SECTION 9
WEED CONTROL

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Preemergence Herbicide Evaluation in Wildflowers

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Nature of Work: There is considerable interest in the establishment of wildflowers in landscapes and along roadsides. Wildflowers add color, diversity and interest to both low and high-maintenance landscapes. Weed growth can interfere with the establishment of wildflowers. Weed control is one of the largest problems associated with wildflower establishment (1).

Although herbicides are commonly used in field and container nursery production and in landscape maintenance, there is little information on the tolerance of wildflowers to herbicides. One recent study reported that ox-eye daisy (Chrysanthemum leucantheum) tolerates Sinbar, Devrinol and Surflan (2). Development of herbicide programs will reduce the need for hand-weeding a landscape planting and reduce the amount of weed competition, resulting in successful wildflower establishment.

To investigate the tolerance of selected wildflowers to preemergence herbicides, lanceleaf coreopsis (Coreopsis lanceolata), ox-eye daisy, blanket flower (Gaillardia aristata) and purple coneflower (Echinacea purpurea) were started from seed in a greenhouse using cell packs containing a commercial growing medium. Wildflowers were transplanted to the field on July 6, 1990 and treated three days later. Wildflowers ranged from 2 to 6 inches in height at treatment. Ten plants of each species were planted per plot in a randomized complete block with 4 replications. The field soil had a pH of 5.9 with 1.9% organic matter. Herbicides were applied with a CO_2-pressurized backpack sprayer and plots were irrigated 2 hours after treatment.

Herbicides and rates evaluated were: granular metolachlor (Pennant) at 4 and 8 lb active ingredient (ai)/A, a granular formulation of metolachlor plus simazine (Derby) at 4 and 8 lb ai/A, and isoxaben (Gallery) at 0.75 and 1.0 lb ai/A. Three combination treatments were evaluated: a tank-mix of isoxaben at 0.75 plus metolachlor liquid at 4.0 lb ai/A, and granular oxadiazon (Ronstar) at 2 and 4 lb ai/A plus 4 lb ai/A granular metolachlor.

Wildflowers were visually evaluated for injury 2 and 12 weeks after treatment. Wildflower stand (number of living plants per plot) was determined 8 weeks after treatment. Weed control was assessed visually 6 weeks after herbicide application.

Results and Discussion: Two weeks after treatment, Derby and Gallery plus Pennant injured all four wildflower species. These combination herbicide treatments reduced the stand of ox-eye daisy, but did not affect the stand of the other three species (Table 1). Gallery applied alone also injured and reduced the stand of ox-eye daisy. Since granular Pennant applied alone did not reduce ox-eye daisy stand, it appears that damage in the combination treatment was probably caused by Gallery. Granular metolachlor or oxadiazon plus metolachlor did not significantly injure any of the four wildflowers. No herbicide reduced the stand of lanceleaf coreopsis, blanket flower or purple coneflower. Visual injury decreased over time, except for Gallery and Gallery plus Pennant on ox-eye daisy, which still showed significant damage 12 weeks after treatment. Stand reduction appeared to be the best indication of wildflower tolerance to these herbicides. Unless the plant stand was reduced, these four species appeared to outgrow any herbicide injury observed soon after treatment.

All treatments containing metolachlor resulted in over 85% control of yellow nutsedge (Cyperus esculentus). Gallery applied alone did not control yellow nutsedge. A11 herbicide treatments gave 90% or greater control of eclipta (Eclipta alba).

Significance to the Nursery Industry: Metolachlor appears promising for weed control in emerged wildflowers. Since metolachlor primarily controls yellow nutsedge and annual grasses, combinations with broadleaf herbicides would improve the weed control spectrum. However, it appears that two broadleaf herbicides, simazine and isoxaben, injure certain wildflowers. Additional research is needed to determine weed control strategies for wildflower maintenance.

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Table 1. Wildflower stand (number of living plants per plot), expressed as percent of the untreated plots, 12 weeks after herbicide application.

