HERBICIDE WEED CONTROL RESULTS IN PINE SEEDBEDS 1/

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Abstract--Several pre- and post-emergent herbicides were tested throughout the Southeast from 1974 to 1976 in seedbeds of loblolly, slash, shortleaf, longleaf, and eastern white pine. Seedling tolerance, weed control, and relative costs are discussed.

Additional Keywords: Nursery, seedling tolerance, cost comparisons, Pinus taeda, P. elliottii P. echinata, P. palustris, P. strobes

INTRODUCTION

Since 1973, efforts of the Cooperative Forest Nursery Weed Control Project have been directed toward establishing efficacy data for use in label applications. Although good tolerance data for several herbicides are available, only diphenamid (Enide 50W) has been registered for pre-emergent use on loblolly (Pinus taeda L.) and slash pine (Pinus elliottii Englem.) seedbeds (Carter and Dill, 1972; Crowley, 1974). By no means can this one herbicide do the job required at all nurseries. Diphenamid provides control of most grasses and a few broadleaf weeds but is usually effective only for early-season weed control at most nurseries in the Southeast. Testing of herbicides that control the weeds for longer periods was stressed during 1975 and 1976. This report covers the principal highlights and conclusions from the past three years.

MATERIALS AND METHODS

In 1974 and 1975, uniform pre-emergent studies were conducted involving nine states and ten state nurseries. Twelve herbicide treatments with two controls (plot size 6 feet by 50 feet) were arranged in a randomized complete block design with four replications at each nursery. Herbicides were applied with a backpack CO_2 sprayer after seeding and mulching. Seedbeds were irrigated with 1/2 to 3/4 inch of water immediately after spraying. Hand-weeding times were recorded to evaluate weed control. At the end of the growing season, seedling samples were counted and weighed to evaluate tolerance for each treatment.

The 1974 pre-emergent treatments consisted of: diphenamid (see Table 1 for chemical names) at 4 lb ai/A (active ingradient per acre), trifluralin (Treflan) at 1 lb ai/A, butralin (Amex-820) at 2 and 4 lb ai/A, napropamide (Devrinol) at 3 and 6 lb ai/A, bifenox (Modown) at 1.5 and 3 lb ai/A, oryzalin (Surflan) at 1 and 2 lb ai/A, and profluralin (Tolban) at 1 and 2

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lb ai/A. The pine species treated in 1974 were loblolly at 6 locations, slash at 2 locations, shortleaf (Pines echinata Mill.) at 1 location, longleaf (P. palustris Mill.) at 1 location, and eastern white (P. strobus L.) at 1 location.

The 1975 pre-emergent treatments were: diphenamid at 4 lb ai/A, trifluralin at 1 lb ai/A, butralin at 3 and 6 lb ai/A, bifenox at 3 and 6 lb ai/A, napropamide at 1.5 and 3 lb ai/A, dinitramine (Cobex) at 0.33 and 0.66 lb ai/A, a combination of diphenamid (4 lb ai/A) with bifenox (3 lb ai/A) and a combination of napropamide (1 lb ai/A) with bifenox (3 lb ai/A). The species treated in 1975 were the same as in 1974 except that no longleaf and only 5 locations of loblolly were treated.

Post-emergent studies were conducted in 1975 with bifenox at 2 and 4 lb ai/A at 2 locations and DPX-3674 (Velpar) at 0.5, 1, 2, and 4 lb ai/A at 3 locations. Treatments were applied to loblolly and slash pine seedbeds 3 to 10 weeks after the seedlings emerged. Cyperquat was tested in the same manner at 1 and 3 lb ai/A on slash pine.

The 1976 post-emergent treatments were: chloramben (ornamental weeder 4G) at 4 and 8 lb ai/A, perfluidone (Destun 5G) at 1 and 2 lb ai/A, oxadiazon (Ronstar 2G) at 2 and 4 lb ai/A, prometryne (Caparol) at 1 and 2 lb ai/A (with a surfactant), and bifenox at 2 and 4 lb ai/A (with and without a surfactant). The pine species treated were loblolly at 5 locations, slash at 2 locations, and eastern white at 1 location.

