# PREEMERGENCE HERBICIDES FOR SEEDED NURSERY CROPS

by

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B.S., Kansas State University, 1978

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A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Horticulture

KANSAS STATE UNIVERSITY

Manhattan, Kansas

1980

Approved by:

Charles E. Long

Major Professor

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# ACKNOWLEDGEMENTS

The author wishes to express her sincere appreciation to Dr. Charles Long for his patient understanding and guidance in the completion of this thesis.

Appreciation is extended to Dr. Wayne Geyer and Dr. Bob Carrow for their constant support of this research. Also, a special thanks to Dr. Robert Campbell for his encouragement and help in data analysis.

To those not mentioned, the author gratefully acknowledges the unselfish giving of their time and assistance.

# INTRODUCTORY STATEMENT

This thesis has been written in manuscript form to be submitted for publication in HortScience. This research was conducted in the spring and summer of 1979 in the Department of Horticulture research greenhouses, laboratories, and turfgrass research field at Kansas State University, Manhattan, Kansas.

# Preemergence Herbicides for Seeded Nursery Crops[1]

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Additional index words. *Gymnocladus dioicus*, *Gleditsia triacanthos*, *Robinia pseudoacacia*, weed control, woody ornamentals

Abstract. Ten preemergence herbicides were applied to the soil surface of nursery containers 1 day after planting seeds of *Gymnocladus dioicus* (L.) K. Koch, *Gleditsia tricanthos* L., and *Robinia pseudoacacia* L. to test herbicide effects on seedling survival and growth. Herbicide treatments in kg/ha were alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide) at 2.25 and 4.49, chlorpropham (isopropyl m-chlorocarbanilate) at 3.37 and 6.74, chloroxuron (3-[p-(p-chlorophenoxy)phenyl]-1,1-dimethylurea) at 2.25 and 4.49, DCPA (dimethyl tetrachloroterephthalate) at 6.74 and 11.23, diphenamid (N,N-dimethyl-2,2-diphenylacetamide) at 4.49 and 8.98, EPTC (S-ethyl dipropylthiocarbamate) at 2.25 and 4.49, napropamide (2-(α-naphthoxy)-N,N-diethylpropionamide) at 1.12

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[1] Received for publication . Journal Paper No. -J of the Kansas Agricultural Experiment Station.

[2] Graduate student and Associate Professors.

and 2.25, oryzalin (3,5-dinitro-$N^4$,$N^4$-dipropylsulfanilamide) at 1.12 and 2.25, oxadiazon (2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-$\Delta^2$-1,3,4-oxadiazolin-5-one) at 2.25 and 4.49, and profluralin (N-cyclopropylmethyl)-α,α,α-trifluoro-2,6-dinitro-N-propyl-p-toluidine) at 0.56 and 1.12. Species varied in response to herbicides, with Robinia most affected by treatments. Most herbicides did not reduce seedling survival, plant height, or dry weight.

High labor costs have made hand weeding noneconomical for tree seedling production. Abbott and Fitch (1) reported that hand weeding can represent 10 to 90% of total production costs in nurseries. Much of the past weed control research with woody plants has been directed toward use of preemergence herbicides on established stock, which does not eliminate the need for hand weeding during germination and early seedling stages (2, 4, 5, 7).

Studies conducted by the Prairie Farm Rehabilitation Administration (PFRA) demonstrated that diphenamid + dinoseb applied at the time of seeding did not significantly reduce the germination of Ulmus pumila, Ulmus americana, and Elaeagnus angustifolia (8). In later studies the PFRA also found that trifluralin at 2.25 kg/ha was not phytotoxic to germinating seeds of Fraxinus pennsylvanica, but reduced the stand of Ulmus pumila (3). Dill and Carter (6) reported that Robinia pseudoacacia was tolerant of 2X the rates of trifluralin and EPTC applied to seedbeds. South, Crowley, and Gjerstad (9) also found that Pinus species were tolerant of herbicide treatment applied after planting and mulching. Trifluralin at 1.12, diphenamid at 4.49, and profluralin at 2.25 kg/ha controlled weeds without affecting seedling production, but Pinus seedlings were non-tolerant of oryzalin at 2.25 kg/ha and napropamide at 6.74 kg/ha.

Results from these studies indicate that preemergence herbicides may be used on selected woody plants without affecting germination, however tolerance to herbicide treatments varies with tree species.

The purpose of this study was to test survival and growth of Gymnocladus dioicus, Gleditsia triacanthos, and Robinia pseudoacacia treated with preemergence herbicide 1 day after planting the seeds.

Seed of all three species was scarified with concentrated sulfuric acid ($H_2SO_4$). Gymnocladus seed was acid treated for 120 minutes, Gleditsia and Robinia for 60 minutes. Twenty-five seeds of each species were planted in individual 3.8 liter plastic nursery containers in a 2:1 mixture of sand and peat. Gymnocladus seeds were planted at a 2.5 cm depth, Gleditsia at 1.3 cm, and Robinia at 0.6 cm. The following day 4 replications of each treatment were applied to the soil surface and containers were randomized by tree species. Treatments in kg/ha were alachlor at 2.25 and 4.49, chlorpropham at 3.37 and 6.74, chloroxuron at 2.25 and 4.49, DCPA at 6.74 and 11.23, diphenamid at 4.49 and 8.98, EPTC at 2.25 and 4.49, napropamide at 1.12 and 2.25, oryzalin at 1.12 and 2.25, oxadiazon at 2.25 and 4.49, and profluralin at 0.56 and 1.12.