Herbicide	Form-ulation	Rate lb ai/A	Plant stand (% of control) Lanceleaf coreopsis	Ox-eye daisy	Blanket flower	Purple cone-flower
Untreated	- -	- -	100	100	100	100
Pennant	5G	4.0	100	88	100	100
Pennant	5G	8.0	100	80	100	90
Derby	5G	4.0	100	47	.100	76
Derby	5G	8.0	95	15	93	78
Gallery	75DF	0.75	100	0	100	96
Gallery	75DF	1.0	100	15	97	84
Gallery +	75DF	0.75	100	6	100	76
Pennant	8L	4.0				
Ronstar +	2G	2.0	100	86	100	84
Pennant	5G	4.0				
Ronstar +	2G	4.0	100	100	100	100
Pennant	5G	4.0				
	LSD (0 . 05)		NS	26	NS	NS

Soil Fumigants for Establishing Wildflowers

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The soil fumigants, methyl bromide and Basamid Granular were evaluated to determine which is most effective for weed control and highway wildflower establishment. Treatments consisted of methyl bromide (Brom-O-Gas, 98% formulation with 2% chloropicrin) at 645 lb/A and sealed with plastic and Basamid Granular at 350 lb/A and sealed either by compressing the soil with a weighted drum or with plastic. Treatments were applied in the fall of 1989 and 1990. When the soil tested clear of the fumigants with a lettuce germination test, wildflower seed were planted. Basamid with plastic was the most effective treatment in terms of both weed control and wildflower establishment. Compressed Basamid was more effective than methyl bromide for overall weed control and wildflower establishment.

The use of soil fumigation is often used by nursery operators for seedling and propagating beds. Methyl bromide is one fumigant used although it is a restricted-use material requiring specialized equipment and handling. Information from this research provides comparative results for the use of Basamid Granular as an alternative fumigant to methyl bromide.

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Response of Ornamental Grasses to Graminicides

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Nature of Work: Use of ornamental grasses in the landscape is becoming increasingly popular. Ornamental grasses, like grasses in general, differ in their susceptibility to the aryloxyphenoxypropionate and cyclohexanedione classes of herbicides (3,4,5,7,9). These herbicides are used for postemergence control of weedy grasses in broadleaf crops, and some are used in turfgrass as well. More information on the response of ornamental grasses to these herbicides is needed so that weedy grasses can be safely controlled without harming desirable ones.

Asexually propagated plants of seven ornamental grasses (Festuca cinerea 'Blauglut', F. cinerea 'Fruehlingsblau', F. cinerea 'Seeigel', F. amethystina superba, Erianthus ravennae, Panicum virgatum 'Warrior', and Pennisetum alopecuroides) were potted in a 3:1 (v/v) pine bark to sand mix and greenhouse-grown for approximately six weeks prior to herbicide screening. Plants of each species were laid out in a randomized complete block design with five replications. The experiment was repeated once over time.

Treatments included Acclaim (fenoxaprop) l.0EC at 0.25 and 0.5 lb ai/A, Assure (quizalofop) 0.8EC at 0.1 and 0.2 lb ai/A, Ornamec (fluazifop) 0.5EC at 0.19 and 0.38 lb ai/A, and Poast (sethoxydim) 1.53EC at 0.29 and 0.58 lb ai/A. Poast treatments included 1% (v/v) crop oil concentrate. These rates fall within the recommended product use rates for labelled plant materials. Over-the-top applications were made with a CO_2-pressurized, track-mounted system with an 8001E flat spray pattern nozzle delivering 16 gal/A at 14 psi.

Various injury ratings were taken twice over a two week period beginning 14 days after treatment (DAT). Ratings included visual phytotoxicity (% basis with 0=no injury and 100=plant death), fresh and dry shoot weights, number of new leaves developed after shoot harvest, and number of new leaves developed + existing leaves elongated after harvest (total-new leaf number).