RESULTS AND DISCUSSION

Uniform Pre-Emergence Herbicide Experiment

In the 1974 and 1975 uniform screening experiments, significant weed control was demonstrated by most herbicides at most locations at the first handweeding (Table 2). The only exceptions were in situations where weed populations on the control plots were too low to provide valid contrasts or where heavy rains eliminated treatment effects. Many pre-emergent treatments provided entire growing-season weed control during both years.

Table 2 shows that trifluralin at 1 lb ai/A and diphenamid at 4 lb ai/A gave good early-season weed control but failed to give entire growing-season control. Neither herbicide significantly reduced seedling production.

In 1974, bifenox at 1.5 and 3 lb ai/A provided good early-season weed control and gave longer control than diphenamid or trifluralin. Since no injury was observed for either rate in 1974, 3 and 6 lb ai/A rates were tested in 1975. No reduction in seedling yields were observed at either rate except at one North Carolina nursery, where the 6 lb rate reduced seedling density of eastern white pine. This reduction was too slight to be detected visually and is not considered serious. Excellent early and full season weed control resulted from both rates of bifenox applied in 1975. Preliminary results from 1976 also indicate excellent entire growing-season weed control (Figure 3).

Butralin in 1974 at 2 and 4 lb ai/A gave very good early- and entire growing-season weed control with no seedling injury (Table 2). In 1975, 3 and 6 lb ai/A rates gave excellent early-season weed control and 70-80%

entire growing-season control. Seedling yields were not reduced at any nursery at the low rate, and only one nursery showed a reduction **in** yield at the high rate.

In 1974, napropamide at 3 and 6 lb ai/A gave excellent early- and entire growing-season weed control. Seedling production was only slightly affected by the 3 lb ai/A rate, but severe stunting was noted in the 6 lb ai/A plots. The 1975 tests showed no injury at the 1.5 lb ai/A rate, which provided excellent early- and entire growing-season weed control. Slight injury was noted visually at two nurseries with the 3 lb ai/A rate, but fresh weights and densities were not statistically different from the controls.

Oryzalin was tested in 1974 at 1 and 2 lb ai/A and gave excellent early- and entire growing-season weed control. However, tolerance to oryzalin at both rates was judged to be unacceptable in all pine species tested.

In 1974, profluralin was tested at 1 and 2 lb ai/A and gave good early-season weed control but only fair entire growing-season control. Neither rate significantly affected southern pine seedling production.

Dinitramine at the .33 and .66 lb ai/A was tested in 1975 and produced very good early-season weed control and good entire growing-season control. No seedling injury was observed with either rate of dinitramine. Injury has been reported when 1 lb ai/A of dinitramine was incorporated into the soil before seeding (Barr and Merkle, 1976).

A combination of napropamide at 1 lb ai/A and bifenox at 3 lb ai/A was tested in 1975 with outstanding results. Early-season weed control was excellent, averaging 92% weed control. Entire growing-season weed control was also excellent, averaging 87% control. No seedling injury was observed on pines with this treatment. This treatment was shown to be most effective at nurseries with different soil textures (Figures 1 and 2).

In 1975, diphenamid at 4 lb ai/A and bifenox at 3 lb ai/A gave excellent early-season and very good entire growing-season control (Table 2). No reduction in seedling production was observed.

Post-Emergent Herbicide Experiments

In 1975, a post-emergent herbicide that controls nutsedge was tested at one location on slash pine. Cyperquat applied at 1 and 3 lb **ai/A** resulted in no seedling injury.

Excellent entire growing-season weed control resulted from DPX-3674 at 0.5, 1, 2, and 4 lb ai/A, but all rates caused severe seedling injury.

In 1975, post-emergent application of bifenox at 2 and 4 lb ai/A gave excellent weed control with no seedling injury. At one nursery, 90% weed control was obtained with both rates.

Preliminary results from the 1976 tests indicate no seedling injury with bifenox at 2 and 4 lb ai/A (with or without a surfactant). Excellent weed control was obtained with both rates (Figure 4).

Prometryne at 1 and 2 lb ai/A with a surfactant seemed to provide good weed control in 1976, but seedling injury was observed at the 2 lb ai/A rate.

