PRE- AND POST-PLANT EMERGENCE HERBICIDES AS THEY AFFECT SEED GERMINATION AND GROWTH OF FOUR HARDWOOD AND ONE CONIFEROUS SPECIES GROWING ON SEWAGE SLUDGE COMPOST-AMENDED SOIL[1]

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Abstract. Weed control tests were conducted in seedbeds amended with composted sewage sludge and seeded to 4 hardwood and 1 coniferous species, at a forest tree nursery using 4 preemergence herbicides applied soon after seeding and granular soil fumigant as a preplant soil treatment. Napropamide and bifenox applied in combination at 1.7 and 3.4 kg/ha provided good weed control without reducing populations and growth of *Quercus rubra*, *Juglans nigra*, and *Pinus taeda* but caused a severe reduction in the population and growth of *Cornus florida* and *Liriodendron tulipifera*. Oxyfluorfen at 0.3 and 0.6 kg/ha provided acceptable weed control without causing any decline in population or growth in any of the species tested except *L. tulipifera*. Prometryn did not provide acceptable weed control at either 0.7 or 1.4 kg/ha. Weed control with sodium azide as a preplant soil treatment at 400 kg/ha was unacceptable.

Although several herbicides are labeled for use on conifer seedbeds (1), none are currently labeled for similar use on seedbeds of hardwood species. Bing (3) reported post-plant premergence treatment with oxyfluorfen at 1 to 9 kg/ha and napropamide at 2 to 18 kg/ha was suitable for use on dogwood liners. Ahrens, *et al.* (2) reported that trifluralin at 2 kg/ha, oxyzalin at 1 kg/ha or DCPA at 6.7 kg/ha did not injure dogwoods when applied as the seedlings emerged.

The purpose of this study was to screen available herbicides known to control weed species, indigenous to the nursery, that could be applied, either preplant or immediately after seeding, that would not affect the germination and growth of 4 commonly grown hardwood species and 1 conifer species.

MATERIALS AND METHODS

These studies were conducted at the Buckingham Forest Tree Nursery in Harmans, Maryland on Gaylestown sandy loam. Within one month of seeding the soil was amended with 124 dry t/ha (48t/ha) of screened compost (through a 2 cm

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screen) made from lime-dewatered sewage sludge (Blue Plains, waste water treatment facilities) and woodchips, composted using the aerated pile method (4) by Maryland Environmental Services, Annapolis, Maryland. The compost was rototilled to a depth of 25 cm 3 weeks before seeding. Plots 3 m long and 15.2 m wide were randomly arranged in 3 continuous replications in the compost-treated area. Two weeks before seeding, sodium azide 15G (PPG Industries, Inc. Pittsburgh, PA 15222) was applied to one plot in each replication (soil temperature 20°C and at nearly field capacity) using a Gandy Turf Tender, rototilled to a depth of 15 cm and covered with 4 mil clear copolymer for 1 week. The plots were allowed to air-out for one week and the area was dragged smooth in preparation for seeding.

Just prior to seeding on November 18, 1981, beds 1.5 m wide and 91 m long with 30 cm wide isles were marked using tractor tire tracks. In the bed to be seeded with *Juglans nigra*, 6 V-shaped grooves 6 cm deep and 6 cm wide and 25 cm apart were made using a modified drag. Seeds for all 4 species of hardwoods were uniformly sown by hand in each plot and covered with a 1:1 mixture of sand and sawdust to a depth of 1 cm. Seeds of *Pinus taeda* were drilled on December 18 using a Whitefield Nursery 8 row Seeder (R.A. Whitfield Co., Mableton, GA 30059).

Within a day after each seeding period, the following preemergence herbicides were applied: prometryn (Caparol 80W, CIBA-GEIGY Corp. Greensboro, NC 27419), oxyfluorfen (Goal 2E, Rohm and Haas Co., Philadelphia, PA 19105) napropamide (Devrinol 50 WP and Devrinol 10G, Stauffer Chemicals, Westport, CT 06881) and bifenox (Modown 80WP, Mobil Chemicals, Richmond, VA 23261) were applied alone or in combination. The granular herbicide was applied using a manually operated Casoron applicator; sprayable materials were applied using a hand-held boom with 0.0108 T-jet nozzles at 276 kPa (40psi) powered by compressed CO_2. An untreated plot in each replication served as a control. On December 20, all beds were mulched with straw held in place with chicken wire.