Results and Discussion: Erianthus, Panicum and Pennisetum were susceptible to all herbicide treatments whereas the four fescues were tolerant. Injury was detected by most parameters for the three susceptible grasses, but in only a few cases for the fescues.

Phytotoxicity ratings (14 DAT) on the susceptible species ranged from over 25% for the least damaging treatment to over 92% for the most damaging. Greatest damage on Erianthus was observed following treatment with both rates of Assure and Poast, while Pennisetum was damaged most by the high rates of Assure and Poast. Greatest damage on Panicum resulted from the high rate of Assure and

Ornamec. In contrast to the susceptible species, the most damaging treatment on any of the fescues caused only 15% injury. Minor damage was noted on newer leaves of F. cinerea 'Fruehlingsblau' and 'Seeigel'.

Fresh weights of shoots harvested 15 DAT were reduced (>39%) for all treatments (compared to the check) on Erianthus, Panicum and Pennisetum. Dry weights showed similar reductions for Panicum and Pennisetum.

Both new leaf development and existing leaf elongation virtually ceased by 18 DAT on Erianthus, Panicum and Pennisetum. F. amethystina superba showed an increase in number of new leaves produced following treatment with high rates of Ornamec and Assure and the low rate of Poast, while F. cinerea 'Fruehlingsblau' exhibited high new leaf production for all treatments except the high rate of Poast and the -low rate of Acclaim. Actual increases in new leaf production are plausible in tolerant plants, since these chemistries exhibit effects in meristematic areas.

The fescues demonstrated a high degree of tolerance to all herbicide treatments, while Erianthus, Panicum and Pennisetum eventually died. More extensive screening will be required to determine sensitivity of established, field-grown plants of Erianthus, Panicum and Pennisetum, since growth stage affects response of some grasses to graminicides (1,2,6,8,9).

Significance to Industry: These data demonstrate that the potential exists for blue fescues to be included on the use labels of graminicide products, so that products will be available which selectively control weedy grasses in blue fescues.

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Proposed N. C. Noxious Weed Regulations- A Preventative Approach for Weed Control in Nurseries

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Nature of Work: Over the past years, plant species other than crops have been introduced into North Carolina's agricultural systems either as purposeful introductions or as contaminants. Once established, many of these weed species are capable of significantly reducing crop productivity and marketability. These weeds directly interfere with crop production and with other activities of man. Estimates place the cost of weeds to agriculture alone in excess of $13 billion per year. Agricultural producers in the United States now spend $3.6 billion annually on chemical weed control and $2.6 billion for cultural, ecological, and biological methods of control (1). This translates into a loss of 10-l5% of the total market value of farm and forest products in the United States. In North Carolina, the impact from losses due to weeds in field/container ornamentals, christmas trees, turf, and aquatics exceeded $23.8 million alone during 1990 (2).

Both Federal and State agencies have enacted laws and regulations to prevent the artificial introduction of noxious weed pests into the United States and individual states. The Federal Noxious Weed Law adopted in 1974 grants the authority to stop the introduction of foreign weeds into the United States and to eradicate small infestations of federally listed noxious weeds prior to their establishment. Many of the more serious weed pests have not gained entry to the United States due to port of entry inspections conducted by USDA, APHIS-PPQ personnel. Even with an extensive federal inspection system in place, the risk of introduction and establishment is high. Several key components are missing from the Federal Noxious Weed Law which, if incorporated, would greatly enhance its effectiveness (3). Notably absent from the Law are provisions which prohibit the interstate movement of federal noxious weeds, grant emergency authority to prohibit foreign weeds that may not be listed, and allow the regulation of shipments of agricultural and vegetable seeds under the Federal Noxious Weed Act.

