may been due to one or more of the following reasons: 1) carryover effect of the herbicide; 2) more seed in untreated pots as a result of the greater *Phyllanthus* population; 3) cooler temperatures that inhibited growth of both species.

Dithiopyr (3.4 kg ai/ha) and oxadiazon (4.5 kg ai/ha) provided the best control of *Phyllanthus*. Oxadiazon provided slightly better control based on visual observations although this conclusion was not clearly evident from the quantitative data. The preemergent activity of oxadiazon on both *Phyllanthus* species concurs with previous studies (Stamps, 1991; Stamps and Poole, 1987; Wehtje et al., 1992). In those three studies, oxadiazon was the common ingredient which provided preemergent control of *Phyllanthus*.

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RESPONSE OF CONTAINER GROWN SEA OATS TO SELECTED PREEMERGENCE HERBICIDES

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Abstract. **Experiments were conducted in 1988 and 1989 to evaluate preemergence herbicides for phytotoxicity to container grown sea oats (*Uniola peniculata*). Twenty-three herbicides, each applied twice, were evaluated in the first experiment and, of these, chloramben, diethatyl ethyl, napropamide, EPTC, and oryzalin were considered too injurious for further consideration. The remaining 18 were further evaluated for phytotoxicity in the 1989 experiment. Plant height was only slightly affected by herbicide treatment, whereas the effect on shoot fresh weight was greater. Diuron, metribuzin, pendimethalin, fluometralin, prodiamine, pyrazon, oxadiazon, oryzalin + oxyfluorfen, and trifluralin reduced shoot fresh weight compared to no herbicide in the 1989 experiment. There were no significant differences among the remaining herbicides; however, from a purely numerical perspective ethofumesate produced the most shoot growth (weight). The diverse genetic background of commercially available sea oats made evaluation difficult because plant form and growth varied greatly.**

Sea oats is a salt tolerant, perennial grass indigenous to sand dunes and other coastal areas from Virginia to Florida and Gulf coast states (Barrick, 1979; Barnett and Crewz, 1991). It is the most important and commonly occurring grass plant in southern coastal dune environments (Craig, 1984). Sea oats have become increasingly more important for use in beach restoration and stabilization due to salinity and drought tolerance (Salmon et al., 1982).

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Since sea oats are a protected species, plant production consists of plant division and collection of seed by permit from selected areas of Florida and culture of the resultant seedlings in containerized nurseries. Production of plants from seed is limited by low germination rates and high seedling mortality under natural conditions (Craig, 1984). Improvements in seedling production have been observed where cultural conditions are improved. Unlike most cultivated crops which have been bred for certain characteristics over the years, sea oats still are genetically diverse. Also, there apparently are differences in viability and vigor within a seed lot. As a result, there appears to be a wide range of response to any factors, such as fertility and herbicides.

One of the problems in containerized production of sea oats is weed control (Otto Bundy, personal communication). Hand labor is expensive and herbicides have produced mixed results. Although much is known about the ability of a given herbicide to control certain weed species, nothing has been reported in the literature about the response of sea oats to specific herbicides. This research was conducted to provide preliminary information about growth effects of selected preemergence herbicides on container-grown sea oats when grown from seed.

Materials and Methods

Two experiments were conducted with recently transplanted sea oats which had been grown from seed in 2.5 cm square cells in styrofoam plant trays. The first experiment was during the fall of 1988 and the second was in the spring of 1989. The common and trade names of the herbicides evaluated are provided in Table 1. In each experiment, seedlings were transplanted into one gallon plastic containers filled with a soilless mix, consisting of 2:1:1 by volume of Florida peat, builder's sand, and coarse vermiculite amended with dolomite and hydrated lime to adjust the pH to about 6.0. Two applications of each herbicide were made over the top of the plants to the pot surface in each experiment. A handweeded, untreated control treatment was included in each experiment. The experimental design was a randomized complete block for both experiments with 6 replications in 1988 and 20 replications in 1989. The first experiment was initiated 30 Sept 1988 with treatments (Table 2) applied 30 Sept and 1 Dec

Table 1. Common and trade names of herbicides evaluated on sea oats.