In mid-April, 1982, the straw was removed. On April 29 and again on June 9, the predominant weeds in each plot were identified and degree of weed control evaluated as 1 = high weed population, and 10 = no weeds present. The beds were handweeded after each evaluation and, when necessary thereafter, during the remaining growing season and irrigated as necessary. In March, 1983, the seedbeds were root-pruned and a 2 meter long bed section from the center of each plot from each species was hand-pulled. The seedlings were counted

and graded according to stem length measured from the root collar to the terminal bud. Measurements were taken in increments of 10 cm; e.g.: 1-10, 11-20, 21-30, etc. The total number of seedlings harvested, as well as the mean stem length of each speices per plot, were statistically analyzed.

RESULTS

Weed Control. Weed growth during the April 29 observation period was low and there was little noticeable difference between the control and the treated plots (Table 1). Dominant weed species during this observation period included: *Poa annual* (annual bluegrass), *Eupatorium capillifolium* (fennel), *Stellaria media* (chickweed), and *Allium vineale* (wild garlic). However, by the June 9 observation period, weed growth in the control plots was extensive. The dominant weed species observed included: *Rumex* sp. (dock), *Ambrosia artemisiifolia* (ragweed), *Linaria genistifolia* ssp. *dalmatica* (toadflax), *Digitaria* sp. (crabgrass), *Mollugo* sp. (carpetweed), *Portulaca oleracea* (purslane), fennel, *Polygonum pensylvanicum* (smartweed), *Rumex acetosella* (red sorrel) and *Erigeron canadensis* (horseweed). The best weed control was observed in plots treated with granular or wettable powder napropamide and bifenox combination at all concentrations. Plots treated with oxyfluorfen provided acceptable weed control at either concentration while weed control in plots treated with sodium azide was unacceptable. The high level of prometryn gave slightly better weed control than the lower level.

Table 1. Degree of weed control from visual evaluation made before and after seed germination of tree species.

Herbicide	kg,a.i./ha	Rating[1] April 29, 1982	Rating[1] June 9, 1982
Control	—	9.7	1.7
Sodium azide G	400	9.3	4.3
Oxyfluorfen	0.3	9.0	7.0
Oxyfluorfen E.C.	0.6	8.5	7.3
Prometryn W.P.	0.7	9.7	3.3
Bifenox W.P.	3.4		
Napropamide W.P. and	3.4	9.0	9.0
Bifenox W.P.	6.8		
Napropamide G. and	1.7	9.5	8.7
Bifenox W.P.	3.4		
Napropamide G. and	3.4	8.8	9.7
Bifenox W.P.	6.8		

[1] 10 = no weeds, 1 = high weed population

Tree Species Response:

Quercus rubra and *Juglans nigra*. None of the herbicides tested appeared to have reduced the population or top growth of either *Q. rubra* or *J. nigra* when compared to the control. (Tables 2 and 3)

Liriodendron tulipifera. Only *L. tulipifera* growing in plots treated with prometryn and sodium azide were similar in population and mean stem length as those growing in the control. Populations of *L. tulipifera* growing in plots treated with oxyfluorfen or in combinations of napropamide and bifenox were significantly reduced. However, the herbicides did not appear to affect the stem lengths of plants that survived.

Cornus florida. Herbicide response on *C. florida* seedbeds were highly variable with regard to plant population but more specific with regard to effect on stem length. Herbicide combinations of napropamide and bifenox cause a reduction in both plant population and stem length. Prometryn, oxyfluorfen, and sodium azide had no effect on plant population or growth when compared to plants in the control plots.

Pinus taeda. All herbicides and herbicide combinations, except napropamide wettable and bifenox wettable at the 3.4 and 6.8 kg a.i./ha applied immediately after seeding, did not reduce plant population below the control and none of the herbicide treatments reduced stem length.

Table 2. The effect of preplant soil fumigant (sodium azide) and preemergence herbicides applied soon after seeding on the number of four hardwood and one coniferous species sown in the fall.

Treatment		Tree population (no. of trees/3 m^2)				
Herbicide	kg,a.i./ha	*Quercus rubra*	*Liriodendron tulipifera*	*Cornus florida*	*Juglans nigra*	*Pinus taeda*
Control	—	49 a[1]	89 abc	47 ab	57 a	211 ab
Sodium azide G	400	49 a	102 a	38 ab	54 a	207 ab
Oxyfluorfen E.C.	0.3	56 a	57 cde	39 ab	75 a	155 ab
Oxyfluorfen E.C.	0.6	45 a	65 bcd	25 ab	63 a	247 ab
Prometryn W.P.	0.7	62 a	97 ab	17 b[2]	67 a	227 ab
Prometryn W.P.	1.4	52 a	94 ab	77 a	62 a	281 a
Napropamide W.P. and bifenox W.P.	1.7 3.4	31 a	44 de	15 b	78 a	183 ab
Napropamide W.P. and bifenox W.P.	3.4 6.8	51 a	32 e	2 b	73 a	94 b
Napropamide G and bifenox W.P.	1.7 3.4	30 a	56 de	21 b	65 a	220 ab
Napropamide G and bifenox W.P.	3.4 6.8	46 a	31 e	17 b	50 a	126 ab

[1] Means wtih the same letter are not significantly different at a k ratio = 100 as determined by Duncan/Waller multiple range test.
[2] Losses due to handweeding.