The granular form of perfluidone at 1 and 2 lb ai/A provided little weed control when applied post-emergent on a sandy soil (Figure 4). Chlorosis of pine seedlings was noticed at the 2 lb ai/A rate at several nurseries.

Granular chloramben at 4 and 8 lb ai/A provided only slight weed control; stunted seedlings were noticed at several nurseries.

Granular oxadiazon at 2 and 4 lb ai/A appears to be the best of the three granular herbicides tested in 1976. Excellent control of Cyperus compressus L. has been observed. Tolerance was good with slash and loblolly pine although severe injury occurred with fraser fir (Abies fraseri Pair.).

COST COMPARISONS AT ONE NURSERY

In 1975, the southeastern forest nurseries expended more than $410,000 for handweeding labor and more than $170,000 for mineral spirits. Approximately 63% of the production acres were treated with methyl bromide at a cost of over $370,000. State nurseries were spending an average of $462 per acre for handweeding and $157 per acre for mineral spirits. Private nurseries were spending an average of $181 per acre for handweeding and $127 per acre for mineral spirits.

In 1976, several studies were conducted at the Coastal Nursery in South Carolina. Cost evaluations were made among areas with normal nursery practice and areas involving experimental herbicides (Figure 5). The normal nursery practice involves a pre-plant and post application of trifluralin with additional applications of mineral spirits. When methyl bromide was used in addition to this practice, the handweeding cost was reduced by $250 per acre. Therefore, the additional cost of $600 per acre for fumigation was only partially offset by a savings in weeding time at this nursery.

The lowest weeding times for the first handweeding were obtained by using the herbicides napropamide and bifenox. The area treated with methyl bromide and trifluralin required tenfold more weeding time.

Two weeks before the third handweeding, a post-emergent application of bifenox was applied to one of the treatments of napropamide and bifenox. This treatment (when compared to the area treated only with a pre-emergent application of napropamide and bifenox) would cost an additional $12 per acre for chemicals but would save approximately $122 per acre in handweeding costs. Although this treatment is the least expensive of those shown in Figure 5, an even greater savings could be achieved by applying the post-emergent herbicide earlier and in combination with an effective pre-emergent grass herbicide.

SUMMARY

A number of pre- and post-emergent herbicides were tested from 1974 to 1976 in seedbeds of loblolly, slash, shortleaf, longleaf, and eastern white pine. When applied shortly after sowing, satisfactory tolerances were obtained with diphenamid at 4 lb ai/A, with butralin at 2, 3, 4, and 6 lb ai/A,

with napropamide at 1.5 lb ai/A, with profluralin at 1 and 2 lb ai/A, with dinitramine at 0.33 and 0.66 lb ai/A, and with combinations of napropamide at 1 lb ai/A and bifenox at 3 lb ai/A, and of diphenamid at 4 lb ai/A and bifenox at 3 lb ai/A. Napropamide at 6 lb ai/A and oryzalin at 1 and 2 lb ai/A caused severe stunting. The best results, in regard to both seedling tolerance and weed control, were obtained with the combination of napropamide at 1 lb ai/A with bifenox at 3 lb ai/A.

Post-emergent applications of Velpar at 0.5, 1, 2, and 4 lb ai/A caused severe seedling mortality. Post-emergent applications of bifenox at 2 and 4 lb ai/A gave excellent weed control with no seedling injury. Cyperquat, a post-emergent nutsedge herbicide, resulted in no injury when applied at 1 and 3 lb ai/A.

The cost of methyl bromide, mineral spirits, and handweeding to the Southeastern forest nurseries approached one million dollars in 1975. If the effective pre- and post-emergent herbicides reported here are registered for use, a savings of over $250,000 per year would be possible.

