LESSONS LEARNED IN THE USE OF HERBICIDES TO ESTABLISH PINE PLANTATIONS ON FIELD SITES[1]. T.B. Harrington, School of Forest Resources, University of Georgia, Athens, GA 30602-2152.

ABSTRACT

Seven field sites were established by site preparation with herbicides and planting of loblolly pine (*Pinus taeda*) or slash pine (*Pinus elliottii*) in Georgia and South Carolina during 1997-99. The plantations were associated with ongoing studies regarding effects of taproot deformity on pine development or vegetation dynamics following control of kudzu (*Pueraria lobata*). Five factors associated with site preparation and planting of the fields were identified that limited subsequent survival and growth of the planted pines, and possible remedies were identified for each. First, site preparation during late June 1998 with a tank mixture of Arsenal® AC (24 oz/acre) and Accord® (4 qts./acre) to control field vegetation and volunteer pines stimulated the development in summer 1999 of a tall and dense herbaceous community dominated by dogfennel (*Eupatorium capillifolium*), camphorplant (*Heterotheca subaxillaris*), and common ragweed (*Ambrosia artemisiifolia*). The new community likely was far more competitive with pine seedlings than the original old-field community, so little was gained by the intensive site-preparation treatment. Second, broadcast burning of herbicide-deadened kudzu in December also stimulated the development of a tall and dense herbaceous community, apparently because the seed bank contained an abundance of agricultural weed species. Third, application of Arsenal® AC at a rate labeled for herbaceous weed control in newly planted slash pine (6 oz/acre) caused severe stunting of the terminal shoot and branches. In addition, this treatment had no detectable effect on soil water content at 0-18" depth during the 1999 growing season. Fourth, nutsedge (*Cyperus* spp.), a common monocot species on field sites, was found to tolerate high rates of Arsenal® AC (24 oz/acre) when applied as a site preparation treatment in the summer. As a result, a monospecific stand of nutsedge became the dominant competitor with planted pines. The final factor that limited survival and growth of planted pines was depth of planting. Roots of pine seedlings were placed at a depth of 4-6" by the planting contractor to expedite the operation and to avoid having to break through a hardpan layer in the soil horizon. Poor survival was attributed to the combined effects of shallow planting and the summer drought of 1999.

Possible remedies to the factors described above include the following. Instead of conducting site preparation with herbicides in the summer before planting it is suggested that herbicides be applied in the fall before planting or soon after planting, and that broadcast burning be avoided. This latter approach ensures the presence of a dead mulch at the beginning of the growing season, thereby providing conditions less likely to facilitate germination of seed stored in the soil or dispersed by wind than would result from an exposed mineral seed bed. For herbaceous weed control in newly planted slash pine, an alternative herbicide or Arsenal® AC at a lower rate (4 oz/acre) should be used to avoid stunting of shoot growth. If nutsedge is present, Arsenal® AC should be avoided for site preparation or herbaceous weed control since it will stimulate the plant's development by releasing it from interspecific competition. In subsequent replanting of several field sites, placement of the roots of pine seedlings at a depth of 8-10" was used to promote survival, particularly given the likelihood of another growing-season drought. Although planting seedlings at this depth required considerably more effort than shallow planting, seedling access to soil water deeper in the soil profile has been increased substantially.

In summary, several factors associated with site preparation and planting of fields were identified that limited survival and growth of planted pines. Treatments that exposed mineral soil prior to the beginning of the growing season were found to greatly stimulate development of agricultural weeds. Procedures should be used that simulate "no-till" agricultural systems, and efforts must be made to ensure that planting and herbaceous weed control practices do not interfere with subsequent development of pine seedlings.

COMPETITION CONTROL FOR SWEETGUM PLANTATIONS USING IMIDAZOLINE PRODUCTS IN PRE-AND POST-EMERGENT APPLICATIONS. A.W. Ezell and H.F. Quicke, Mississippi State University, Starkville, and American Cyanamid Co., Auburn, AL.