Table 3. The effect of a preplant soil fumigant (sodium azide) and preemergence herbicides applied soon after seeding on the mean stem length of four hardwood and one coniferous species sown in the fall.

Treatment		Average stem length (cm)				
Herbicide	kg,a.i./ha	*Quercus rubra*	*Liriodendron tulipifera*	*Cornus florida*	*Juglans nigra*	*Pinus taeda*
Control	—	16 a	37 a[1]	27 ab	50 a	12 a
Sodium azide G	400	17 a	41 a	28 ab	49 a	12 a
Oxyfluorfen E.C.	0.3	15 a	35 a	23 abc	50 a	13 a
Oxyfluorfen E.C.	0.6	15 a	40 a	24 abc	44 a	14 a
Prometryn W.P.	0.7	15 a	37 a	20 abc	47 a	12 a
Prometryn W.P.	1.4	10 a	30 a	32 a	38 a	11 a
Napropamide W.P. and bifenox W.P.	1.7 3.4	8 a	27 a	12 cd	48 a	12 a
Napropamide W.P. and bifenox W.P.	1.7 6.8	11 a	29 a	1 d	41 a	11 a
Napropamide G and bifenox W.P.	3.4a 6.8	12 a	36 a	16 bc	42 a	11 a

[1] Means with the same letter are not significantly different at a k ratio = 100 as determined by Duncan/Waller multiple comparison procedure.

DISCUSSION

It is apparent from this study that there exists large differences in susceptibility of hardwood species to preemergence herbicides. Although combinations of napropamide and bifenox provided good weed control, they reduced the population and mean stem length of *C. florida* and *L. tulipifera* seedlings, but did not reduce the population or mean stem length of *Q. rubra* and *J. nigra* seedlings. Since acceptable weed control was achieved using 1.7 and 3.4 kg a.i./ha of napropamide and bifenox, these lower concentrations would increase its margin of safety and extend its use for weed control in seedbeds of *P. taeda*. There appears to be no advantages of using granular napropamide over wettable powders. Of the herbicides tested, oxyfluorfen provided acceptable weed control and appears safe for use with all species tested except *L. tulipifera*. Since oxyfluorfen is labelled for weed control in coniferous seedbeds, it appears that it could be used at 0.3 kg a.i./ha soon after seeding *Q. rubra*, *J. nigra*, and *C. florida* in the fall.

Although prometryn did not appear to reduce plant populations or mean stem length of any of the species tested, it did not provide adequate weed control. The poor weed control experienced with sodium azide as a preplant fumigant makes it unsatisfactory for this application. Previous studies conducted with sodium azide at these nursery facilities have been variable and inconsistent.

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JUNIPER PRODUCTION WITHOUT HERBICIDES

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Let me say at the outset that I am not against herbicides nor am I against the use of them. In fact our nursery makes limited use of herbicides such as Devrinol, Gramaxone, Ronstar, Roundup, Simazine, and Treflan. Devrinol and Ronstar are on a trial basis only because neither of these are registered for nursery use in Canada. Ronstar probably will not be registered since the manufacturer is reluctant to spend the money required to have it tested. The estimated cost to obtain a label for a crop is about $1,000,000.

As I mentioned, we are not against the manufacture or the use of herbicides, but we are against the reckless use of chemicals. Many farms in our land are suffering from a shortage of earthworms and beneficial bacteria, the "living phase" of the soil, so vital to produce superior crops.

God did not intend for us to abuse the soil, rather we are to be good stewards of it. Future generations will also need to make a living from the land. I believe that the fewer chemicals we use the better off we are.

We have found that certain *Malus* and *Tilia* cultivars, for examples, will react to Gramoxone (Paraquat). We also suspect that with a heavy rainfall, severe stem splitting can occur on *Acer platanoides* 'Crimson King' after Gramoxone treatment. In order to obtain good weed control in containers when using Ronstar G you must use the high rate of 200 lb/acre which will discolor the plant to the point where blue or green becomes grey and plant growth is reduced. It has also been our