ACKNOWLEDGMENTS

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PESTICIDE PRECAUTIONARY STATEMENT

This paper reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State or Federal agencies before they can be recommended. Caution: Pesticides can be injurious to human, domestic animals, desirable plants, and fish or other wildlife--if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

Table 1. Chemical identification of some herbicides evaluated by the Cooperative Forest Nursery Weed Control Project

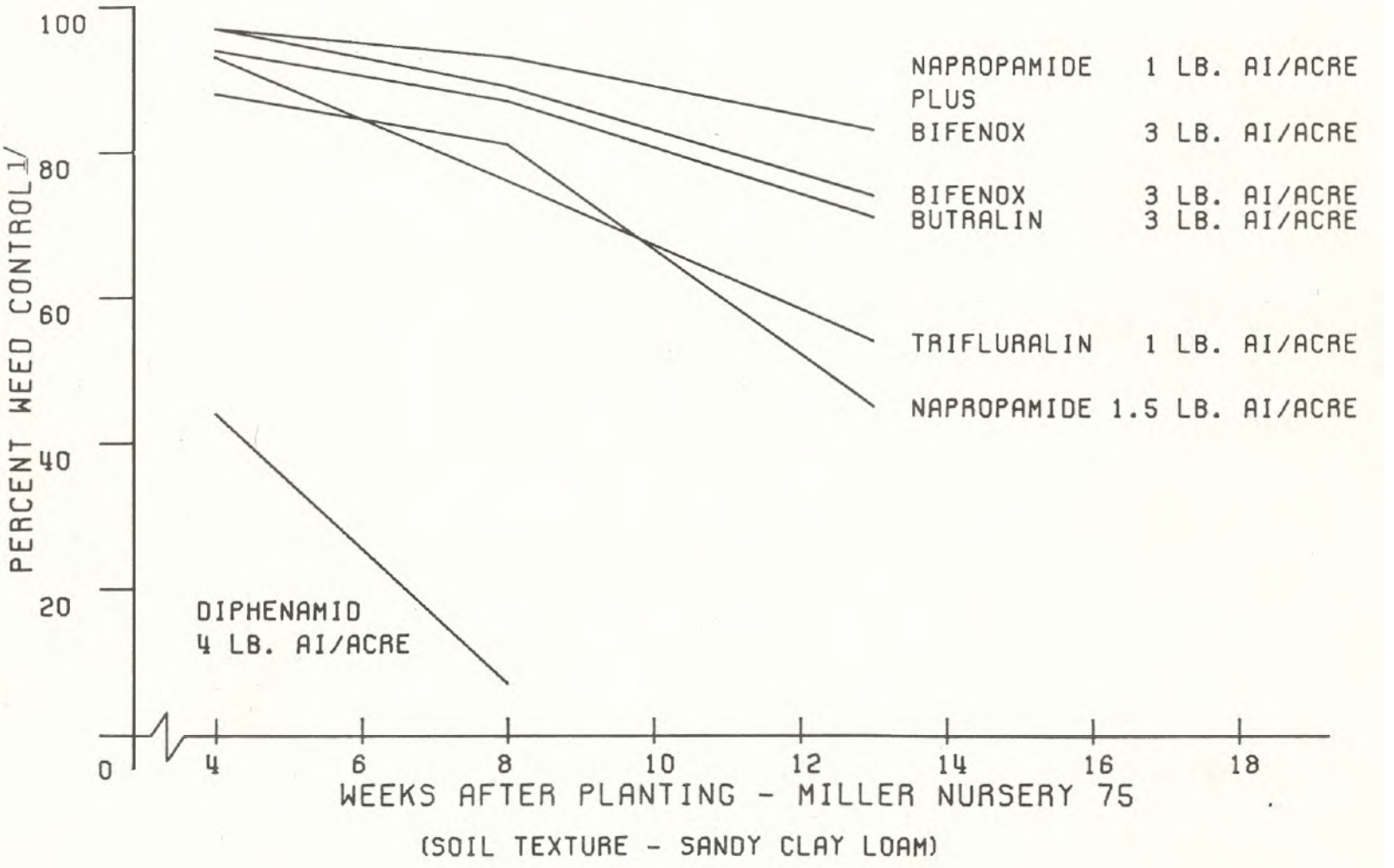
Common Name of Designation	Formulation	Trade Name and Manufacturer	Chemical Name
bifenox	80 WP 2 EC	Modown Mobil Chemical	Methyl 5-(2,4-dichlorophenoxy)-2-nitrobenxoate
butralin	4 EC	Amex-820 Amchem Products	(4-(1,1-dimethylethyl)-N-(1-methyl-propy1)-2,6-dinitrobenzenamine)
chloramben	4 G	Ornamental Weeder Amchem Products	**3-amino-2,5-dichlorobenxoic acid**
cyperquat	3 EC	Gulf Oil Chem. Co.	**1-methyl-4-phenylpyridinium chloride**
dinitramine	2 EC	Cobex U.S. Borax Corp.	**N**^{4},N^4-diethyl-a,a,a-trifluoro-3,5-dinitrotoluene-2,4-diamine
diphenamid	50 WP	Enide Tuco Products	N,N-dimethy1-2,2-diphenylacet-amide
napropamide	50 WP 2 EC	Devrinol Stauffer Chemical	2-(a-naphthoxy)-N,N-diethyl-propionamide
oxadiazon	2 G	Ronstar Rhodia	2-tert-buty1-4-(2,4-dichloro-5-isopropoxypheny1)-A2-1.3.4-oxadiaxolin-5-one
oryzalin	75 WP	Surf lan Elanco Products Co.	3,5-dinitro-N^4,N^4-dipropyl-sulfanilamide
perfluidone	5 G	Destun 3-M Co.	1,1,1-trifluoro-N-[2-methy1-4-(phenylsulfonyl)phenyl]methane-sulfonamide
profluralin	4 EC	Tolban CIBA-Geigy Corp.	N-(cyclopropylmethyl)-a,a,a-trifluro-2,6-dinitro-N-propyl-p-toluidine
prometryne	80 WP	Caparol CIBA-Geigy Corp.	2,4-bis(isopropylamino)-6-methylthio-s-triazine
trifluralin	4 EC	Treflan Elanco Products Co.	a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine
DPX- 36 74	90 WP	Velpar Dupont Co.	3-cyclohexy1-6-(dimethylamino)-l-methyl-s-triazine-2,4-(1H,3H)-dione