Common name	Trade name	Common name	Trade name
Choramben	Amiben	Oxyfluorfen + Pendimethalin	OH-2
Diethatyl ethyl	Antor		
DCPA	Dacthal	Metolachlor	Pennant
Napropamide	Devrinol	Fluometralin	Premier
Isoxaben	Gallery	Simazine	Princep
EPTC	Eptam	Prodiamine	Blockade
Oxyfluorfen	Goal	Pendimethalin	Prowl
Diuron	Karmex	Pyrazon	Pyramin
Pronamide	Kerb	Oxadiazon	Ronstar
Alachlor	Lasso	Oryzalin + Oxyfluorfen	Rout
Metribuzin	Sencor/ Lexone		
Ethofumesate	Nortron	Trifluralin	Treflan

1988. The second experiment was begun 7 March 1989 with the first application of herbicide (Table 3) and the second application followed on 18 April 1989. Liquid spray preparations were applied with a CO_2 back pack sprayer equipped with a two nozzle boom and calibrated to deliver 234 liters/ha. Granular herbicides were applied manually as preweighed samples. Plants were grown in containers on black polyethylene film and were watered as needed with overhead sprinklers to provide 1.2 cm of water. Fertility was supplied by application of slow release fertilizer (Osmocote 14N-6.2P-11.6K [14-14-14], 3 to 4 month formulation, 10 g per container) prior to each herbicide application. Overhead irrigation was supplied immediately following completion of each herbicide application to remove

Table 2. Effect of one or two applications of preemergence herbicides on the increase in plant height and root and shoot weight of sea oats in the first experiment. Fall 1988.

Treatment	Rate (kg/ha)	Height increase (cm)[z] 1 Appl.	2 Appl.	Shoot wt (g)	Root wt (g)
Untreated	—	32	67	45	11
Choramben	3.4	3*	33*	20*	12
Diethatyl ethyl	2.2	18	45	36	8
DCPA	9.0	32	54	37	12
Napropamide	2.2	12*	32*	28*	6
Isoxaben	1.1	31	66	54	14
EPTC	5.6	4*	27*	24*	8
Oxyfluorfen	0.6	27	64	39	10
Diuron	2.2	42	70	37	9
Pronamide	2.2	8*	49	37	9
Alachlor	1.7	21	62	33	10
Metribuzin	0.6	20	46	45	12
Ethofumesate	1.7	17	59	43	12
Oxyfluorfen +	2.2	35	66	38	14
Pendimethalin	1.1				
Metolachlor	1.1	11*	41	37	10
Fluometralin	1.1	18	49	40	15
Simazine	1.1	21	51	40	14
Prodiamine	2.2	10*	24*	30	4*
Pendimethalin	1.1	33	73	42	12
Pyrazon	2.2	16	57	30	11
Oxadiazon	2.2	18	44	37	13
Oryzalin +	1.1	17	44	37	9
Oxyfluorfen	2.2				
Oryzalin	2.2	4*	37*	34	6*
Trifluralin	1.1	20	57	42	11

[z]Height increase represents the amount of increase in plant height over the indicated time interval and not the actual height of the plant.
*Comparison of individual treatment means with the untreated control by Dunnett's 1 sided procedure were either significant (*) or nonsignificant (no symbol) at the 5% level of significance.

Table 3. Effect of two applications of preemergence herbicides on the increase in plant height and shoot weight of sea oats in the second experiment. Spring 1989.

Treatment	Rate (kg/ha)	Height increase[z] (cm)	Shoot wt (g)
Untreated	—	68	70
DCPA	9.0	66	59
Isoxaben	1.1	68	63
Oxyfluorfen	0.6	87	62
Diuron	2.2	75	44*
Pronamide	2.2	67	61
Alachlor	1.7	72	60
Metribuzin	0.6	62	48*
Ethofumesate	1.7	83	76
Oxyfluorfen +	2.2	79	60
Pendimethalin	1.1		
Metolachlor	1.1	49	40*
Fluometralin	1.1	66	50*
Simazine	1.1	71	57
Prodiamine	2.2	52	37*
Pendimethalin	1.1	79	66
Pyrazon	2.2	56	39*
Oxadiazon	2.2	68	42
Oryzalin +	1.1	68	33*
Oxyfluorfen	2.2		
Trifluralin	1.1	57	45*

[z]Height increase represents the amount of increase in plant height over the indicated time interval and not the actual height of the plant.
*Comparison of individual treatment means with the untreated control by Dunnett's 1 sided procedure were either significant (*) or nonsignificant (no symbol) at the 5% level of significance.

the herbicide from the plant foliage and move it into the soil.

Plant height (experiments 1 and 2) and numbers of leaves and tillers (experiment 1) were determined at the time of test initiation, prior to the second application of herbicide, and at the end of the experiment. These data were used to determine increases in the specified growth parameters during each experiment by comparing data from the most recent observations with that from the previous determination. For example, data for increase in plant height represent the amount of height increase over time, not the actual height of the plant. Fresh weights of roots (experiment 1) and shoots (experiment 1 and 2) were also determined at the end of each experiment. Data were analyzed by analysis of variance and each treatment mean was compared against the mean of the untreated control using Dunnett's one sided test at the 5% level of significance to determine those treatments which reduced plant growth relative to no herbicide. Those treatments in the second experiment which had values which were not less than those of the control (based on Dunnett's test) were subjected to analysis of variance and their means were ranked by Duncan's new multiple range test at the 5% level of significance.