ABSTRACT

The objective was to evaluate prebudbreak and postbudbreak treatments of imidazolinone herbicides and pendimethalin. Treatments included 1) prebudbreak applications of sulfometuron in combination with imazethapyr, imazapic or pendimethalin, 2) prebudbreak applications of imazapic alone and 3) sequential applications of imazethapyr, imazaquin, imazapic or imazamox following a prebudbreak sulfometuron treatment. Sweetgum seedlings were planted on February 3, prebudbreak treatments applied February 23 and postbudbreak sequential treatments applied April 26.

Imazapic applied prebudbreak in a tank mix with sulfometuron or as a sequential directed treatment following prebudbreak sulfometuron, improved weed control and sweetgum growth over sulfometuron alone. For the prebudbreak tank mix treatments, there was little difference in sweetgum growth between 0.2 and 0.4 lb ae/A imazapic. For the sequential treatments, 0.4 lb imazapic resulted in better weed control but less growth response than 0.2 lb imazapic.

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The best treatment in the cultivated area was 0.2 lb imazapic applied as a sequential treatment following a prebudbreak treatment of 1.5 ai/A sulfometuron (2 oz Oust®). Height growth was 24.2 cm compared to 15.9 cm for 1.5 sulfometuron alone (52% increase) and diameter growth was 5.5 mm compared to 3.3 mm for 1.5 lb sulfometuron alone (67% increase).

Imazethapyr applied as a prebudbreak tank mix with sulfometuron oras a sequential treatment following sulfometuron, also improved growth over sulfometuron alone. The best sweetgum growth was achieved with the lower rate of 0.125 lb imazethapyr.

METHODS

The study was located in Winston, Co., MS approximately 14 miles south of Starkville, MS. The site was abandoned agriculture land that had received annual mowing for 10-15 years prior to study installation. Soils were of clay loam textures with a pH of 5.5. Prior to study installation, half of the site was cultivated (double disced) to allow a comparison of treatment response in cultivated vs. uncultivated areas.

Objectives were to evaluate 1) different rates of imidazolinones and pendimethalin applied in prebudbreak tank mixtures with sulfometuron and 2) imidazolinones as sequential directed sprays following prebudbreak application of sulfometuron. Response variables included competition control, crop tree tolerance and crop tree growth.

Sweetgum seedlings (1-0, bareroot) were planted February 3, 1999, prebudbreak treatments applied February 23 and sequential directed spray treatments applied April 26 (62 days after prebudbreak treatments). All treatments were applied with a CO2-pressurized backpack sprayer using a 4-nozzle boom (8002 tips). A 6-foot wide swath was applied with the planting row as the center of the swath.

Separate studies were installed in the cultivated and uncultivated areas. The experimental design for each area was a randomized complete block with three replications. Each treatment plot was a row of ten measurement trees planted on 2-ft. spacings. A 10-ft. buffer space was established between treatment plots. Weed control and herbicide symptoms were assessed at 60, 90, 120, and 150 days after prebudbreak treatments. Weed free area and percent cover for grasses, broadleaf weeds, vines, and shrubs was ocularly estimated. Total tree height and groundline diameter were recorded prior to budbreak and at the end of the first growing season.

RESULTS

At the 60 day assessment weed free area was > 88% for all treatments compared to untreated weed free areas of 44% on cultivated plots and 13% on uncultivated plots (Table 1). At the 150 day assessment, weed free areas ranged from 30-63% for prebudbreak imazapic tank mixes and 53-85% for sequential imazapic treatments compared to 13-15% for 1.5 lb sulfometuron alone.

There was no visible herbicide damage from any treatment at any assessment and no clear survival rate trends (Table 2). The study site was subjected to a prolonged and extreme drought from May until December, and mortality is attributed to drought stress differentials on individual seedlings. With few exceptions, imidazolinones applied in tank mixes or as sequential sprays improved survival over 1.5 lb sulfometuron alone.

All average increases in groundline diameter in the cultivated area exceeded the average in the uncultivated area (Table 2). The impact of cultivation on competition control was not consistent. Cultivation may have increased rooting volume and allowed better infiltration of the poor supply of precipitation during the growing season.