Procedure for herbicide application was to prepare chemical stock solutions of each treatment. A 1 ml aliquot of stock solution was withdrawn and mixed with 232 ml of water to simulate 1.3 cm irrigation per pot. Applications were made with a plastic bottle topped with a sprinkler can head. Routine watering and fertilizing was performed throughout the experimental period.

Seedling counts were made at 6 day intervals. Sixty days after seeding, plant height and final survival counts

were taken. Plants were cut at the soil surface and oven dried at 65°C for 48 hr for dry weight measurement.

Survival, plant height and dry weight was greatest among Gymnocladus seedlings. Chlorpropham at 6.74 kg/ha, EPTC, and oxadiazon soil treatments caused significantly lower Gymnocladus seedling survival (Table 1). The growing point was necrotic in EPTC treatments. Non-surviving plants in the oxadiazon treatments had constricted necrotic stems. Chlorpropham at 6.74 kg/ha had shorter plants than the control, while oxadiazon at 2.25 kg/ha seedlings were taller, with thin stems and leggy growth. Treatments did not cause dry weight to be different than the control.

Gleditsia seedlings grown in soil that received EPTC at 4.49 kg/ha and oxadiazon at both rates had lower survival (Table 2). In oxadiazon treatments 90% germination occurred 14 days after planting, but seedlings died thereafter. Both rates of chlorpropham and EPTC caused Gleditsia seedlings to be shorter than the control. Dry weight per plant was least for Gleditsia seedlings grown in soil treated with chlorpropham at 6.74 kg/ha.

Robinia seedlings showed the poorest survival and growth of the 3 species (Table 3). Seedlings grown in soil treated with chlorpropham, napropamide at 2.25, oryzalin at 2.25, and diphenamid at 8.98 kg/ha had decreased survival. Robinia seedlings were shorter in soil treated with chlorpropham, oryzalin, EPTC at 4.49, and alachlor at 4.49 kg/ha. In EPTC treatments Robinia leaves were deformed, reduced in size, and

never fully expanded. Dry weight of surviving plants grown in chlorpropham at 6.74 kg/ha was greater than the control.

The three species responded differently to each herbicide treatment. These results indicate that selectivity is dependent upon the herbicide and species. Most herbicides used in this study did not decrease seedling survival and growth. Thus, herbicide application 1 day after planting may be a promising alternative to hand weeding in seedling nurseries. However, weed control evaluations under field conditions are necessary before such a practice is recommended.

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**THIS BOOK CONTAINS NUMEROUS PAGES WITH DIAGRAMS THAT ARE CROOKED COMPARED TO THE REST OF THE INFORMATION ON THE PAGE.**

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Table 1. Survival, plant height, and dry weight of Gymnocladus dioicus 60 days after planting.[z]

| Treatment | | | | |
|---|---|---|---|---|
| Chemical | Rate (kg a.i./ha) | Survival | Plant ht (cm) | Dry wt (mg/plant) |
| Alachlor | 2.25 | 24.3a[y] | 23.4ab | 730abc |
| Alachlor | 4.49 | 22.5ab | 25.5ab | 830ab |
| Chlorpropham | 3.37 | 22.8ab | 23.5ab | 690abc |
| Chlorpropham | 6.74 | 17.8de | 17.6c | 600c |
| Chloroxuron | 2.25 | 24.0a | 25.1ab | 720abc |
| Chloroxuron | 4.49 | 23.8a | 25.3ab | 780abc |
| DCPA | 6.74 | 24.5a | 26.1ab | 720abc |
| DCPA | 11.23 | 22.5ab | 22.8b | 740abc |
| Diphenamid | 4.49 | 23.3ab | 26.3ab | 750abc |
| Diphenamid | 8.98 | 22.3ab | 25.8ab | 670abc |
| EPTC | 2.25 | 17.5de | 24.5ab | 880a |
| EPTC | 4.49 | 15.8e | 22.3b | 840ab |
| Napropamide | 1.12 | 21.5abc | 24.4ab | 670abc |
| Napropamide | 2.25 | 21.8abc | 23.2b | 670abc |
| Oryzalin | 1.12 | 22.8ab | 25.7ab | 810abc |
| Oryzalin | 2.25 | 23.3ab | 23.0b | 640bc |
| Oxadiazon | 2.25 | 19.8bcd | 27.5a | 740abc |
| Oxadiazon | 4.49 | 18.8cde | 23.0b | 780abc |
| Profluralin | 0.56 | 24.0a | 24.5ab | 760abc |
| Profluralin | 1.12 | 24.8a | 23.1b | 690abc |
| Control | - | 23.8a | 26.2ab | 760abc |

[z] Means represent 4 replications of 25 seedlings.

