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Tolerance of Selected Tree Seed to Combinations of Preemergent Herbicides[1]

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Abstract

Black locust (*Robinia pseudoacacia* L.), honey locust (*Gleditsia triacanthos* L.), and Kentucky coffee tree (*Gymnocladus dioica* (L.) C. Koch) seed were planted in soil treated with various combinations of preemergent herbicides and grown in the greenhouse to determine herbicide effect on seedling survival and growth. Herbicides evaluated included Lasso (alachlor) alone at 2.2 a.i. kg/ha (2.0 a.i. lb/a), and in combination with Lorox (linuron) 1.7 (1.5), Surflan (oryzalin) 2.2 (2.0), or Dacthal (DCPA) at 11.8 (10.5); Surflan (oryzalin) alone at 2.2 (2.0) and in combination with Dacthal (DCPA) 11.8 (10.5) or Lorox (linuron) 1.7 (1.5); Dacthal (DCPA) alone at 11.8 (10.5) and in combination with Lorox (linuron) 1.7 (1.5); and Lorox (linuron) at either 1.7 (1.5) or 3.3 (3.0). All treatment were acceptable on Kentucky coffee tree seed. Lasso (alachlor) or Dacthal (DCPA) alone or mixed together and applied to honey locust or black locust were acceptable in respect to height and/or dry weight growth. All other treatments were damaging to these two species.

Index words: toxicity, herbicide

Species used in this study: Black locust (*Robinia pseudoacacia* L.); Honey locust (*Gleditsia triacanthos* L.); Kentucky coffee tree (*Gymnocladus dioica* (L.) C. Koch).

Herbicides used in this study: Lasso (alachlor), 2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl)acetamide; Surflan (oryzalin), 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide; Dacthal (DCPA), dimethyl 2,3,5,6-tetrachloro-1,4-benzenedicarboxylate; Lorox (linuron), N′-(3,4-dichlorophyenyl)-N-methoxy-N-methylurea.

Significance to the Nursery Industry

Our studies show that some herbicide tank mixes could replace hand weeding in tree nursery beds, but the three species responded differently to each herbicide treatment. Efficacy of the mixes should be ascertained under field conditions, where they can be evaluated for broad spectrum weed control. All combinations of the preemergent herbicides Lasso (alachlor), Surflan (oryzalin), Dacthal (DCPA), and Lorox (linuron) at the rates tested could be used in nursery bed seeding without seriously affecting survival or growth of Kentucky coffee tree crops.

Both honey locust and black locust are sensitive to herbicide combinations, as shown by drastically reduced seedling growth. Black locust seed was affected by all herbicides tested, except Lasso (alachlor) or Dacthal (DCPA) alone or mixed together. Additional herbicides need to be evaluated in tank mixes, especially for use on tree seed with thin coats.

Introduction

Labor costs in tree seedling production can be substantially reduced with a herbicide weed control program (1, 2). Extensive research in the past has been devoted to evaluating preemergent herbicides on established stock, with less effort focused on the germination and early seedling period (7). Previous studies indicate that preemergent herbicides can be used on selected woody plants without affecting germination; however, herbicide tolerance varies with tree species (3, 4, 5). New products to reduce weeds in tree nursery production need evaluation.

Previously reported (7) growth-chamber screening tests of black locust (*Robinia pseudoacacia* L.), honey locust (*Gleditsia triacanthos* L.), and Kentucky coffee tree (*Gymnocladus dioica* (L.) C. Koch) in petri dishes indicated few effects on germination from Lasso and Dacthal herbicides at 2.2 and 11.8 kg/ha, (2.0 and 10.5 lb ai/A) respectively.

Studies with seed of black locust, honey locust, and Kentucky coffee tree have shown their tolerance to various herbicides in greenhouse pot studies with peat/sand (6) or peat/sand/soil mixtures (8, 9), and several soil types (3, 4, 5) suggesting the feasibility of herbicide use in nursery bed seeding. Application of a single herbicide has often shown promising results; however, tank mix combinations usually result in greater control of weeds in the field.

This research compares seedling survival and growth of three tree species when seeded in a peat-sand mixture that was treated with several different tank-mix combinations of preemergent herbicides one day after seed sowing under controlled greenhouse conditions.

Materials and Methods

Seed was scarified with concentrated sulfuric acid for 120 (Kentucky coffee tree) or 60 min (honey locust and black locust). Ten (coffee tree) or 20 (honey locust and black locust) seed were planted per 3.8 l (#1) plastic nursery container in a medium of sand:peat (2:1 by vol). Kentucky coffee tree seed was planted at 2.5 cm (1 in) depth, honey locust at 1.3 cm (0.5 in), and black locust at 0.6 cm (0.25 in). The following day, 12 herbicide treatments each rep-

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Table 1. Survival, plant height, and dry weight of Kentucky coffee tree 60 days after planting.[z]

Herbicide type	Rate a.i. kg/ha (lb/a)	Survival (%)	Plant ht. (cm)	Dry wt. (mg)
Lasso	2.2 (2.0)	98 a	22.1 a	637 ab
Lasso + Lorox	2.2 (2.0) 1.7 (1.5)	90 ab	20.4 ab	608 abc
Lasso + Surflan	2.2 (2.0) 2.2 (2.0)	88 ab	15.2 de	452 bcd
Lasso + Dacthal	2.2 (2.0) 11.8 (10.5)	90 ab	17.2 bcde	554 abcd
Surflan	2.2 (2.0)	90 ab	14.8 e	454 bcd
Surflan + Dacthal	2.2 (2.0) 11.8 (10.5)	98 a	11.4 f	408 d
Surflan + Lorox	2.2 (2.0) 1.7 (1.5)	90 ab	15.9 cde	428 cd
Dacthal	11.8 (10.5)	78 b	15.9 cde	601 abc
Dacthal + Lorox	11.8 (10.5) 1.7 (1.5)	98 a	18.9 abc	694 a
Lorox	1.7 (1.5)	85 ab	20.1 ab	641 ab
Lorox	3.3 (3.0)	88 ab	18.2 bcd	638 ab
Control	—	90 ab	19.6 ab	631 ab

[z]Means within a column followed by the same letter or letters do not differ significantly using Duncan's multiple range test, 5% level.

licated four times were applied to the soil surface of randomly selected containers.

