged from 5.1 to 6.1 (mean of 5.5) and 29 to 83 (mean of 53) pounds per acre, respectively. Containerized longleaf seedlings were machine planted (7.25x12 feet spacing to achieve 500 stems per acre) in December 1999. The BASF study area was flagged (approximately 5 acres) in early May. The operational treatment (2 ounce Oust XP per acre + 24-ounce Velpar L VU per acre) was applied on 7 April 2000 on the balance of the field. Four plots of 40 living seedlings/plot were wire flagged and numbered in the early April Oust XP + Velpar L VU treatment area to compare to the early May herbicide treatments. The BASF herbicide protocol treatments were applied by tractor and CO₂ sprayer at 15 gallons per acre on 9 May 2000 and are listed in Table 1. The April and May herbicide treatments were applied one-time in a five feet wide band overtop of the seedlings. The experimental design was a randomized complete block with four replications per treatment and 40 (4 rows of 10) living seedlings per replication (as of 8 May 2000). All living seedlings were wire flagged, numbered, and followed initially for two years. Initial survival was tallied on 21 June 2000. First growing season survival was tallied on 29 September 2000 (Table 2). Second year survival, number of seedlings out of the grass stage, and total heights were tallied on 19 December 2001. Dead seedlings were replaced in December 2000 on all May 2000 treatment plots. The statistical analysis was performed on the May treatments and the control using ANOVA and least squares means were compared using Duncan's Multiple Range Test at the 5 percent alpha level. The means tested were seedling survival, percent seedlings out of the grass stage, and height of seedlings out of the grass stage during the first two years. The best five May 2000 treatments, the control, and the April 2000 treatment plots in replications 2, 3 and 4 were re-established in March 2006 in the interior two rows. Means tested at the end of the sixth growing season (measured March 2006) were survival, d.b.h., total height, and green weight per acre (estimated from log:log equations for green weight of wood+bark by Baldwin and Saucier 1983 x fraction survival x 500 trees per acre). Rainfall patterns during 2000 from the closest weather station in Vidalia (approximately 30 miles south-southwest of the study area) were compared to the 50-year running average (Figure 1).



RESULTS

Initial longleaf pine seedling survival (21 June 2000) after the banded herbicide applications ranged from 48 percent for Arsenal at 8 ounces per acre to 74 percent for Arsenal at 6 ounces per acre for the May treatments and 91 percent for the April Oust XP+Velpar L VU application and 62 percent for the control (Table 2). There were no significant differences between the May treatments six weeks after treatment. End of the first growing season survival ranged from 40 percent for Arsenal at 8 ounces per acre to 63 percent for Arsenal at 6 ounces per acre for the May treatments and 90 percent for the April Oust XP+Velpar L VU treatment and 51 percent for the control (Table 2). There were no significant differences between the May treatments at the end of the first growing season (Table 2). Survival at the end of the second growing season (all May treated plots and control plots were replanted in December 2000) ranged from 58 percent for the May Arsenal+Pendulum treatment to 91 percent for Arsenal+Oustar for the May treatments and 90 percent for the April Oust XP+Velpar L VU treatment compared to 64 percent for the control. Second year survival for the Arsenal+Oustar treatment was significantly greater than the control, Arsenal at 8 ounces per acre, and the Arsenal+Pendulum treatments (Table 2). Percent trees out of the grass stage at year two ranged from 30 percent for Arsenal at 8 ounces per acre and Arsenal+Pendulum (A6P1.2) treatment to 54 percent for the Arsenal+Oustar May treatments. There were no significant differences in percent seedlings out of the grass stage among the May treatments (Table 2). The April Oust XP+Velpar L VU treatment had 81 percent of seedlings out of the grass stage at the end of the second growing season (Table 2). Mean longleaf seedling height at the end of the second growing season ranged from 0.7 feet for the May treatment plots for the control and Arsenal+Pendulum (A6P1.2) treatment to 1.3 feet for the Arsenal+Velpar L VU treatment. The April Oust XP+Velpar L VU treatment longleaf seedlings were taller (1.6 feet) than all the May treatments by 0.3 to 0.9 feet at the end of the second growing season (Table 2).

There were no significant differences for six-year survival, d.b.h., height, or green weights per acre between the May treatments (Table 3). May treatment six year survival ranged from 41 percent for the control treatment to 67 percent for the Arsenal+Oustar treatment (Table 3). The April Oust XP+Velpar L VU treatment six-year survival was 79 percent (Table 3). Six-year heights ranged from 12.7 feet (Arsenal at 4 ounces per acre) to 13.7 feet (control) for the May treatments and 16.5 feet for the April Oust XP+Velpar L VU treatment (Table 3). Six-year d.b.h ranged from 2.7 inches (Oustar at 13 ounces and Arsenal at 4 ounces per acre treatments) to 3.1 inches (Arsenal at 6 ounces per acre) and 3.5 inches for the April Oust XP+Velpar L VU treatment. Six-year green weight per acre estimates ranged from 3.00 tons (control and Arsenal at 4 ounces per acre) to 4.79 tons (Arsenal at 6 ounces per acre) for the May treatments and 9.04 tons for the April Oust XP+Velpar L VU treatment (Table 3).