[y] Mean separation in columns by Duncan's multiple range test, 5% level.

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

| Treatment | | | | |
|---|---|---|---|---|
| Chemical | Rate (kg a.i./ha) | Survival | Plant ht (cm) | Dry wt (mg/plant) |
| Alachlor | 2.25 | 21.8abc[y] | 19.6ab | 380abc |
| Alachlor | 4.49 | 19.8abcde | 19.7ab | 410ab |
| Chlorpropham | 3.37 | 19.3abcde | 16.4d | 370abc |
| Chlorpropham | 6.74 | 17.5def | 11.3ef | 200d |
| Chloroxuron | 2.25 | 21.0abcd | 19.8ab | 390abc |
| Chloroxuron | 4.49 | 19.8abcde | 19.0abc | 390abc |
| DCPA | 6.74 | 18.8bcdef | 17.9bcd | 390abc |
| DCPA | 11.23 | 23.0a | 20.7a | 440a |
| Diphenamid | 4.49 | 21.3abcd | 18.8abc | 370abc |
| Diphenamid | 8.98 | 19.5abcde | 18.0bcd | 290bcd |
| EPTC | 2.25 | 17.8cdef | 12.4e | 280cd |
| EPTC | 4.49 | 11.0g | 10.1f | 270cd |
| Napropamide | 1.12 | 20.0abcde | 19.2abc | 420ab |
| Napropamide | 2.25 | 22.5ab | 19.2abc | 340abc |
| Oryzalin | 1.12 | 21.5abcd | 19.1abc | 350abc |
| Oryzalin | 2.25 | 23.0a | 16.9cd | 300bcd |
| Oxadiazon | 2.25 | 16.8ef | 19.0abc | 390abc |
| Oxadiazon | 4.49 | 15.3f | 18.5abcd | 450a |
| Profluralin | 0.56 | 20.5abcde | 17.9bcd | 370abc |
| Profluralin | 1.12 | 18.3cdef | 19.2abc | 450a |
| Control | - | 21.3abcd | 18.9abc | 380abc |

[z] Means represent 4 replications of 25 seedlings.

[y] Mean separation in columns by Duncan's multiple range test, 5% level.

Table 3. Survival, plant height, and dry weight of *Robinia pseudoacacia* 60 days after planting.[z]

| Treatment | | | | |
|---|---|---|---|---|
| Chemical | Rate (kg a.i./ha) | Survival | Plant ht (cm) | Dry wt (mg/plant) |
| Alachlor | 2.25 | 16.0bcde[y] | 8.0abcd | 170b |
| Alachlor | 4.49 | 15.5cde | 6.7cd | 140b |
| Chlorpropham | 3.37 | 5.3gh | 6.4d | 330ab |
| Chlorpropham | 6.74 | 2.8h | 6.2d | 610a |
| Chloroxuron | 2.25 | 17.5abcd | 10.0ab | 150b |
| Chloroxuron | 4.49 | 15.3cde | 10.0ab | 170b |
| DCPA | 6.74 | 16.3bcde | 9.4abc | 140b |
| DCPA | 11.23 | 17.8abcd | 9.9ab | 240ab |
| Diphenamid | 4.49 | 15.5cde | 8.4abcd | 150b |
| Diphenamid | 8.98 | 11.8ef | 8.5abcd | 240ab |
| EPTC | 2.25 | 18.0abcd | 8.5abcd | 130b |
| EPTC | 4.49 | 20.8ab | 7.9bcd | 90b |
| Napropamide | 1.12 | 16.5bcde | 10.2ab | 130b |
| Napropamide | 2.25 | 13.0de | 9.5abc | 140b |
| Oryzalin | 1.12 | 15.3cde | 6.7cd | 120b |
| Oryzalin | 2.24 | 8.0g | 2.2e | 510ab |
| Oxadiazon | 2.25 | 14.8cde | 9.6ab | 150b |
| Oxadiazon | 4.49 | 16.3bcde | 9.9ab | 130b |
| Profluralin | 0.56 | 21.8a | 10.0ab | 100b |
| Profluralin | 1.12 | 15.8bcde | 10.8a | 180b |
| Control | - | 19.8abc | 10.9a | 150b |

[z] Means represent 4 replications of 25 seedlings.

[y] Mean separation in columns by Duncan's multiple range test, 5% level.

# APPENDIX

Tables 4, 5, and 6 include germination of seeds and final survival data over time for the greenhouse study. Most treatments had increasing seed germination during the experimental period except for the treatments that caused significantly lower seedling survival than the control. Most of these treatments had seeds that germinated, but not all seedlings survived the 60 day period.

