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BASAL STREAMLINE SPRAYS FOR HARDWOOD RESPROUT CONTROL: HERBICIDES, CONCENTRATIONS, AND STREAKS PER STEM.

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ABSTRACT

Basal streamline sprays were tested to control sweetgum. water oak , and southern red oak that ranged from OS-2 inches groundline diameter. Primary test herbicides and mixtures were triclopyr (Garlon 4) at 20 and 40 percent mixed with 10 percent d-limonene (Cide-Kick) and the remainder diesel; and imazapyr (Chopper) at 5 and 10 percent mixed in only diesel. Primary herbicide mixtures were applied with three doses: a) lo one stem side using one streak. b) to one side using two streaks. and c) to hvo sides using two streaks per side. Secondary test herbicides were picloram + triclopyr (Access) at IO and 20 percent mixtures and fluroxypyr (Dowco 433 or Starane) at 24 and 48 percent mixtures with IO percent d-limonene and the remainder diesel. Secondary herbicides were tested only using two streaks to one side. All applications were in April. Individual rootstocks were the experimental units and assessment was 18 months after application. Increasing doses of primary herbicides resulted in increasing control. Both triclopyr and imazapyr at the highest concentrations and doses yielded greater than 80 percent crown volume reduction for sweetgum and the oaks. Rootstock control was greatest for the highest concentration-doses as well. Treatments to one stem side were most effective with imazapyr at the high concentration. Southern red oak was the most difficult species to control. In general, the secondary herbicides were less effective than the primary herbicides.

INTRODUCTION

Basal streamline is an application option for selectively controlling small woody stems less than 2 to 3 inches in groundline diameter (I. 5, 6, 13.14). Basal streamline applications are especially useful for controlling sprouting clumps of hardwoods and shrubs, in particular red maple (*Acer rubrum* L.) This method is costly as currently applied however. compared to foliar directed sprays (4.7). Both directed sprays and basal streamline treatments have limitations on target plant size and basal streamline has poorly defined seasons of effective application. For further development of basal streamline treatments, refinements are needed in herbicide selection relative to target species, timing. concentrations of mixtures, carriers. and application methods to improve efficacy and reduce costs. Much recent research has focused on carriers (4, 9, IO, I I). mainly tested as low-volume basal sprays, but few studies have examined altered application methods for streamline (2) and further testing of alternative herbicides appears warranted.

The objectives of this research were:

1. To examine the number of stem spray streaks required for satisfactory woody stem control for the more commonly-used herbicides using standard and test herbicide concentrations. Currently the application of two streaks of herbicide on two stem sides is the operational recommendation (5) and lesser numbers of sides is the focus of this test.
2. To compare control characteristics of commonly-used herbicides to a lesser-used labeled herbicide (Access) and a promising test herbicide (Starane).

This study was part of a larger investigation of application timing (8).

METHODS

This research was established on a Piedmont site with Gwinnett sandy loam soils in east central Alabama, near Auburn. The site had been rootraked 2.5 years earlier and loblolly pine (*Pinus taeda* L.) seedlings had been planted. Test hardwood species were sweetgum (*Liquidambar styraciflua* L.), water oak (*Quercus nigra* L.), and southern red oak (*Quercus falcata* Michaux) that ranged in size from 0.5-2 inches groundline diameter. These are three of the most common competing hardwood species in the region. Primary test herbicides and mixtures were Garlon 4 (62 percent triclopyr ester) at 20 and 40 percent (volume: volume) mixed with IO percent Cide-Kick (100 percent d-limonene and emulsifiers) and the remainder diesel; and Chopper (28 percent imazapyr) at 5 and IO percent mised in only diesel. Garlon 4 at 40 percent exceeds the current maximum label recommended concentration of 30 percent and Chopper at 5 percent is less than the minimum label recommended concentration of 6 percent. The other two test concentrations for each product are within current label recommendation. Chopper is currently labeled for forest site preparation and Garlon 4 is labeled for conifer release, and both for managing wildlife openings. Garlon has no soil activity, while Chopper does.

Secondary test herbicides were Access (32 percent triclopyr and 17 percent picloram) at 10 and 20 percent mixtures and Starane (Dowco 433) (30 percent fluroxypyr ester) at 24 and 48 percent mixtures with 10 percent Cide-Kick and the remainder diesel. Access has soil activity and Starane does not. Access is currently labeled for forest site preparation, while Starane remains a test product Access' label recommendations are for low volume basal applications at 20 and 30 percent mixtures with full lower-stem cover, not the streamline being tested here.