Table 2. Summary of Pre-Emergent Herbicide Application at Seven Southeastern Forest Nurseries during 1974-1975.

Herbicide	Rate lb. ai/A	1974 % Weed Control 1/ EARLY SEASON	1974 % Weed Control 1/ TOTAL SEASON	1974 Injury # of Locations	1975 % Weed Control 1/ EARLY SEASON	1975 % Weed Control 1/ TOTAL SEASON	1975 Injury # of Locations
diphenamid	4.0	64	35	0	71	52	0
trifluralin	1.0	53	31	0	75	55	0
bifenox	1.5	65	42	0			--
	3.0	79	56	0	90	78	0
	6.0				92	82	1
butralin	2.0	69	43	0			--
	3.0	--			84	70	0
	CO	84	58	0		--	
	6.0	--			86	80	1
napropamide	1.5				89	90	0
	3.0	84	63	3	93	89	2
	6.0	87	75	7			
oryzalin	1.0	83	66	7	--		
	2.0	90	75	7			
profluralin	1.0	56	35	0	--		
	2.0	75	46	0			
napropamide & bifenox	1.0 & 3.0	--	--		92	87	0
diphenamid & bifenox	4.0 & 3.0		--	--	90	81	0
dinitramine	.33				80	60	0
	.66				88	73	0

1/ % weed control = [1-(handweeding time for herbicide treatment -:- handweeding time for control)] X 100.

