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Preemergent Herbicides for Direct Seeding Kentucky Coffeetree, Honeylocust, and Black Locust

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Alachlor, DCPA, and oryzalin herbicides applied 1 day after sowing tree seeds provided good weed control and did not adversely affect Kentucky coffeetree or honeylocust growth.

Direct seeding of pine has been successful in the Southern United States (*6*), but broad-leaved species are seldom seeded in the field. One exception is black locust, which has been seeded extensively on surface-mined lands in the Southeast (*3, 5*). Weed competition is one major obstacle to successful direct seeding. Tree nurseries usually overcome this problem with handweeding and scant use of herbicides. If adequate silviculture techniques could be developed for field operations, direct seeding might be a feasible way of establishing high-density, short-rotation plantations for energy forests (*4*).

Labor costs for handweeding can be as high as 90 percent of the total production costs in some tree nurseries (1). Labor-intensive weeding may be reduced with the use of selective herbicides on nursery crops. Previous weed control research on woody plants has focused on preemergent herbicides used on established seedlings, while only a few reports have been made on the effects of herbicides on seed germination and early seedling growth (*2, 7, 8*). Understanding the tolerance of germinating broadleaf species to preemergent herbicides is important in developing a successful silviculture technique for direct seeding.

This study evaluated resultant seedling survival and growth of Kentucky coffeetree (*Gymnocladus dioicus* (L.) K. Koch), honeylocust (*Gleditsia triancanthos* LJ, and black locust (*Robinia pseudoacacia* L.) when treated with preemergent herbicide 1 day after seed sowing in the field.

Methods and Materials

All seeds were scarified with concentrated sulfuric acid (H_2S0_4). Kentucky coffeetree seeds were acid treated for 120 minutes and honeylocust and black locust for 60 minutes. A preliminary growth-chamber study was conducted with all three species and herbicides. Acid-scarified seeds of each species were placed on filter paper in glass petri dishes. Chemical stock solutions of 1 milliliter of herbicide mixed with 5 milliliters of water were applied at field rates as subsequently described. Another sheet of filter paper was placed on top of seeds to retain moisture. Petri dishes were placed in a Mangeldorf germinator at 23° C, and paper was routinely moistened with distilled water until germination.

A weed-free seedbed was prepared at the Rocky Ford experimental field located near Manhattan, Kans. Scarified Kentucky coffeetree, honeylocust, and black locust seeds were then planted in the phase silty-loam soils at depths of 2.5, 1.3, and 0.6 centimeters, respectively. Plots consisted of 40 seeds sown at 10-centimeter intervals in a 1.1- by 3.8-meter area with three replications arranged in a randomized design.

The herbicide treatments, in kilograms per hectare, included DCPA (dimethyl tetrachloro-terephthalate) at 11.2, chloroxuron (3-[p-(p-chlorophenoxy) phenyl] -1, 1-dimethylurea) at 2.2, alachlor (2-chloro-2', 6'-diethyl-N-(methoxymethyp acentanilide) at 2.2, and profluralin (N-cyclopropylmethyl) -α,α,α-triflroro-2, 6 dinitro-N-propyl-p-toluidine) at 0.6 for all three species. Other herbicide treatments for Kentucky coffeetree and honeylocust plots, in kilograms per hectare, included napropamide (2-(α-napthoxy)-N, N-diethyl-2, 2-diphenylacetamide) at 2.2, diphenamid (N,-N-dimethyl-2, 2-diphenylacetamide) at 4.5, and oryazlin (3,5-dinitro-N^4,N^4-dipropyl sulfanilamide) at 2.2. EPTC (5-ethyl dipropylthiocarbamate) at 4.5, napropamide at 1.1, and oxadiazon 2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazolin-5-one) at 4.5 kilograms per hectare were the additional herbicides for black locust treatments. Selected rates were based on previous seedling survival and growth studies conducted in the greenhouse with these tree species (*7*).

A CO_2 constant-pressure plot sprayer was used for liquid applications and a drop spreader was used for the granular herbicide. Treatments were applied in May 1979 at 23° C with a wind velocity of less than 8 kilometers per hour. Plots were irrigated immediately following application and periodically throughout the summer to supply supplemental moisture.

Seedling survival data and weed control evaluations were recorded 60 days after treatment. One year after herbicide application, survival and plant heights were measured.

Table 1.—*Seed germination of Kentucky coffeetree, honeylocust, and black locust in growth chamber tests*

Chemical	Treatment rate	Germination		
		Kentucky coffeetree	Honeylocust	Black locust
	Kg a.i./ha	- - - - - - - -	%	- - - - - - - -
Alachlor	2.25	100	95	90
Chloroxuron	2.25	100	90	100
DCPA	11.23	100	90	95
Diphenamid	4.49	100	85	—[1]
EPTC	4.49	—	—	85
Napropamide	1.12	—	—	85
Napropamide	2.25	100	95	—
Oryzalin	2.25	100	90	—
Oxadiazon	4.49	—	—	95
Profluralin	.56	95	85	100
Control	—	95	85	85

[1]— = not applied to these species.