All applications were made using a CO_2 sprayer at 20 psi and a handgun equipped with a straight-stream nozzle (a Spraying Systems Co. 0002 for Chopper and a 0001 for the other herbicides). Applications was made between 6-l 2 inches of the soil surface and below major branches. Gardiner and Yeiser (2) reported that higher positioning of streaks generally resulted in less crown reduction because lower branches survived and epiconnic branching occurred following March applications.

The primary herbicide concentration mixtures were applied with the following test methods: a) to one stem side using one spray streak b) to one side using two streaks, and c) to two sides using two streaks per side--an assumed 1X, 2X, and 4X dose, respectively. The secondary herbicides were tested using only two streaks to one side. To make these treatments the applicator stood 3-4 ft from the target rootstock and sprayed with a constant left to right motion and then back again if two streaks were required. For treating a second side, the applicator took two steps forward and applied the other two streaks al a point 90° around the stem (rootstock) center. This two-side method is the current operational recommendation (5). Multi-stemmed or single-stemmed rootstocks were tagged and randomly assigned treatments or left as untreated check plants. Twenty rootstocks per species were in each treatment replication, including the checks. All rootstocks were a minimum of 6-ft apart, with no evidence of a common root system.

Rootstocks were measured at the time of treatment and again 18 months after treatment (MAT) as the final assessment in September. Measurements were number of stuns in the rootstock crown height, maximum crown diameter, and right-angle crown diameter. After-treatment crown measurements were made to normal-sized (non-stunted) leaf tips and included basal resprouts. Rootstock control was judged by breaking stems progressively from the top down to groundline or by cutting away the lower bark on larger sterns. The degree of *rootstock reduction was* calculated as the percent of treated rootstocks completely controlled that showed no resprouting. ***Crown volume*** *reduction (CVR) was* calculated using the total height and average of the two crown diameters, for both the treated and cheek trees. to calculate the volume of cylinders. Linear regressions were calculated with the check-tree data describing the relationship between initial crown volume and the crown volume at end of the 18 *month period* (3). These equations for each species were used to calculate a *projected crown **volume*** **for each treated rootstock**. CVR was then calculated as follows: CVR = (Projected crown volume - Final crown volume) ÷ (Projected crown volume). Thus, CVR takes into account the amount of growth that would have occurred during the period between the initial and final measurements.

A completely randomized design was used with the number of replications equaling the number of test plants per treatment--usually twenty if all were relocated. All percentage values were transformed using the arcsine square root before analysis. An analysis of variance (ANOVA) was used and the model included herbicide, concentration, and dose as the independent variables. The three doses were as follows: (a) 1 streak on 1 side, (b) 2 streaks on 1 side, and (c) 2 streaks on 2 sides. Mean separation was with Tukey's HD analysis. A level of "effective" treatment is considered lo be above 80 percent for both crown volume reduction and rootstock reduction. This is a conservative level considering that this would be 80 percent of the projected crown volume that would occur over two growing seasons.

RESULTS AND DISCUSSION

Streaks per stem side

Basal streamline applications of both Garlon and Chopper herbicides at the highest concentrations and doses yielded greater than 80 percent crown volume reduction for sweetgum, water oak, and red oak with these April applications (Table I). Lower concentrations and doses also yielded effective control (>80 percent CVR) of water oak and with Garlon on sweetgum, but not for southern red oak. Garlon at 20 percent and 2 streaks on 2 sides was effective on both sweetgum and water oak, with 77 percent control of southern red oak Others have noted difficulty with basal-spray control of species within the red oak group (2, 12, I 3.14).

Secondary test herbicides were Access (32 percent triclopyr and 17 percent picloram) at 10 and 20 percent mixtures and Starane (Dowco 433) (30 percent fluroxypyr ester) at 24 and 48 percent mixtures with 10 percent Cide-Kick and the remainder diesel. Access has soil activity and Starane does not. Access is currently labeled for forest site preparation, while Starane remains a test product Access' label recommendations are for low volume basal applications at 20 and 30 percent mixtures with full lower-stem cover, not the streamline being tested here.