Table 4. *Gymnocladus dioicus* germination and final seedling survival.[z]

| Treatment | | Days after planting | | | |
|---|---|---|---|---|---|
| Chemical | Rate (kg a.i./ha) | 5 | 11 | 17 | 60 |
| Alachlor | 2.25 | 0.00a[y] | 12.25bcde | 21.50ab | 24.25a |
| Alachlor | 4.49 | 0.00a | 15.50abcd | 20.50ab | 22.50ab |
| Chlorpropham | 3.37 | 0.00a | 11.50cde | 21.50ab | 22.75ab |
| Chlorpropham | 6.74 | 0.75a | 8.25efg | 20.00ab | 17.75de |
| Chloroxuron | 2.25 | 0.00a | 17.75abc | 23.00a | 24.00a |
| Chloroxuron | 4.49 | 0.25a | 20.00a | 23.50a | 23.75a |
| DCPA | 6.74 | 0.25a | 15.25abcd | 22.50ab | 24.50a |
| DCPA | 11.23 | 0.00a | 16.25abc | 21.00ab | 22.50ab |
| Diphenamid | 4.49 | 0.50a | 21.25a | 22.25ab | 23.25ab |
| Diphenamid | 8.98 | 0.75a | 16.00abc | 18.25b | 22.25ab |
| EPTC | 2.25 | 0.00a | 5.25fg | 14.50c | 17.50de |
| EPTC | 4.49 | 0.75a | 3.25g | 12.00c | 15.75e |
| Napropamide | 1.12 | 0.50a | 12.00cde | 20.25ab | 21.50abc |
| Napropamide | 2.25 | 0.00a | 16.25abc | 21.75ab | 21.75abc |
| Oryzalin | 1.12 | 0.25a | 17.50abc | 21.25ab | 22.75ab |
| Oryzalin | 2.25 | 0.00a | 16.75abc | 21.50ab | 23.25ab |
| Oxadiazon | 2.25 | 0.25a | 12.75bcde | 6.50d | 19.75bcd |
| Oxadiazon | 4.49 | 1.00a | 9.75def | 7.75d | 18.75cde |
| Profluralin | 0.56 | 0.50a | 21.50a | 24.00a | 24.00a |
| Profluralin | 1.12 | 0.00a | 18.50ab | 23.75a | 24.75a |
| Control | - | 0.00a | 17.25abc | 21.50ab | 23.75a |

[z] Means represent 4 replications of 25 seedlings

[y] Mean separation in columns by Duncan's multiple range test, 5% level.

Table 5. Gleditsia triacanthos germination and final seedling survival.[z]

| Treatment | | Days after planting | | | |
|---|---|---|---|---|---|
| Chemical | Rate (kg a.i./ha) | 5 | 11 | 17 | 60 |
| Alachlor | 2.25 | 3.00abc[y] | 23.25ab | 22.25abc | 21.75abc |
| Alachlor | 4.49 | 1.75abc | 20.25ef | 20.00abcde | 19.75abcde |
| Chlorpropham | 3.37 | 2.25abc | 21.75abcdef | 20.50abcd | 19.25abcde |
| Chlorpropham | 6.74 | 0.75bc | 21.00cdef | 20.50abcd | 17.50def |
| Chloroxuron | 2.25 | 1.00abc | 20.75cdef | 20.75abcd | 21.00abcd |
| Chloroxuron | 4.49 | 4.50ab | 22.75abc | 20.25abcde | 19.75abcde |
| DCPA | 6.74 | 2.25abc | 20.50def | 19.00bcdef | 18.75bcdef |
| DCPA | 11.23 | 1.25abc | 23.50a | 23.00ab | 23.00a |
| Diphenamid | 4.49 | 1.50abc | 21.50abcdef | 21.00abcd | 21.25abcd |
| Diphenamid | 8.98 | 2.75abc | 21.25bcdef | 20.75abcd | 19.50abcde |
| EPTC | 2.25 | 1.00abc | 21.50abcdef | 18.25cdef | 17.75cdef |
| EPTC | 4.49 | 0.75bc | 19.75f | 15.25f | 11.00g |
| Napropamide | 1.12 | 2.75abc | 20.75cdef | 20.25abcde | 20.00abcde |
| Napropamide | 2.25 | 1.25abc | 23.25ab | 23.00ab | 22.50ab |
| Oryzalin | 1.12 | 1.00abc | 22.00abcde | 22.25abc | 21.50abcd |
| Oryzalin | 2.25 | 0.25c | 23.25ab | 23.50a | 23.00a |
| Oxadiazon | 2.25 | 5.00a | 22.50abcd | 17.25def | 16.75f |
| Oxadiazon | 4.49 | 3.00abc | 20.50def | 16.25ef | 15.25f |
| Profluralin | 0.56 | 2.25abc | 20.75cdef | 21.75abc | 20.50abcde |
| Profluralin | 1.12 | 2.50abc | 19.75f | 19.00bcdef | 18.25cdef |
| Control | - | 1.75abc | 21.75abcdef | 21.50abcd | 21.25abcd |

[z] Means represent 4 replications of 25 seedlings.

[y] Mean separation in columns by Duncan's multiple range test, 5% level.