Without these components in place, states must rely on their own regulations for regulatory support. At the state level, many agencies have adopted noxious weed laws and regulations that are essential in reducing the introduction and spread of noxious weeds. In North Carolina, it is the responsibility of the North Carolina Department of Agriculture (NCDA) to prevent the introduction and spread of noxious weeds and other injurious plant pests. The Department is also authorized to carry our eradication programs associated with regulated pests. Currently, North Carolina does not have regulations in place that grant full authority to restrict the transport, movement, and sale of noxious weeds into the state. The NCDA has been actively examining the need and justification for laws and regulations that will effectively prevent the introduction, establishment, and subsequent spread of injurious noxious weeds. The objectives of this paper are to outline two initiatives that are underway which will allow the NCDA to strengthen its regulatory weed activities in the state.

Results and Discussion: The NCDA has been actively involved in developing a law that would give full authority to restrict the transport, movement, and sale of aquatic noxious weeds in the state. With the identification of hydrilla in North Carolina in 1981, the need for effective regulation in the area of aquatics was noted. The N. C. Aquatic Weed Control Council along with the NCDA has been instrumental in drafting an act that would provide for the control, eradication, and regulation of aquatic weeds in the state. After introduction in the 1991 session of the General Assembly of North Carolina by the Department of Environrnent, Health, and Natural Resources, the Aquatic Weed Control Act of 1991 was ratified by the legislature with an effective date of October 1, 1991. The Aquatic Weed Control Act of 1991 contains the following provisions:

1. The ability to designate noxious aquatic weeds.

2. The ability to conduct research and planning related to the control of noxious aquatic weeds.

3. The ability to coordinate activities of agencies that control and eradicate noxious aquatic weeds.

4. The ability to control, remove, or destroy any noxious aquatic weed located in the waters of the state or in areas adjacent to water bodies.

5. The ability to regulate the importation, sale, use, culture, collection, transportation, and distribution of any noxious aquatic weed.

The Governor has identified the Department of Environment, Health, and Natural Resources as the lead agency in the administration of the Aquatic Weed Control Act. Under the newly adopted statutory autbority, NCDA will be responsible for regulating the movement and distribution of noxious aquatic weeds.

Any individual who violates this law or adopted regulations shall be guilty of a misdemeanor and upon conviction shall be fined not less than $50 or more than $1000, or imprisoned for not less than 10 days nor more than 180 days, or both, for each offense. Rules necessary to implement the provisions of the law and a list of noxious aquatic weeds will be developed in the near future.

Presently, there are no regulations that specifically exclude'other noxious weeds in North Carolina. Contained in North Carolina's Seed Law (Article 31, Chapter 106 of the General Statutes of North Carolina) are provisions that only regulate the movement of listed prohibited and restricted noxious weeds associated with crop seed. Importation of the same listed prohibited and restricted noxious weeds not associated with crop seed is not covered under the Seed Law. A draft regulation that would grant full authority to the Department to restrict the transport, movement, and'sale of listed noxious weeds in the state is currently under consideration. This draft is proposed for adoption under the North Carolina Plant Pest Law (Chapter 106, Article 36 of the General Statues of North Carolina) where authority is granted to eradicate, repress, and prevent the spread of listed noxious weeds. The Noxious Weed Regulations provide for the following:

1. The listing of designated state noxious weeds.

2. The listing of regulated articles and areas.

3. Conditions governing the movement of regulated articles within and outside regulated areas utilizing a certificate or permit system.

4. Scientific permits that will allow movement of listed noxious weeds for research purposes.

Any individual violating any of the provisions of these regulations shall be guilty of a misdemeanor and shall be fined not less than $5 nor more than $50, or imprisoned for not less than 10 nor more than 30 days for each offense. These draft regulations will be submitted to the Board of Agriculture during the fall of 1991 for consideration and adoption.

Significance to Industry: The field implementation of these regulations will provide the framework for preventing the introduction and spread of noxious weeds in nursery production, landscape areas, and water bodies in the state. With full regulatory authority in place, the Department will be able to detect and eliminate at an early stage, noxious weeds that have the potential to create serious problems. Implementation of the regulations will require nurserymen to become familiar with designated noxious weeds and the conditions necessary for movement of regulated articles within and outside the quarantine areas. A permitting system will enable researchers to move designated noxious weeds for scientific purposes.