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Chopper at 10 percent on water oak exceeded 80 percent CVR when applied as 1 or 2 streaks on 1 side as well as the 2 streaks on 2 sides. Chopper at 5 percent resulted in a CVR of 93 percent for water oak when applied al 2 streaks on 2 sides, while CVR's of 79 percent were achieved by Chopper at IO percent applied on sweetgum at both 1 and 2 streaks on 1 side. The significant interactions for sweetgum and water oak necessitates examining the graphical summaries shown in Figure 1 (and southern red oak is included) and invalidates the ANOVA and Tukey HD tests for these species. For red oak the herbicides performed equally overall with the low concentration of Chopper showing significantly less control than the high concentrations of both herbicides.

Only one treatment resulted in greater than 80 percent RR on the three species, which was Garlon on sweetgum at the highest concentration and dose combination (Table 1). Seventy to eighty percent RR was achieved on water oak with both herbicides at the highest concentrations and doses and on sweetgum with Chopper at the high rate. Southern red oak was the most resistant to rootstock control of the three species.

The April timing was found to be comparable to other effective timings (i.e., the February timing) in the overall study in regards to CVR but less effective for RR (8).

New vs old herbicides

In general, the herbicides **Access** and Starane were less effective than Garlon and Chopper at these test concentrations and **with** treating only one stem side with two streaks (Table 2). The exception was Access control on southern red oak. Access treatments provided the greatest control **of southern** red oak in this group of treatments with both concentrations performing equally. Statistically, the **Access** control was comparable to the Garlon and Chopper treatments. Very low levels of rootstock reduction were produced by all the treatments, with **the** highest being 70 percent of treated **sweetgum** rootstocks by the high rate **of Garlon.** Similar conclusions with Starane were reported by Yeiser and Reed (14) when treating **sweetgum and southern *red oak,*** while effective CVR's were found for red maple and hickory (***Carya*** spp.). **Burch** et **al.(1)** found that increasing rates of Starane resulted in decreased CVR's when testing larger stem sizes.

CONCLUSIONS

These conclusions can be draw-n **from** these findings:

1. For Garlon basal streamline, a reduction in dose **from** 2 streaks on 2 sides to 2 streaks on 1 side will require a higher concentration than the label-minimum recommendation of 20 percent for effective treatments. Gardiner and Yeiser(2) **reported that increasing** the number **of treated** sides did not improve CVR's for I -inch stems, but yielded significant increases for 2- and 3-inch stems, although **control decreased** greatly with increasing stem diameter regardless of sides treated. Garlon has no soil activity and can be used in the proximity of nontarget woody stems.
2. For Chopper with the higher concentration **(10 percent),** effective crown reduction was achieved with 2 streaks on 1 side **with** water oak and **sweetgum.** The lower **concentration only** performed adequately on water oak in crown volume reduction but still inadequately in rootstock reduction. Chopper has soil activity and cannot be used within the rooting zone of **susceptible** nontarget plants.
3. The highest concentrations and doses were required to achieve greater than 70 percent rootstock reductions with **sweetgum** and water oak. **Rootstock** reductions of less than 45 percent were found with any concentration-dose of test herbicides on red oak.
4. The April timing resulted in crown reductions comparable to other timings as found in the overall study, but the levels of rootstock control were unsatisfactory.
5. The **comparisons** including **Access and Starane** found that **Access was** only effective with southern red oak and only for crown reduction. Neither showed enhanced rootstock control over the commonly-used herbicides.

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Table 1. Percent crown volume reduction and rootstock reduction 18 months after treatment with basal streamline applications comparing herbicides, concentrations, stem-sides treated, and number of treatment streaks per side.

Dose(D)		Herbicide (H) and Concentration Percent (C)										
		Crown Volume Reduction						Rootstock Reduction				
		Garlon 4		Chopper				Garlon 4		Chopper		
Sides	Streaks	20	40	5	10	Mean	Interactions[1]	20	40	S	10	Mean
						Sweetgum						
1	1	40	42	33	79	49c[2]	HxC**	5	5	0	20	8
1	2	69	90	37	79	70b	HxD**	21	70	0	40	33
2	2	88	96	61	99	87a	CxD ns	53	84	24	70	58
		63B	76AB	44C	86A	69		26	53	8	43	31
herbicide means			71A		66A				39		26	
						Water Oak						
1	1	37	46	51	81	58c	HxC ns	0	10	5	10	6
1	2	63	77	69	91	77b	HxD**	20	42	5	40	27
2	2	94	94	93	99	95a	CxD ns	62	74	30	75	60
		65B	72B	71B	90A	77		27	42	13	42	29
herbicide means			69B		81A				35		28	
						Southern Red Oak						
1	1	55	54	40	64	59c	HxC ns	0	5	10	14	7
1	2	68	75	59	74	74b	HxD ns	0	24	23	24	18
2	2	77	94	67	85	83a	CxD ns	16	42	25	36	30
		67AB	74A	55B	74A	7 2		5	24	19	25	16
herbicide means			70A		64A				15		22	

[1]Interaction significance levels indicated as *=.05 level;**=.01 level; and ns=non significant.
[2]Means in a column within a species with different letters are significantly different at the 0.05-level as determined by Tukey's mean separate test.