FIGURE 2. - PREEMERGENCE WEED CONTROL IN SLASH PINE SEEDBEDS - 1975



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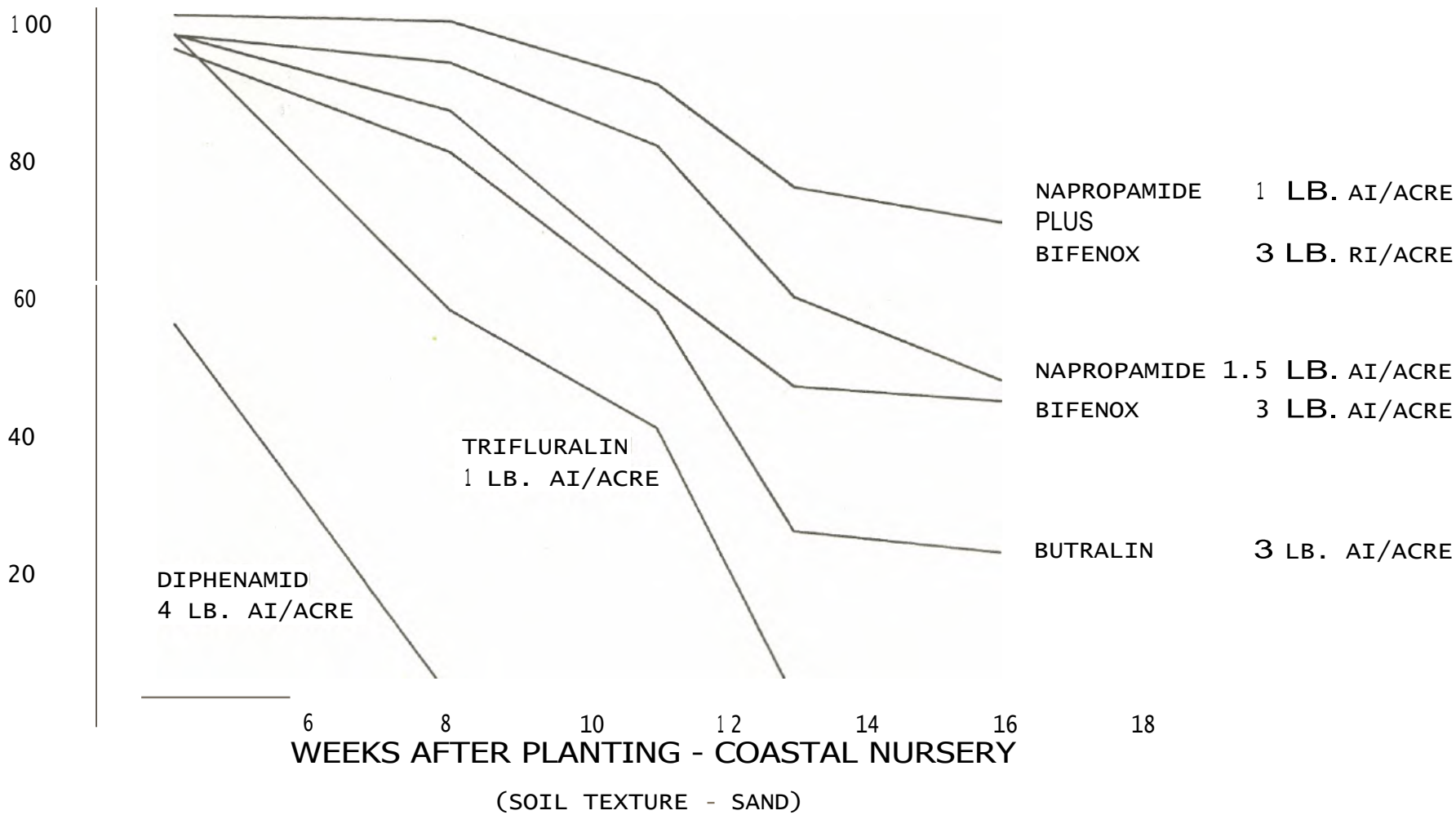
1/ % weed control = [1-(handweeding time for herbicide treatment ÷ handweeding time for control)] X 100.

FIGURE 1. - PREEMERGENCE WEED CONTROL IN LOBLOLLY PINE SEEDBEDS - 1975



1/ % weed control = 11-handweeding time for herbicide treatment / handweeding time for control)] X 100.