Imazapic applied prebudbreak in a tank mix with sulfometuron or as a sequential treatment following sulfometuron, improved growth over sulfometuron alone. For the prebudbreak tank mix treatments, there was little difference in growth between 0.2 and 0.4 lb imazapic. For the sequential directed treatments, 0.4 lb imazapic resulted in better weed control but less growth response than 0.2 lb imazapic. The best treatment in the cultivated area was 0.2 lb imazapic applied as a sequential treatment. Height growth was 24.2 cm compared to 15.9 cm for 1.5 lb sulfometuron alone (52% increase) and diameter growth was 5.5 mm compared to 3.3 mm for 1.5 lb sulfometuron alone (67% increase).

Imazethapyr applied as a prebudbreak tank mix with sulfometuron or as a sequential treatment following sulfometuron, also improved growth over sulfometuron alone. The best growth was achieved with the lower rate of 0.125 lb imazethapyr.

SUMMARY

Imazapic and imazethapyr provided good weed control, crop tolerance and sweetgum growth response when applied in a tank mix with sulfometuron overtop dormant sweetgum or as directed sequential treatments after a prebudbreak sulfometuron treatment. The best treatment overall on the cultivated area was a directed sequential treatment of 0.2 lb imazapic following a prebudbreak sulfometuron treatment. In addition to broad spectrum broadleaf weed and grass control, a major benefit of imazapic treatment during the growing season is the ability to control morning-glory species.

These vines are often not controlled by early season treatments and cause serious problems in sweetgum plantations when they grow over the trees.

Table 1. Weedfree area at 60, 90, 120, and 150 days after prebudbreak treatments.

	Cultivated				Uncultivated			
	Days after treatment				Days after treatment			
Treatment * (application date)	60	90	120	150	60	90	120	150
	percent							
	96	59	45	13	93	33	28	10
0.4 lb imazapic (2/23)	98	83	62	20	96	68	37	17
1.5 oz sulfometuron (2/23)	94	55	35	13	94	73	63	15
+ 0.2 lb imazapic (2/23)	98	85	63	47	95	78	78	63
+ 0.4 lb imazapic (2/23)	98	89	77	30	96	60	52	37
+ 0.2 lb imazapic (4/26)	97	90	79	67	92	72	65	53
+ 0.4 lb imazapic (4/26)	97	90	90	83	93	82	86	85
+ 0.125 imazethapyr (2/23)	98	70	55	20	98	55	32	13
+ 0.250 lb imazethapyr (2/23)	97	77	60	10	91	67	47	10
+ 0.125 lb imazethapyr (4/26)	98	90	77	30	95	75	55	27
+ 0.250 lb imazethapyr (4/26)	96	87	75	33	92	73	63	33
+ 2 lb pendimethalin (2/23)	96	85	60	10	94	63	63	20
+ 4 lb pendimethalin (2/23)	97	73	35	15	88	63	60	5
+ 0.25 lb imazaquin (4/26)	96	67	55	13	91	67	50	10
+ 0.50 lb imazaquin (4/26)	98	80	67	23	92	63	63	27
+ 0.125 lb imazamox (4/26)	97	75	62	33	93	70	53	37
+ 0.250 lb imazamox (4/26)	98	88	78	37	93	78	57	23
2.25 oz sulfometuron (2/23)	96	87	60	10	94	57	60	12
Untreated	44	3	0	3	13	3	0	0

* Rates are acid equivalent per acre for imidazolinones, active ingredient for pendimethalin and sulfometuron
1.5 oz sulfometuron = 2 oz Oust ®
2.25 oz sulfometuron = 3 oz Oust ®

Table 2. Average sweetgum height growth, groundline diameter growth (GLD) and survival at the end of the first growing season after planting