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Response of Container-Grown Herbaceous Flowering Perennials to Isoxaben and Isoxaben Combinations

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Nature of Work: Herbicide formulations containing isoxaben (Gallery DF, Snapshot DF, and Snapshot TG) have been found to provide good weed control and with good crop tolerance to many container- and field-grown woody ornamentals. Gilliam et al. (2) found that Gallery generally provided inferior grass control compared with Surflan but noted no visual crop injury in field-grown plants. Neal and Senesac (3) found no injury to container-grown ornametals by Gallery alone or in combination with Treflan or Surflan. However, field-grown Douglas fir and barberry were injured by Snapshot DF and Surflan alone. Fuller (1) reported that some species may be injured when multiple applications of Gallery DF, Snapshot DF, and Snapshot TG were made. Snapshot DF caused the most injury to the most plant species.

Limited research has been conducted on the response of herbaceous perennials to application of herbicides. Schuett and Klett (4) reported that container-grown herbaceous perennials were not affected by preemergence herbicides applied at normal use rates. However, carpet bugle (*Ajuga repens atropurpurea*) was injured by Surflan at 4.0 or 6.0 lb ai/A. Skroch et al.(5) reported several species of herbaceous flowering perennials moderately injured by OH-2 but little or no injury from other herbicides tested. Smith et al.(6) reported field-grown shasta daisy to be slightly injured by Surflan 75W at 2.0 lb ai/A.

This study was initiated to determine the response of container-grown herbaceous flowering perennials to Gallery DF, Snapshot DF, and Snapshot TG. Coreopsis *(Coreopsis lanceolata),* gloriosa daisy *(Rudbeckia hirta),* shasta daisy *(Chrysanthemum maximum),* and columbine *(Aquilegia spp.)* were grown in seedling flats in the greenhouse for 12 weeks prior to transplanting. The seedlings were transplanted into trade-gallon containers containing pine bark:sand (7:1 v/v) amended with 8 lb/yd^3 slow release fertilizer (18-6-12), 1.5 lb/yd^3 micronutrients, 10 lb/yd^3 dolomitic lime, and 2 lb/yd^3 13-13-13. After transplanting, approximately 0.5 inches of water were applied. Sprayable treatments were applied the next day with a CO_2 backpack sprayer delivering 13 gpa at 30 psi. Granular treatments were applied with a paperbag shaker. After treatments were applied, 0.3 inches of water were applied to rinse the herbicides from the leaves.

Results and discussion: Weed populations were low in this study. All herbicide treatments provided excellent control of crabgrass and annual sedge (data not shown). Gloriosa daisy exhibited minor injury (0-13%) from treatment with Gallery DF, Snapshot TG, or Treflan 5G (Table 1). Injury from application of Snapshot DF increased from moderate (18%) to severe (69%) as the rate increased. Surflan 4AS alone also caused moderate injury. Plants treated with Snapshot DF at 5 lb ai/A tended to be shorter and had fewer flower buds.

Coreopsis was not adversely affected by any herbicide treatment (Table 1).

Shasta daisy exhibited moderate (24%) to severe (66%) injury from treatment with Surflan 4AS, Gallery DF, or Snapshot DF (Table 1). Treatment with Snapshot TG or Treflan 5G caused no adverse effects.

Columbine showed slight injury (12-19%) to Gallery DF applied at 0.5 and 0.75 lb ai/A and to Surflan 4AS (Table 1). Gallery DF at 1.0 lb ai/A and all Snapshot DF treatments caused moderate injury (29-37%).

Significance to Industry: This preliminary study indicates that further screening of herbaceous flowering perennials needs to be conducted to determine their tolerance to Gallery DF and Snapshot DF. A wide range of injury was found in the species evaluated in this study. Snapshot TG, however, appears to be considerably safer to use on these crops. Care should be taken to wash the granules from the leaves after application.