FIGURE 3. PRE-EMERGENCE WEED CONTROL IN LOBLOLLY PINE SEEDBEDS AT COASTAL NURSERY 1976

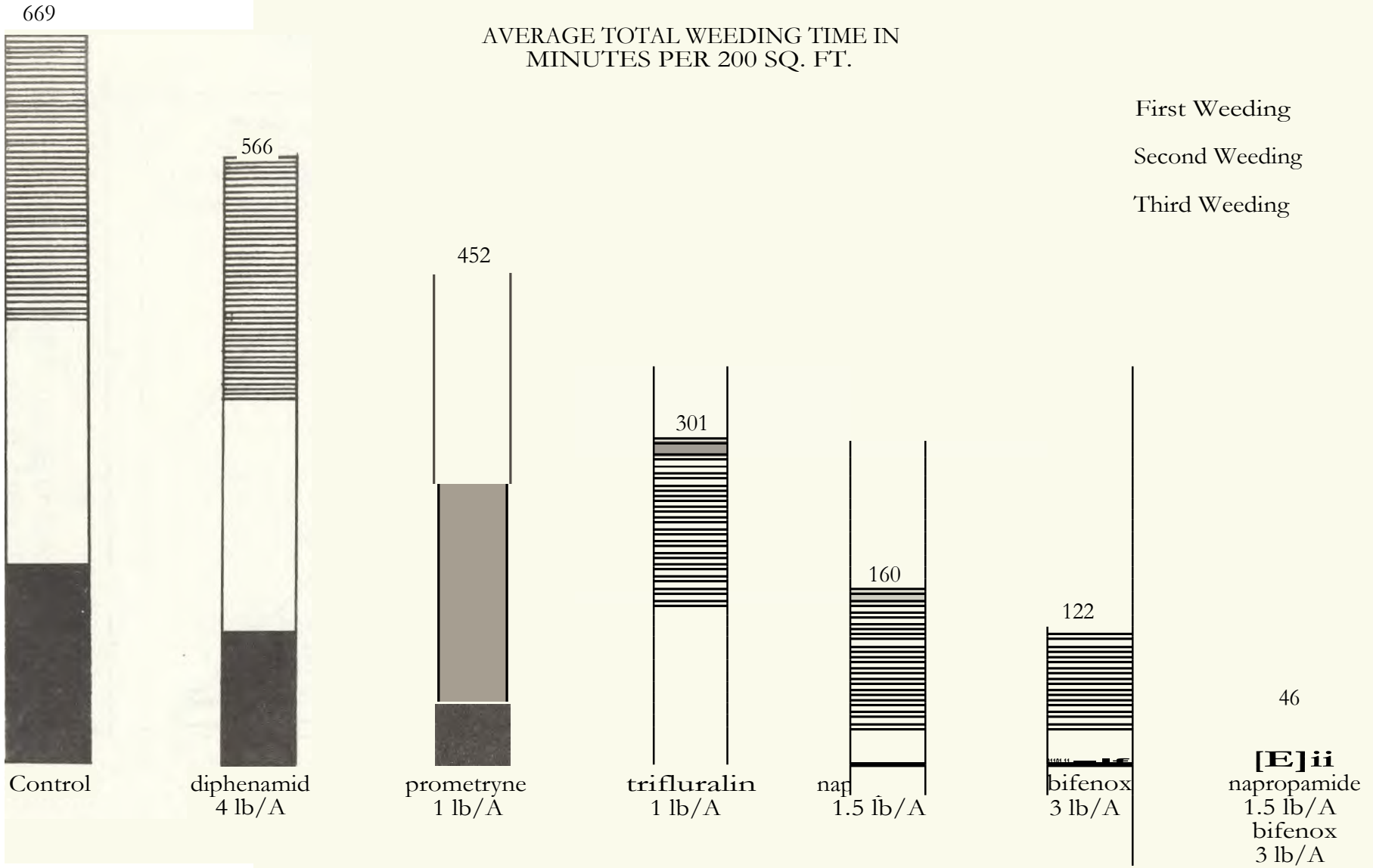


FIGURE 4. POST-EMERGENCE WEED CONTROL IN LOBLOLLY PINE SEEDBEDS AT COASTAL NURSERY 1976

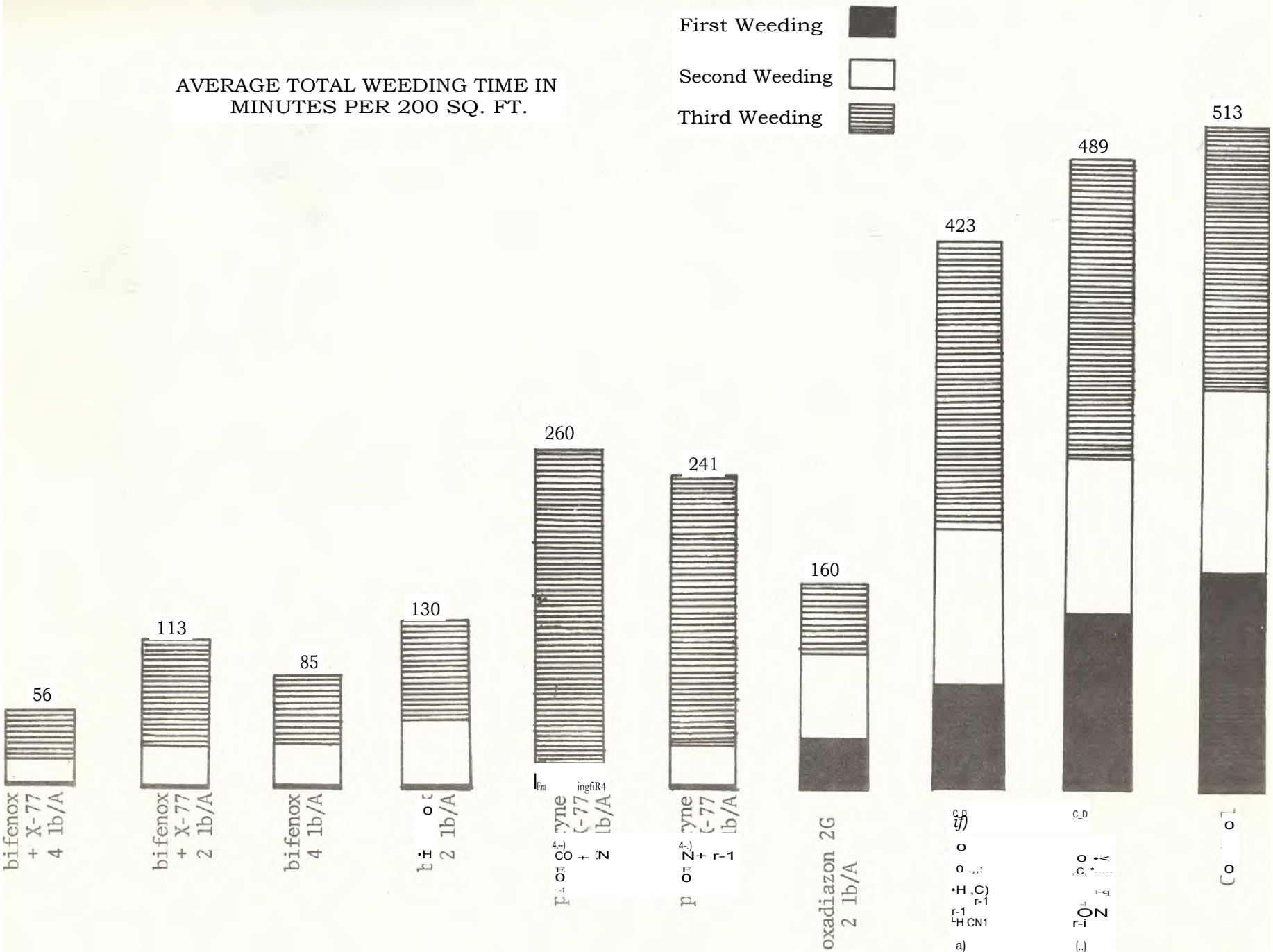


FIGURE S. TREATMENT COSTS PER ACRE

Hand Labor (@ 2.40/hr.)	$395	$273	$106	$354	$2980
Soil Fumigation	$ 0	$ 0	$600	$ 0	$ 0
Mineral Spirits	$ 0	$ 0	$ 40	$ 40	$ 0
Herbicides	$ 30	$ 42	$ 29	$ 29	0
TOTAL	$425	$315	$775	$423	$2980

COASTAL NURSERY - COMPARISON OF TREATMENTS FROM SEVERAL STUDIES