Table 6. *Robinia pseudoacacia* germination and final seedling survival.[z]

| Treatment | | Days after planting | | | |
|---|---|---|---|---|---|
| Chemical | Rate (kg a.i./ha) | 5 | 11 | 17 | 60 |
| Alachlor | 2.25 | 1.75abcde[y] | 15.50bcd | 15.25bcd | 16.00bcde |
| Alachlor | 4.49 | 2.00abcde | 17.75abc | 16.75abc | 15.50cde |
| Chlorpropham | 3.37 | 5.25a | 11.75d | 10.25d | 5.25gh |
| Chlorpropham | 6.74 | 1.50bcde | 18.25abc | 18.00abc | 2.75h |
| Chloroxuron | 2.25 | 1.75abcde | 17.00abc | 17.50abc | 17.50abcd |
| Chloroxuron | 4.49 | 4.75abc | 17.75abc | 17.75abc | 15.25cde |
| DCPA | 6.74 | 0.50e | 17.25abc | 15.25bcd | 16.25bcde |
| DCPA | 11.23 | 2.75abcde | 15.25bcd | 18.25abc | 17.75abcd |
| Diphenamid | 4.49 | 2.75abcde | 19.25abc | 19.00abc | 15.50cde |
| Diphenamid | 8.98 | 4.00abcde | 16.75abcd | 15.75bc | 11.75ef |
| EPTC | 2.25 | 2.25abcde | 16.00bcd | 17.25abc | 18.00abcd |
| EPTC | 4.49 | 1.75abcde | 20.00ab | 20.25ab | 20.75ab |
| Napropamide | 1.12 | 4.00abcde | 17.25abc | 16.50abc | 16.50bcde |
| Napropamide | 2.25 | 4.50abcd | 18.75abc | 17.75abc | 13.00de |
| Oryzalin | 1.12 | 1.00de | 19.25abc | 20.25ab | 15.25cde |
| Oryzalin | 2.25 | 1.25cde | 15.75bcd | 15.25bcd | 8.00fg |
| Oxadiazon | 2.25 | 3.75abcde | 14.50cd | 14.25cd | 14.75cde |
| Oxadiazon | 4.49 | 5.00ab | 17.00abc | 15.75bc | 16.25bcde |
| Profluralin | 0.56 | 1.75abcde | 21.75a | 21.75a | 21.75a |
| Profluralin | 1.12 | 4.00abcde | 16.50abcd | 17.00abc | 15.75bcde |
| Control | - | 2.00abcde | 18.50abc | 18.75abc | 19.75abc |

[z] Means represent 4 replications of 25 seedlings.

[y] Mean separation in columns by Duncan's multiple range test, 5% level.

Plate 1. Application of herbicides in greenhouse.

Plate 2. Profluralin (tolban) at 0.56 kg/ha treatment effects on Gymnocladus dioicus.

Plate 3. Chlorpropham (furloe) at 6.74 kg/ha treatment effects on Gymnocladus dioicus.

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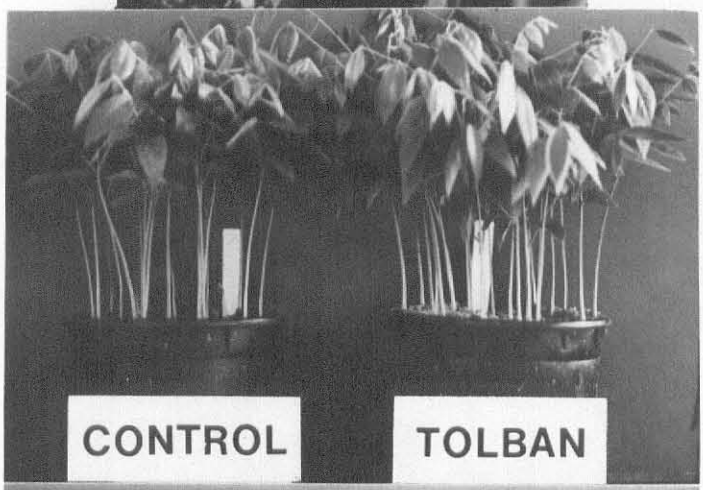