Results and Discussion

Herbicide treatments had no affect on the number of leaves or tillers produced on sea oats in the first experiment (data not presented). However, chloramben, napropamide, EPTC, pronamide, metolachlor, prodiamine, and oryzalin stunted sea oat plants in the first experiment (Table 2). Fresh weight of shoots also was reduced by chloramben, napropamide, and EPTC, whereas the effect of prodiamine and oryzalin was limited *to the roots which*

Table 4. Relative effect of selected preemergence herbicides on growth of sea oats in the second experiment. Spring 1989.

Treatment	Rate (kg/ha)	Height increase[z] (cm)	Shoot wt (g)
DCPA	9.0	66 a[y]	59 ab
Isoxaben	1.1	68 a	63 ab
Oxyfluorfen	0.6	87 a	62 ab
Pronamide	2.2	67 a	61 ab
Alachlor	1.7	72 a	60 ab
Ethofumesate	1.7	83 a	76 a
Oxyfluorfen + Pendimethalin	2.2 1.1	79 a	60 ab
Simazine	1.1	71 a	57 b
Pendimethalin	1.1	79 a	66 ab

[z]Height increase represents the amount of increase in plant height over the indicated time interval and not the actual height of the plant.
[y]Means within columns followed by the same letter are not significantly different at the 5% level as determined by Duncan's new multiple range test.

weighed less than roots of sea oats in the untreated control. Those herbicides which reduced both plant height and shoot or root weight, with the exception of prodiamine, were eliminated from further testing. Diethatyl ethyl was deleted for unrelated reasons.

None of the herbicides reduced growth compared to the check as measured by the increase in plant height in the second experiment (Table 3). Diuron, metribuzin, metolachlor, fluometralin, prodiamine, pyrazon, oryzalin + oxyfluorfen, and trifluralin reduced sea oat shoot weight compared to the untreated control. Remaining herbicides which did not reduce growth relative to the untreated control were compared separately (Table 4). Growth (shoot weight) of simazine treated plants was lower than that of sea oats grown in pots treated with ethofumesate, but was not significantly different from that obtained with the other selected herbicides (Table 4).

Although nine herbicides were determined to be safe on sea oats, the extreme variability of plant response believed due to genetics and seed vigor may have masked what might have been a marginally acceptable herbicide. Growers wishing to evaluate herbicides for use on the ecotype of sea oats produced by them and under their cultural conditions are advised to select from those listed in Table 4 with the possible exception of simazine since it has high potential for leaching. Also, some growers use commercial potting media high in organic matter and simazine has provided poor weed control in other situations where high organic matter was encountered (Gilreath et al., 1985). Alachlor does not merit consideration because it is no longer sold in Florida. Registration of ethofumesate is questionable at this time. DCPA historically has provided erratic weed control in many cropping situations and probably is not worthy of extensive consideration. Thus, growers should focus their evaluations on isoxaben, oxyfluorfen, pronamide, pendimethalin, and the commercially available combination of oxyfluorfen and pendimethalin. Isoxaben and oxyfluorfen control mostly broadleaf weeds and provide poor control of grasses in most situations. Pronamide and pendimethalin control both grass and broadleaf weeds. Oxyfluorfen combined with pendimethalin provides good control of many weeds, especially spurges; however, this combination sometimes is too active for some crops. Data from these experiments indicate sea oats has good tolerance for these herbicides, but growers are strongly encouraged to evaluate several herbicides under their conditions before beginning wide scale use of a product.

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SEASONAL OCCURRENCE AND MANAGEMENT OF LANDSCAPE AND ORNAMENTAL PESTS IN NORTH FLORIDA AND SOUTH GEORGIA

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Abstract. **Identification and management of arthropod pests is one of the most important decisions facing the nurseryman. Understanding pest biology and predicting pest outbreaks are crucial to environmentally-sensitive and cost-effective pest suppression. The general biology, seasonal abundance and monitoring methods for pests commonly found infesting ornamental plants from south Georgia and north Florida as far south as the Orlando-Tampa area, are discussed in the context of IPM as a part of total nursery management.**

Management of insect and mite pests in Florida's nurseries and landscapes is a year-round task. Florida's climate and weather provide a long growing season that produces high quality plants, but such conditions are also conducive to the development of pests. At least one or more species

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