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Table 1. Crop response of container-grown ornamentals.

		% Injury *			
Treatment	Rate lb ai/A	Gloriosa Daisy	Shasta Coreopsis	Daisy	Columbine
Check,weed free	—	5	1	1	0
Check,weedy	—	0	0	1	4
Gallery DF 75DF	0.5	13	9	46	12
Gallery DF 75DF	0.75	9	6	41	19
Gallery DF 75DF	1.0	12	4	35	31
Snapshot 80DF	2.5	18	5	35	37
Snapshot 80DF	3.75	28	9	37	34
Snapshot 80DF	5.0	69	8	66	29
Snapshot 2.5TG	2.5	0	6	8	3
Snapshot 2.5TG	3.75	4	4	5	10
Snapshot 2.5TG	5.0	10	3	3	8
Surflan 4AS	3.0	25	0	24	19
Treflan 5G	3.0	1	1	5	8
LSD @ 0.05		15	NS	29	NS

* Injury rated - 0 = no injury, 100 = crop dead.

Control of Prostrate Spurge in Container-Grown 'Stewartsonia' Azalea

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Nature of Work: Prostrate spurge (Euphorbia humistrata Engelm ex Gray) is a primary weed problem in container-grown ornamentals in the southeastern United States (3). One prostrate spurge plant per container has been shown to limit the growth of 'Fashion' and 'Gumpo White Sport' azalea (1). Combinations of herbicides have increased control of several weed species (2,4). The objective of this study was to evaluate several combinations of herbicides for control of prostrate spurge in container-grown Rhododendron 'Stewartsonia'.

Research was conducted at the Coastal Plain Experiment Station located in Tifton, GA. 'Stewartsonia' azalea liners were potted in #1 containers on 28 June, 1990. The potting medium was milled pine bark and river sand (4:1 by vol) amended with 1.5 lbs/yd^3 Micromax (Grace/Sierra). Osmocote 18N-2.6P-9.9K (18-6-12) was top dressed at the rate of 1.5 lbs N/yd^3 (Grace/Sierra). Herbicide treatments were applied and prostrate spurge seeds were broadcast over the containers 10 July, 1990. Granular formulations of herbicides were broadcast over the containers while liquid formulations were applied with a CO_2 backpack sprayer at 20 gallons per acre of solution. Irrigation at 0.5 inches per day was applied to the containers using solid-set irrigation. All treatments were replicated four times with three containers per replication in a randomized complete block design.

Numbers of prostrate spurge plants per container were determined every two weeks. Growth index (height x width x width/3), root grade (1 to 5 where 1 = 0 to 20%, 2 = 21 to 40%, 3 = 41 to 60%, 4 = 61 to 80%, and 5 = 81 to 100% white roots covering rootball surface); final plant dry weight and final spurge plant dry weight were determined on 18 September, 1990, 10 weeks after treatment.

Results and Discussion: After 8 weeks, all herbicide treatments reduced the number of prostrate spurge plants per container (Table 1). At week 10, only the Rout treatment reduced the number of weeds per container compared to the untreated control. All herbicide treatments reduced the dry weight of prostrate spurge in 'Stewartsonia' azalea compared to the control (Table 2). The Ronstar plus Surflan treatment caused the greatest reduction in dry weight of prostrate spurge. Root grade of 'Stewartsonia' azalea was influenced by herbicide treatments (Table 2). OH-2 and Ronstar plus Surflan reduced the percentage of rootball covered by white roots compared to the untreated control. Derr (2) showed that applications of OH-2 injured 'Hershey's Red' azalea. Surflan decreased root and shoot growth of 'Southern Charm' azalea (5). Only a few live roots of 'Stewartsonia' azalea were found in the lower half of the containers treated with Ronstar plus Surflan in our study. None of the herbicides tested caused visible phytotoxic responses to shoot growth.