CONTROL
TOLBAN

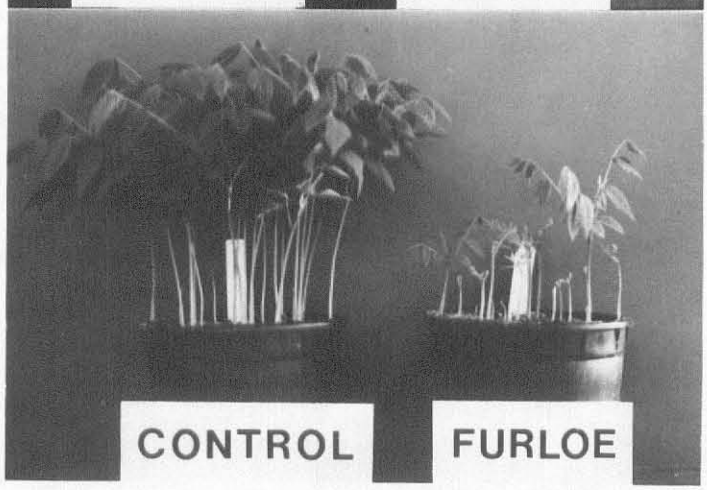
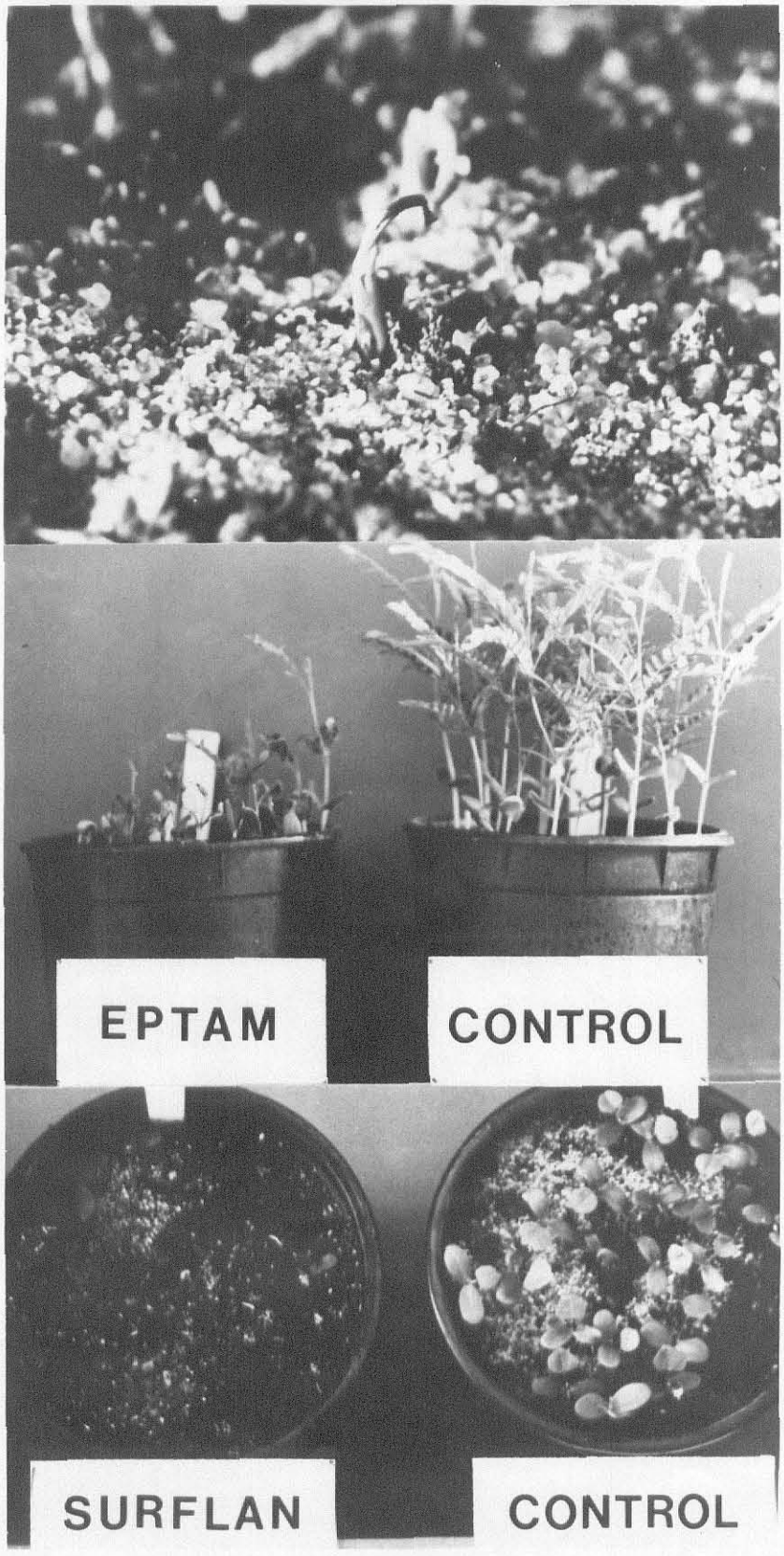

CONTROL
FURLOE

Plate 4. Phytotoxic effects of oxadiazon on Gymnocladus dioicus.

Plate 5. EPTC (eptam) at 4.49 kg/ha treatment effects on Gleditsia triacanthos.

Plate 6. Oryzalin (surflan) at 2.25 kg/ha treatment effects on Robinia pseudoacacia.


EPTAM
CONTROL
SURFLAN
CONTROL

## Growth Chamber Study

A growth chamber study was conducted to test the phytotoxicity of herbicides to germinating seed of Gymnocladus dioicus, Gleditsia triacanthos, and Robinia pseudoacacia.

Seed of each species was scarified in concentrated sulfuric acid ($H_2SO_4$) and was placed on filter paper in glass petri dishes. Chemical stock solutions of each treatment were prepared. A 1 ml aliquot of herbicide was withdrawn and mixed with 5 ml of water. Treatments previously listed (p. 4) were then applied to the seeds of all three species. Another sheet of filter paper was placed on top of seeds to retain moisture. Petri dishes were placed in a Mangelsdorf germinator at 23°C and filter paper was routinely moistened with distilled water until germination.