Treatments including the best herbicide rates from previous trials (6, 7): Lasso at 2.2 kg/ha (2.0 lb/a) alone or combined with Lorox 1.7 (1.5), Surflan 2.2 (2.0), or Dacthal 11.8 (10.5); Surflan at 2.2 (2.0) alone or combined with Lorox 1.7 (1.5) or Dacthal 11.8 (10.5); Dacthal at 11.8 (10.5) alone or combined with Lorox 1.7 (1.5); Lorox at 1.7 (1.5) and 3.3 (3.0); and an untreated control.

A 1 ml aliquot stock solution was mixed with 232 ml of water to simulate a 1.3 cm (0.5 in) irrigation per pot. Applications were made with a plastic bottle topped with a sprinkler can head. Water and fertilizer were provided as needed throughout the experimental period in the greenhouse. Seedling counts were made at about 12-day intervals. Sixty days after seeding, plant height and final survival counts were recorded. Plants were cut at the soil surface and oven-dried at 65°C (140°F) for 48 hours for dry weight measurements.

Results and Discussion

Survival of Kentucky coffee tree was generally unaffected by the 11 preemergent herbicide treatments evaluated in this study (Table 1). Height of surviving Kentucky coffee tree seedlings was not significantly reduced by most treatments. Surflan and Dacthal alone were inhibitory, resulting in a 20 to 40% reduction in plant height. Most herbicide applications did not cause reductions in dry weight, except for the two Surflan combinations which had 35% less dry weight than the controls. These results support our previous work (5) with Lasso and Dacthal.

Honey locust treated with Lasso and Lorox exhibited only 2% germination (Table 2). Height was 50 to 70% less than

Table 2. Survival, plant height, and dry weight of honey locust 60 days after planting.[z]

Herbicide type	Rate a.i. kg/ha (lb/a)	Survival (%)	Plant ht. (cm)	Dry wt. (mg)
Lasso	2.2 (2.0)	35 ab	13.2 b	302 b
Lasso + Lorox	2.2 (2.0) 1.7 (1.5)	2 c	15.2 b	341 b
Lasso + Surflan	2.2 (2.0) 2.2 (2.0)	15 ab	5.2 c	70 c
Lasso + Dacthal	2.2 (2.0) 11.8 (10.5)	61 a	14.3 b	327 b
Surflan	2.2 (2.0)	18 bc	8.3 c	128 c
Surflan + Dacxthal	2.2 (2.0) 11.8 (10.5)	22 bc	7.5 c	134 c
Surflan + Lorox	2.2 (2.0) 1.7 (1.5)	15 bc	8.6 c	132 c
Dacthal	11.8 (10.5)	24 ab	21.3 a	549 a
Dacthal + Lorox	11.8 (10.5) 1.7 (1.5)	35 ab	17.4 ab	410 b
Lorox	1.7 (1.5)	19 bc	15.1 b	301 b
Lorox	3.3 (3.0)	16 bc	14.4 b	336 b
Control	—	34 ab	17.1 ab	376 b

[z]Means within a column followed by the same letter or letters do not differ significantly using Duncan's multiple range test, 5% level.

Table 3. Survival, plant height, and dry weight of black locust 60 days after planting.[z]

Herbicide type	Rate a.i. kg/ha (lb/a)	Survival (%)	Plant ht. (cm)	Dry wt. (mg)
Lasso	2.2 (2.0)	52 a	6.2 a	92 bc
Lasso + Lorox	2.2 (2.0) 1.7 (1.5)	0	0	0
Lasso + Surflan	2.2 (2.0) 2.2 (2.0)	2 c	1.6 b	10 c
Lasso + Dacthal	2.2 (2.0) 11.8 (10.5)	49 a	5.0 a	74 bc
Surflan	2.2 (2.0)	10 b	0.7 b	11 c
Surflan + Dacthal	2.2 (2.0) 11.8 (10.5)	5 b	0.7 b	8 c
Surflan + Lorox	2.2 (2.0) 1.7 (1.5)	0	0	0
Dacthal	11.8 (10.5)	42 a	7.0 a	150 b
Dacthal + Lorox	11.8 (10.5) 1.7 (1.5)	0	0	0
Lorox	1.7 (1.5)	1 c	2.3 b	250 a
Lorox	3.3 (3.0)	0	0	0
Control	—	49 a	6.0 a	98 b

[z]Means within a column followed by the same letter or letters do not differ significantly using Duncan's multiple range test, 5% level.

that of the control with all Surflan treatments. Individual plant weight was 50 to 70% less than the control plants. No other treatments affected survival or growth. Previous tests with Lasso and Dacthal gave similar results (4).

Results with black locust seed were less promising (Table 3). Apparently, the seed is sensitive to many of the herbicides evaluated. Only Lasso or Dacthal alone, or in combination did not significantly reduce survival or growth, as reported in previous trials (3).

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