Table 2. Percent crown volume reduction (CVR) and rootstock reduction (RR) 18 months after treatment with basal streamline applications to one stem side using two streaks, comparing herbicide and two concentrations (percent).

Species	Response	Garlon 4		Chopper		Access		Starane	
		20	40	5	IO	IO	20	24	48
Sweetgum	CVR	69abc[1]	90a	37c	79ab	57abc	47bc	41c	53bc
	RR	21	70	0	40	33	10	11	35
Water Oak	CVR	63bc	77ab	69abc	91a	42cd	3Sd	39cd	48cd
	RR	20	42	5	40	10	0	0	0
S. Red Oak	CVR	68ab	75a	59ab	7 4 s	76a	77a	18bc	38c
	RR	0	24	22	24	20	24	10	0

[1]Means in a row followed by the same letter are not significantly different at the 0.05 level.

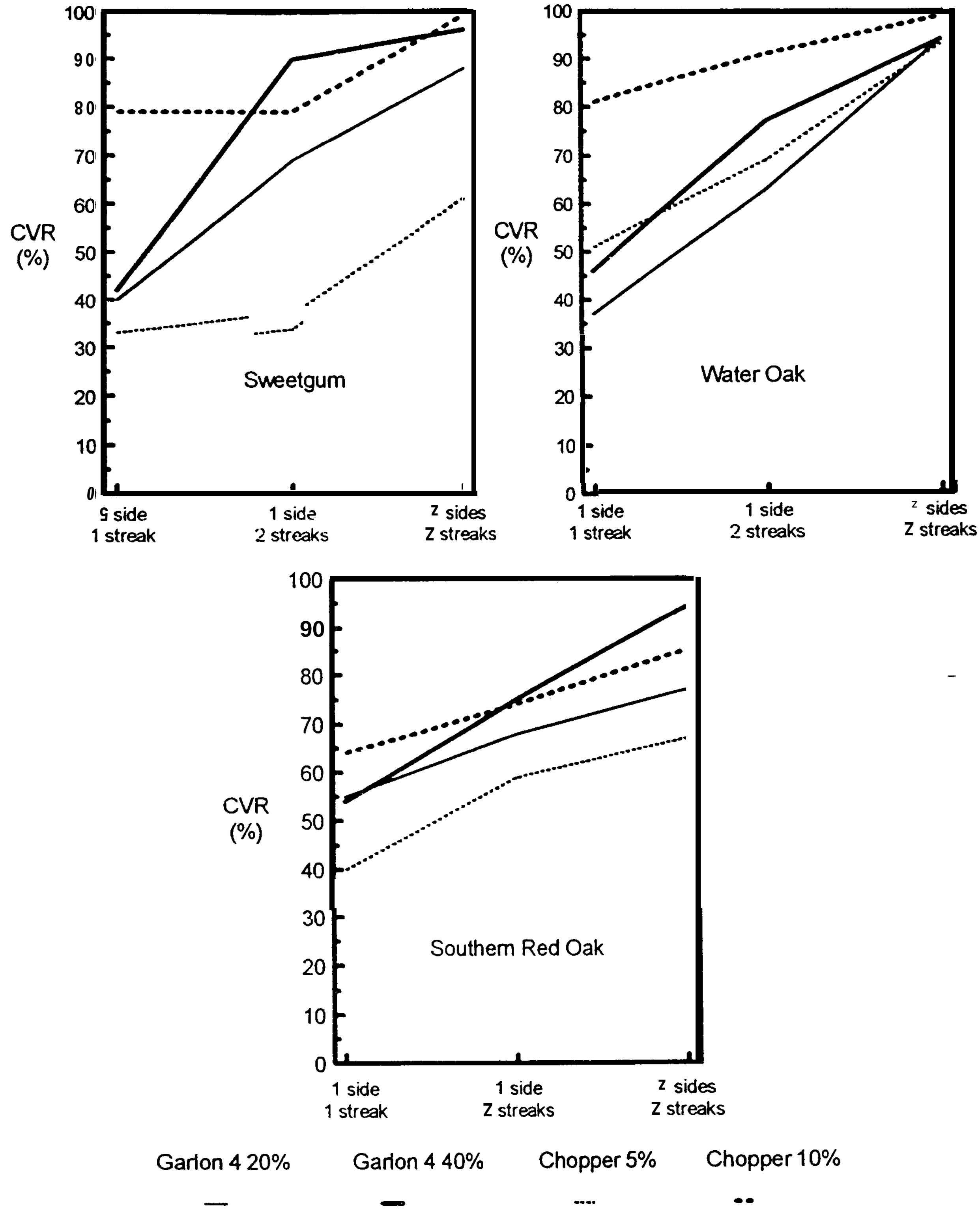

Figure 1. Percent crown volume reduction (CVR) 18 months after treatment with basal streamline applications comparing herbicides, concentrations, stem-sides treated, and number of treatment streaks per side.

IMPACT OF HEHBACEOUS WEED SUPPRESSION ON ROOT GROWTH OF FOUR SPECIES OF SOUTHERN PINE. T. R. Clason, Hill Farm Research Station, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Homer, LA 71040, and D.P. Reed, School of Forestry, Wildlife, and Fishcries, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Intensive vegetation management alters seedling growth and development in southern pine plantations. Adequate light, moisture. and nutrients stimulate seedling stem growth and crown development. This rapid stem growth could deplete nutrient and energy resources required for aggressive root growth. Early root system expansion within the available rooting zone is critical because structural root growth culminates in the early stages of plantation development.

In 1995, a study was established at the Louisiana State University Lee Memorial Forest to determine the impact of rapid seedling stem growth on root system expansion in young southern pine plantations. The experimental area was a 12 ha pasture. Four southern pine species, loblolly pine (*Pinus taeda*), slash pine (*Pinus elliottii*), shortleaf pine (*Pinus echinata*), and ionglcafpine (*Pinus palustris*) were planted in separate 3 ha plantations at a spacing of 2.4m X 3.6m. Each plantation was divided into sis 0.5 ha plots. Two herbaceous weed suppression treatments, no weed suppression (NWS) and single growing season weed suppression (WS), were assigned in a randomized complete block design and