Herbicide treatments did not affect Gymnocladus germination (Table 7). Treated Gymnocladus seed had 95 to 100% germination in 16 days.

Gleditsia seeds that were treated had 75 to 100% germination in 5 days. Ungerminated seed did not swell and rotted.

Most herbicide treated Robinia seed had 70 to 100% germination in 8 days. Inhibition of Robinia seed germination occurred in the chlorpropham at 6.74 kg/ha treatment. All seeds were swollen but only 25% germinated.

Table 7. Germination of Gymnocladus dioicus, Gleditsia triacanthos and Robinia pseudoacacia in growth chamber.

| Treatment | | Gymnocladus | Gleditsia | Robinia |
|---|---|---|---|---|
| Chemical | Rate (kg a.i./ha) | % germ. | % germ. | % germ. |
| Alachlor | 2.25 | 100 | 95 | 90 |
| Alachlor | 4.49 | 95 | 90 | 100 |
| Chlorpropham | 3.37 | 100 | 100 | 90 |
| Chlorpropham | 6.74 | 100 | 95 | 25 |
| Chloroxuron | 2.25 | 100 | 90 | 100 |
| Chloroxuron | 4.49 | 100 | 95 | 100 |
| DCPA | 6.74 | 100 | 95 | 95 |
| DCPA | 11.23 | 100 | 90 | 95 |
| Diphenamid | 4.49 | 100 | 85 | 100 |
| Diphenamid | 8.98 | 100 | 90 | 90 |
| EPTC | 2.25 | 95 | 95 | 90 |
| EPTC | 4.49 | 95 | 90 | 85 |
| Napropamide | 1.12 | 95 | 75 | 85 |
| Napropamide | 2.25 | 100 | 95 | 95 |
| Oryzalin | 1.12 | 100 | 85 | 100 |
| Oryzalin | 2.25 | 100 | 90 | 100 |
| Oxadiazon | 2.25 | 100 | 80 | 100 |
| Oxadiazon | 4.49 | 95 | 100 | 95 |
| Profluralin | 0.56 | 95 | 85 | 100 |
| Profluralin | 1.12 | 100 | 90 | 100 |
| Control | - | 95 | 85 | 85 |

## Preemergence Herbicides for Seeded Nursery Crops Tested under Field Conditions

Results from the greenhouse study (p. 5) demonstrated that some herbicides applied one day after planting did not decrease seedling survival and growth. The next important factor to be evaluated was seedling survival and effectiveness of weed control under field conditions.

The Chase silty loam soil at the Rocky Ford experimental field was rototilled to remove existing weeds. Scarified seed of Gymnocladus dioicus, Gleditsia triacanthos, and Robinia pseudoacacia, which had been acid treated as in previous experiments (p. 4) was planted at a depth of 2.5, 1.3, and 0.6 cm, respectively. Plots consisted of 40 seeds sown at 10 cm intervals in 1.1 x 3.8 m area with three replications arranged in a randomized block design. Due to space limitations 7 different herbicides were selected per plant species based upon survival and growth results obtained from the greenhouse study. The herbicide treatments in kg/ha included DCPA 11.23, chloroxuron at 2.25, alachlor at 2.25, and profluralin at 0.56 for all three species. Other herbicide treatments for Gymnocladus and Gleditsia plots included napropamide at 2.25, diphenamid at 4.49, and oryzalin at 2.25 kg/ha. EPTC at 4.49 napropamide at 1.12, and oxadiazon at 4.49 kg/ha were the additional herbicides selected for Robinia treatments.

A $CO_2$ constant pressure plot sprayer was used for liquid applications and a drop spreader for the granular herbicide.

Treatments were applied on May 17, at 23°C and less than 8 km/hr wind velocity. Plots were irrigated immediately following herbicide application, and throughout the summer to provide supplemental moisture.

Seedling survival data and weed control evaluations were recorded 60 days after treatment. The weed control rating system was as follows:

| Rating | % Weed Control |
|---|---|
| 0 | 0 |
| 1 | 1- 10 |
| 2 | 11- 20 |
| 3 | 21- 30 |
| 4 | 31- 40 |
| 5 | 41- 50 |
| 6 | 51- 60 |
| 7 | 61- 70 |
| 8 | 71- 80 |
| 9 | 81- 90 |
| 10 | 91-100 |

Herbicide treatments differed in effectiveness of weed control due to variations in weed populations. Weeds in Robinia and Gymnocladus plots were predominately grasses such as Setaria lutescens (Weigel) Hubb., and Digitaria sanguinalis (L.) Scop., while Gleditsia plots had mostly Amaranthus retroflexus L., Abutilon theophrasti Medic., and other

broadleaved weeds.

Gymnocladus seedling survival was not affected by herbicide treatments. However, DCPA, alachlor, and oryazlin were the only herbicides that provided significant weed control (Table 8). These three herbicides controlled 71 to 76% of the weeds in plots under heavy weed pressure.