Results and Discussion

Herbicide treatments did not seriously affect germination of any of the three species during the preliminary growth chamber study. Seed germination was 95 to 100 percent for Kentucky coffeetree in 16-day trials, 85 to 100 percent for honeylocust in 5-day trials, and 85 to 100 percent for black locust in 8-day trials (table 1). Germination in the control treatments was 85 to 95 percent, thus indicating that, under controlled conditions, the herbicides were not toxic to the tree seeds.

Field herbicide treatments differed in effectiveness of weed control because of variations in weed populations (table 2). Weeds in Kentucky coffeetree and black locust plots were predominately grasses such as yellow foxtail (*Setaria lutescens* (Weigel) Hubb.) and large crabgrass (*Digitaria sanguinalis* (L.) Scop.), while honeylocust plots had mostly redroot pigweed (*Amaranthus retroflexus* L.), velvet-leaf (*Abutilon theophrasti* Medic.), and other broad-leaved weeds.

Kentucky coffeetree seedling survival was not affected by any herbicide treatments. However, alachlor, DCPA, and oryzalin were the only herbicides that provided significant weed control. These three herbicides controlled 80 to 86.7 percent of the weeds in the plots.

There was no significant difference in survival among honeylocust seeds receiving chemical treatments. All herbicide-treated plots had fewer weeds than untreated plots. Alachlor, DCPA, and oryzalin were most effective in controlling 93.3 to 100 percent of the weeds, followed by diphenamid, which controlled 86.7 percent. Napropamide, chloroxuron, and profluralin all provided 71.7-percent control.

Overall germination of black locust was low. Only 4 percent of the seedlings survived in control plots, while 15 percent of the seedlings were present in DCPA-treated plots. Seedling survival in other treated plots was no different than the control. Profluralin, napropamide, and chloroxuron provided no better weed control than the untreated plots. EPTC controlled 66.7 percent of the weeds, and DCPA controlled 86.7 percent of the weeds. Alachlor plots were approximately 91.7 percent weed free. Oxadiazon-treated plots had 100-percent weed control, but also had no surviving seedlings.

There was only a 2-percent added seedling loss 1 year later with Kentucky coffeetree, and less

Table 2.—*Survival, weed control ratings, and plant height of Kentucky coffeetree, honeylocust, and black locust seedlings in field planting*

Herbicide	Treatment rate	60 days after treatment: Seedling survival	60 days after treatment: Weed control	Plant height 365 days after treatment
	Kg a.i./ha	- - - - - - - - - - - %	- - - - - - - - - - -	*Cm*
		Kentucky coffeetree		
Alachlor	2.2	92.5a[1]	85.0a	38.1 ab
Chloroxuron	2.2	95.8a	.0b	30.1 be
DCPA	11.2	92.5a	86.7a	38.5ab
Diphenamid	4.5	92.5a	20.0b	36.0ab
Napropamide	2.2	86.7a	16.7b	34.7abc
Oryzalin	2.2	93.3a	80.0a	39.8a
Profluralin	0.6	82.5a	.0b	25.8c
Control	—[2]	85.0a	.0b	32.2abc
		Honeylocust		
Alachlor	2.2	72.5a	93.3ab	74.5a
Chloroxuron	2.2	69.2a	71.7b	61.8ab
DCPA	11.2	65.0a	100.0a	79.6a
Diphenamid	4.5	71.7a	86.7ab	62.6ab
Napropamide	2.2	70.8a	71.7b	66.0ab
Oryzalin	2.2	60.0a	95.0ab	71.3a
Profluralin	.6	71.7a	71.7b	50.0bc
Control	—	63.3a	67.0c	37.2c
		Black locust		
Alachlor	2.2	3.3bc	91.7a	.0a
Chloroxuron	2.2	8.3abc	5.0c	.0a
DCPA	11.2	15.0a	86.7ab	.0a
EPTC	4.5	4.2bc	66.7b	.0a
Napropamide	1.1	8.3abc	16.7c	.0a
Oxadiazon	4.5	0.0c	100.0a	.0a
Profluralin	.6	11.7ab	21.7c	.0a
Control	—	4.2bc	.0c	.0a

[1] Means within a column followed by the same letter do not differ significantly at the 5-percent level using Duncan's multiple range test.
[2]— = not applicable.

than a 5-percent added loss of honeylocust. None of the black locust survived.

The various herbicides affected honeylocust plant heights after 1 year. All treatments, except profluralin at 0.6 kilograms per hectare produced trees significantly taller than the control. Treatments did not cause Kentucky coffeetree plant heights to differ from the control.

In summary, results from black locust seedlings were inconclusive because of poor field germination. DCPA at 11.2, alachlor at 2.2, and oryzalin at 2.2 kilograms per hectare provided acceptable weed control with no decrease in survival of Kentucky coffeetree and honeylocust seedlings. These herbicides applied 1 day after planting can reduce costly handweeding in nursery seedbeds and lower plant establishment costs in the field. However, further research on subsequent growth and herbicide treatments is necessary before such a practice is recommended.

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