Treatment * (application date)	Cultivated Height growth	Cultivated GLD growth	Cultivated Surv.	Uncultivated Height growth	Uncultivated GLD growth	Uncultivated Surv.
	…cm….	…mm…	…%…	…cm…	…mm…	…%…
0.2 lb imazapic (2/23)	21.3	3.1	90	15.6	2.2	93
0.4 lb imazapic (2/23)	22.9	3.9	90	11.5	2.6	57
1.5 oz sulfometuron (2/23)	15.9	3.3	73	11.0	2.3	73
+ 0.2 lb imazapic (2/23)	24.7	4.0	93	20.8	3.1	63
+ 0.4 lb imazapic (2/23)	23.0	4.1	77	16.7	3.0	83
+ 0.2 lb imazapic (4/26)	24.2	5.5	90	14.6	3.1	73
+ 0.4 lb imazapic (4/26)	17.8	4.2	93	13.0	2.7	93
+ 0.125 imazethapyr (2/23)	21.9	4.7	80	20.8	4.0	73
+ 0.250 lb imazethapyr (2/23)	21.4	3.5	93	13.6	2.4	77
+ 0.125 lb imazethapyr (4/26)	28.0	4.5	83	13.0	3.6	87
+ 0.250 lb imazethapyr (4/26)	17.3	3.9	87	11.1	2.4	87
+ 2 lb pendimethalin (2/23)	27.4	4.2	73	17.0	3.2	73
+ 4 lb pendimethalin (2/23)	17.1	3.9	67	7.5	2.0	80
+ 0.25 lb imazaquin (4/26)	15.9	4.2	73	17.0	3.2	73
+ 0.50 lb imazaquin (4/26)	22.8	3.5	87	9.8	1.8	73
+ 0.125 lb imazamox (4/26)	20.4	3.5	90	13.5	2.6	53
+ 0.250 lb imazamox (4/26)	18.2	3.7	93	15.5	2.9	93
2.25 oz sulfometuron (2/23)	16.7	3.2	90	11.4	2.7	80
Untreated	16.4	2.7	82	16.0	1.7	75

* Rates are acid equivalent per acre for imidazolinones, active ingredient for pendimethalin and sulfometuron
1.5 oz sulfometuron = 2 oz Oust ®
2.25 oz sulfometuron = 3 oz Oust ®

MID-SEASON HERBACEOUS WEED CONTROL SCREENINGS IN HARDWOOD PLANTATIONS ON AGRICULTURAL SITES IN THE COASTAL PLAIN AND PIEDMONT: FIRST-YEAR RESULTS. D.K. Lauer, R.L Muir Jr., and B.R. Zutter. School of Forestry and Wildlife Sciences, Auburn University, AL.

ABSTRACT

Operational herbaceous weed control in hardwood plantations relies on pre-emergent, early post-emergent chemistry applied before leaf-out to achieve control with minimal crop damage. Generally, these herbicides provide control for a maximum of 12 weeks. The objective of this study was to determine if duration of control could be improved without substantial crop damage on sites previously in agriculture by a second (mid-season) herbicide application.

Six mid-season herbicide treatments were compared following three initial pre-emergent herbicide treatments in a factorial arrangement. Initial treatments were oxyfluorfen at 1.0 lb ai/ac, sulfometuron at 1.125 oz ai/ac, and azafenidin at 16 oz ai/ac. The six mid-season herbicide treatments included imazaquin at 0.24 lb ai/ac, imazapic at 0.18 lb ai/ac, oxyfluorfen at 1.0 lb ai/ac, oxyfluorfen at 1.0 lb ai/ac in combination with pendimethalin at 3.3 lb ai/ac or in combination with a low and high rate of sulfometuron at 0.4 and 0.8 oz ai/ac, respectively. Initial herbicide treatments were applied in March over the top of hardwood seedlings prior to bud break. Mid-season herbicide treatments were applied as directed sprays away from crop tree foliage 11 weeks after initial treatments.

Herbaceous cover was compared among initial herbicide treatments 12 weeks after initial application (1 week after mid-season applications) and compared among mid-season treatments 24 weeks after application (12 weeks after mid-season application). Major weed species were pigweed, coffeeweed, crabgrass, horseweed, and dog-fennel. Initial treatments varied in their control. Oxyfluorfen provided poor control and averaged 83% cover. Sulfometuron averaged 27% cover due to suppression of crabgrass and control of horseweed and dog-fennel. Azafenidin averaged 41% cover with suppression of crabgrass, pigweed, and coffeeweed. After 24 weeks (12 weeks after mid-season) mid-season treatments differed in terms of control. Performance of mid-season treatments depended on the initial treatment with average cover following oxyfluorfen, sulfometuron, and azafenidin of 94%, 69%, and 63%, respectively. Imazapic was the only mid-season treatment to substantially improve control through control of coffeeweed. The imazapic mid-season treatment