There was no significant difference in survival among Gleditsia seeds receiving chemical treatments. All herbicide treated plots had fewer weeds than untreated plots. DCPA, oryzalin, and alachlor were most effective in controlling 83 to 100% of the weeds, followed by diphenamid which had 76% weed control. Napropamide, chloroxuron, and profluralin all provided 72% control.

Overall germination of Robinia was low. Only 4% of the seedlings survived in control plots, while 15% of the seedlings were present in DCPA treated plots. Seedling survival in the other treated plots was no different than the control.

Profluralin, napropamide, and chloroxuron provided no better weed control than the untreated plots. EPTC controlled 57% of the weeds, DCPA controlled 77%, and alachlor plots were approximately 82% weed free. Oxadiazon treated plots had 100% weed control, but also had no surviving plants.

In conclusion, DCPA at 11.23, alachlor at 2.25, and oryzalin at 2.25 kg/ha provided acceptable weed control with no decrease in survival of Gymnocladus and Gleditsia seedlings. These herbicides applied 1 day after planting may reduce the costly hand weeding associated with direct-seeded

tree production. However further information concerning subsequent growth is necessary before herbicides are recommended. Results from Robinia seedlings were inconclusive due to poor germination.

Table 8. Survival and weed control ratings for field study.

| Treatment | | % seedling survival | Weed control rating[z] |
|---|---|---|---|
| Chemical | Rate (kg a.i./ha) | | |
| | *Gymnocladus dioicus* | | |
| Alachlor | 2.25 | 92.50a[y] | 8.50a |
| Chloroxuron | 2.25 | 95.83a | 0.00b |
| DCPA | 11.23 | 92.50a | 8.67a |
| Diphenamid | 4.49 | 92.50a | 2.00b |
| Napropamide | 2.25 | 86.67a | 1.67b |
| Oryzalin | 2.25 | 93.33a | 8.00a |
| Profluralin | 0.56 | 82.50a | 0.00b |
| Control | - | 85.00a | 0.00b |
| | *Gleditsia triacanthos* | | |
| Alachlor | 2.25 | 72.50a | 9.33ab |
| Chloroxuron | 2.25 | 69.17a | 7.17b |
| DCPA | 11.23 | 65.00a | 10.00a |
| Diphenamid | 4.49 | 71.67a | 8.67ab |
| Napropamide | 2.25 | 70.83a | 7.17b |
| Oryzalin | 2.25 | 60.00a | 9.50ab |
| Profluralin | 0.56 | 71.67a | 7.17b |
| Control | - | 63.33a | 0.67c |

Table 8. continued

| Treatment | | % seedling survival | Weed control rating[z] |
|---|---|---|---|
| Chemical | Rate (kg a.i./ha) | | |
| | *Robinia pseudoacacia* | | |
| Alachlor | 2.25 | 3.33bc | 9.17a |
| Chloroxuron | 2.25 | 8.33abc | 0.50c |
| DCPA | 11.23 | 15.00a | 8.67ab |
| EPTC | 4.49 | 4.17bc | 6.67b |
| Napropamide | 1.12 | 8.33abc | 1.67c |
| Oxadiazon | 4.49 | 0.00c | 10.00a |
| Profluralin | 0.56 | 11.67ab | 2.17c |
| Control | - | 4.17bc | 0.00c |

[z] 0 (no weed control) to 10 (total weed control).

[y] Mean separation in columns by Duncan's multiple range test, 5% level.

# PREEMERGENCE HERBIDICES FOR SEEDED NURSERY CROPS

by

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AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Horticulture

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1980

Ten preemergence herbicides were applied to the soil surface of nursery containers 1 day after planting seeds of Gymnocladus dioicus (L.) K. Koch, Gleditsia triacanthos L., and Robinia pseudoacacia L. to test herbicide effects on seedling survival and growth. Herbicide treatments in kg/ha were alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide) at 2.25 and 4.49, chlorpropham (isopropyl m-chlorocarbanilate) at 3.37 and 6.74, chloroxuron (3-[p-(p-chlorophenoxy)phenyl]-1,1-dimethylurea) at 2.25 and 4.49, DCPA (dimethyl tetrachloroterephthalate) at 6.74 and 11.23, diphenamid (N,N-dimethyl-2,2-diphenylacetamide) at 4.49 and 8.98, EPTC (S-ethyl dipropylthiocarbamate) at 2.25 and 4.49, napropamide (2-(α-naphthoxy)-N,N-diethylpropionamide) at 1.12 and 2.25, oryzalin (3,5-dinitro-$N^4$,$N^4$-dipropylsulfanilamide) at 1.12 and 2.25, oxadiazon (2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-$\Delta^2$-1,3,4-oxadiazolin-5-one) at 2.25 and 4.49, and profluralin (N-cyclopropylmethyl)-α,α,α-trifluoro-2, 6-dinitro-N-propyl-p-toluidine) at 0.56 and 1.12. Species varied in response to herbicides, with Robinia most affected by treatments. Most herbicides did not reduce seedling survival, plant height, or dry weight.