SUMMARY AND DISCUSSION

Although the 7 April 2000 Oust XP+Velpar L VU banded herbicide treatment could not be statistically compared to the May treatments, it outperformed all the 9 May 2000 treatments and the control treatment for initial survival, first year survival, second year survival, percentage of trees out of the grass stage and height, and six-year survival, d.b.h., height, and green weight per acre. The April Oust XP+Velpar L VU treatment area did not need a re-plant with 90 percent survival whereas the May treatments and the control plots were re-planted at the landowner's request. Second year planted (December 2000) longleaf pines were compared to first year (December 1999) planted longleaf in the May herbicide treated plots for d.b.h. and total height. The mean d.b.h. (3.4 inches) and total height (16.0 feet) from the first year planted longleaf were significantly greater than the second year planted longleaf (1.9 inches and 9.0 feet, respectively). There was not a second year (spring of 2001) banded herbicide application.

Southern Georgia experienced an excessive drought during 2000. Precipitation at the Vidalia weather station was 11.4 inches below the fifty-year average of 48.2 inches (Figure 1). Historically, April and May have been the two months with the lowest rainfall during the first half of the year for



all interior Georgia Coastal Plain weather stations. April and May rainfall in 2000 totaled 1.8 inches, whereas the historic average is 7.1 inches for the Vidalia weather station. The April and May 2000 rainfall deficit accounted for 46.5 percent of the entire year's rainfall deficit. Note that the majority (81 percent on average) of first year mortality occurred between 8 May and 21 June for all treatments and the control during this very droughty period. For example, as of 21 June 2000 (six weeks after the May treatments and ten weeks after the April treatment) mortality ranged from 26 to 52 percent in the May herbicide treated plots and 9 percent in the April Oust XP+Velpar L VU (O2V24) plots (Table 2). The end of the first growing season mortality ranged from 37 to 60 percent for the May treatments and 10 percent for the April treatment (Table 2). This study illustrates that an early herbicide application on well drained upland soils prior to droughty spring conditions can be crucial for early survival, growth, stand uniformity, and reduce the need for replanting. The photos at the end of this paper illustrate the different early May and the early April 2000 herbicide overtop treatments in March 2006 (the beginning of the 7th growing season for original planted trees and the beginning of the 6th growing season for interplants in early May treatment plots).

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Table 1—Longleaf pine herbaceous weed control trial treatments on a former cotton field in Emanuel County, Georgia (fine-loamy well drained Tifton soil)

Code	Treatment ^a	Application Date
^b C	Control, no treatment	May 9, 2000
^b A4	Arsenal 4 ounces per acre	May 9, 2000
^b A6	Arsenal 6 ounces per acre	May 9, 2000
A8	Arsenal 8 ounces per acre	May 9, 2000
^b A4O2	Arsenal 4 ounces per acre and Oust XP 2 ounces per acre	May 9, 2000
^b A4OS6.5	Arsenal 4 ounces per acre and Oustar 6.5 ounces per acre	May 9, 2000
A4P1.2	Arsenal 4 ounces per acre and Pendulum 1.2 quarts per acre	May 9, 2000
A6P1.2	Arsenal 6 ounces per acre and Pendulum 1.2 quarts per acre	May 9, 2000
A4V24	Arsenal 4 ounces per acre and Velpar L VU L 24 ounces per acre	May 9, 2000
^b OS13	Oustar 13 ounces per acre	May 9, 2000
^b O2V24	Oust XP 2 ounces per acre and Velpar L VU L 24 ounces per acre	April 7, 2000

^a Treatments were applied overtop of the longleaf seedlings in a five feet band with a tractor/sprayer system at 15 gallons per acre

^b treatments that were followed for six growing seasons in replications 2, 3, and 4

Table 2— Longleaf pine herbaceous weed control trial mean initial (June 2000) and year one survival (October 2000), percent trees out of the grass stage, and height by treatment and measurement period on a former cotton field in Emanuel County, Georgia (fine-loamy well drained Tifton soil)

Application date	Treatment code ^a	Initial survival	Year one survival	Year two		
				Survival ^c	Trees out of grass stage	Height
		-----percent-----			feet	
May 2000	^b C	62	51	64cd	32	0.7b
May 2000	^b A4	64	54	76abcd	43	0.8b
May 2000	^b A6	74	63	74abcd	47	0.9b
May 2000	A8	48	40	64cd	30	0.8b
May 2000	^b A4O2	61	56	81abc	52	1.2a
May 2000	^b A4OS6.5	65	58	91a	54	1.2a
May 2000	A4P1.2	49	44	58d	35	0.8b
May 2000	A6P1.2	66	56	69bcd	30	0.7b
May 2000	A4V24	54	48	84ab	41	1.3a
May 2000	^b OS13	52	44	84ab	42	1.2a
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April 2000	^b O2V24	91	90	90	81	1.6