replicated three times. Predominant herbaceous species were bahiagrass (*Paspalum notatum*), vaseygrass (*Paspalum urvillei*), broomsedge (*Andropogon virginicus*), and maypop passionflower (*Passiflora incarnata*). Weed suppression treatment was a 1.8m wide band centered over the seedling row with season long suppression maintained by applying suifometuron at 140g/ha in April, gyphosate as a directed spray in June, and mctsulfuron at 70g/ha in July. Seedling height and groundline diameter (GLD) were taken immediately after planting and at the end of the first growing season. In February, 1996, nine seedlings were excavated from each pine species/weed suppression treatment combination. Each seedling was separated into four components, stem, foliage, tap root, and lateral roots. and green and oven-dry weights determined for each component

Except for longleaf pine, WS treatment increased seedling stem growth. Height growth increases were detected for loblolly and shortleaf, averaging 133mm and 72mm, and GLD increases were detected for lobloiiy, shortleaf, and slash, averaging 5mm, 4mm, and 5mm. Total oven-dry stem biomass for all pine species differed between treatments with the WS treatment being at least two times greater than the NWS. For both treatments and all species, the foliage component biomass exceeded the stem component by 66%. WS treatment total oven-dry root biomass exceeded NWS by at least two times. Although both WS treatment tap and lateral roo: biomass were greater than NWS treatment, biomass distribution between the two components differed among species. Shortleaf lateral root biomass exceeded tap root biomass, longleaf tap root biomass exceeded lateral root biomass, and loblolly tap and lateral root biomass did not differ. Slash pine root biomass distribution differed between treatments, lateral root biomass exceeding tap root in the WS treatment. Root/shoot ratio comparisons, which differed among species, indicated that intensive vegetation management did not alter seedling nourishment distribution patterns during the first growing season. Respective loblolly, shortleaf, slash, and longleaf root/shoot ratios were 20, 26, 39. and 47% for the WS treatment; and 20, 22, 38, and 47% for the NWS treatment. After one growing season, rapid stem growth did not preferentially diminish root system growth and expansion.