^a Refer to Table 1 for full treatment descriptions

^b Treatments that were followed for six growing seasons

^c Means followed by a different letter within a measurement period are significantly different using Duncan's Multiple Range Test at the 5 percent alpha level for the May treatments – the May treatments survival included the interplanted seedlings

Table 3— Longleaf pine herbaceous weed control trial mean survival, height, d.b.h., and green weight per acre by treatment through March 2006 (age 6-years for Dec 1999 planted seedlings) on a former cotton field in Emanuel County, Georgia (fine-loamy well drained Tifton soil)

Treatment date	Treatment code ^a	Year six			
		Survival <i>Percent</i>	Height <i>feet</i>	D.b.h. <i>inches</i>	Green weight <i>tons per acre</i>
May 2000	C	41	13.7	3.0	3.00
May 2000	A4	53	12.7	2.7	3.00
May 2000	A6	59	14.4	3.1	4.79
May 2000	A4O2	60	13.6	2.9	4.24
May 2000	A4OS6.5	67	13.4	2.9	4.01
May 2000	OS13	66	12.9	2.7	4.64
April 2000	02V24	79	16.5	3.5	9.04

^a Refer to Table 1 for complete treatment description

There were no significant differences between the May treatments six growing seasons after application

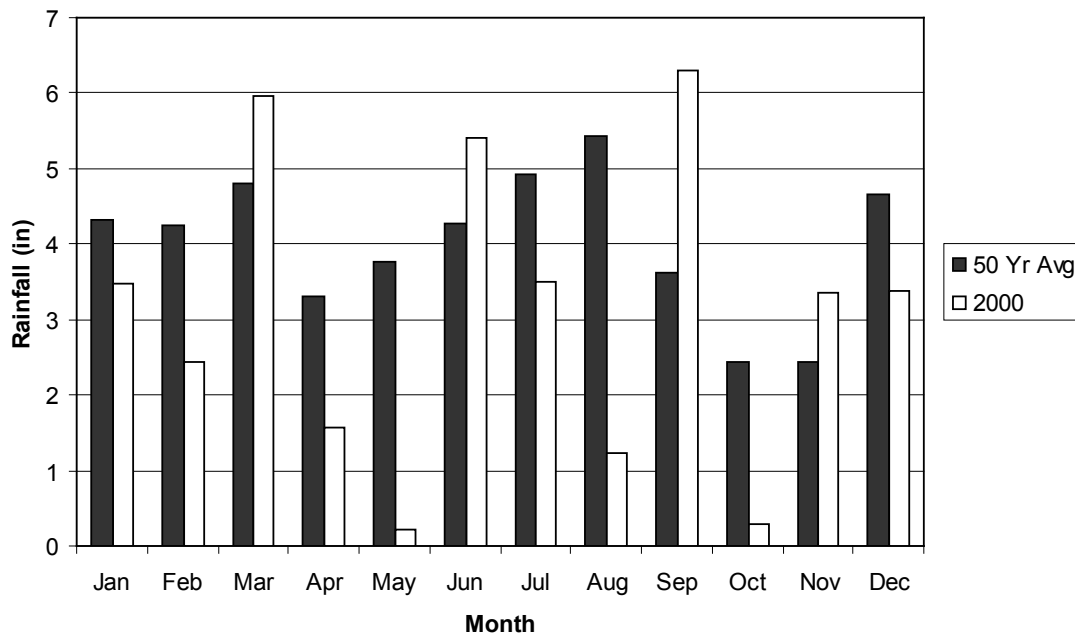


Figure 1: Vidalia, Georgia weather station rainfall patterns for the year 2000 and the 50-year average.



Photos 1 and 2: *A control plot longleaf pine post-plant HWC trial photo (left) and an Arsenal @ 4 oz/ac (applied as a 5 ft band on 8 May 2000) plot photo (right) taken at the start of the seventh growing season, March 2006, on an old-field site (Tifton soil) in Emanuel County, Georgia.*



Photos 3 and 4: *An Arsenal @ 6 oz/ac (applied as a 5 ft band on 8 May 2000) longleaf pine post-plant HWC trial plot photo (left) and an Arsenal @ 4 oz/ac + Oust @ 2 oz/ac (applied as a 5 ft band on 8 May 2000) photo (right) taken at the start of the seventh growing season, March 2006, on an old-field site (Tifton soil) in Emanuel County, Georgia.*



Photos 5 and 6: *An Arsenal @ 4 oz/ac + Oustar @ 6.5 oz/ac (applied as a 5 ft band on 8 May 2000) longleaf pine post-plant HWC trial plot photo (left) and an Oustar @ 13 oz/ac (applied as a 5 ft band on 8 May 2000) photo (right) taken at the start of the seventh growing season, March 2006, on an old-field site (Tifton soil) in Emanuel County, Georgia.*



Photo 7: *An Oust XP @ 2oz/ac + Velpar L VU @ 24 oz/ac (applied as a 5 ft band on 7 April 2000) longleaf pine post-plant HWC trial plot photo taken at the start of the seventh growing season, March 2006, on an old-field site (Tifton soil) in Emanuel County, Georgia.*

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