Significance to Industry: Various combinations of herbicides reduced the number of prostrate spurge plants per container in 'Stewartsonia' azalea for an 8 week period when compared to an untreated control. Certain herbicide combinations containing dinitroanaline herbicides (Surflan and Southern Weedgrass Control) damaged the root system of 'Stewartsonia' azalea. The potential for reduced plant growth caused by reductions in root growth due to herbicide application should be weighed against herbicide efficacy. (Names are necessary to report factually on available data; however, the USDA neither guarantees nor warrants the standard of the product, and the use of the same by USDA implies no approval of the product to the exclusion of others that may also be suitable).

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Table 1. Number of prostrate spurge plants per container for a 10 week period (July 10 to September 18, 1990) in 'Stewartsonia' azalea.

			Weeks after treatment				
Treatment	Formulation	Rate (lbs ai/A)	2	4	6	8	10
Untreated control	- -	- -	16.7a[z]	17.4a	19.3a	19.3a	25.4a
Ronstar	2G	4	3.5b	6.3bc	8.1bc	9.9bc	14.8ab
Rout (oryzalin + oxyfluorfen)	3G	1 + 2	0.9b	2.8c	3.3cd	4.3cd	7.0b
Ornamental herbicide 2 (pendimethalin + oxyfluorfen)	3G	1 + 2	0.8b	4.0c	4.2cd	6.3cd	16.0ab
Ronstar + Surflan	2G + 4.0 AS	2 + 2	0.5b	0.8c	1.7d	2.3d	14.4ab
Ronstar + Pennant	2G + 5G	2 + 4	4.3b	10.6b	11.3b	12.8b	19.7ab

[z] Means in a column followed by the same letter are not different (P=0.05) according to the Waller-Duncan k-ratio t-test.

Table 2. Effect of herbicide treatments on plant growth (growth index, root grade and shoot dry weight) of 'Stewartsonia' azalea and prostrate spurge.

Treatment	Formulation	Rate (lbs ai/A)	Growth[z] index	Root[y] grade	Shoot dry weight	Spurge dry weight
Untreated control	- -	- -	1443	3.2a[w]	9.0	48.3a
Ronstar	2G	4	1326	2.6ab	9.4	27.9bc
Rout (oryzalin + oxyfluorfen)	3G	1 + 2	1257	2.5ab	9.1	22.3bc
Ornamental herbicide 2 (pendimethalin + oxyfluorfen)	3G	1+ 2	1622	2.3b	10.9	18.2c
Ronstar + Surflan	2G + 4.0 AS	2 + 2	854	1.3c	7.7	2.3d
Ronstar + Pennant	2G + 5G	2 + 4	1652	3.0ab	9.4	32.5b
PR>F[x]			NS	**	NS	**

[z] Growth index (height x width x width/3).

[y] Root grade: 1 = 0-20%, 2 = 21-40%, 3 = 41-60%, 4 = 61-80%, 5 = 81 100% of rootball surface covered with white roots.

[x] ** indicates significant treatment effect at 0.01.

[w] Means in a column followed by the same letter are not different (P=0.05) according to the Waller-Duncan k-ratio t-test.

Movement of Herbicides in Container Media

Charles Gilliam, Donna Fare, Gary Keever,
Glenn Wehtje, and Danny Lacompte
Alabama

Nature of Work: Movement of pesticides from container nursery production facilities is a major concern of growers and environmentalists. The container industry requires intensive cultural practices including frequent applications of irrigation, fertilizers, and pesticides. A major concern is the movement of herbicides from container nurseries. Weed control in container nurseries requires repeated application of herbicides throughout the year. Some nurserymen apply herbicides up to five times a year (1). Little or no information is available on herbicide movement in container media and subsequent container effluent and container bed runoff levels when herbicides are applied.

A commercial nursery facility was selected for the study. The container bed sampled contained recently transplanted 3 gallon pots spaced pot to pot on a gravel base with a 15 inch walkway every eight feet. Base line data were collected prior to the initiation of the study to determine existing levels of Goal herbicide. Samples were collected from six locations in the nursery: irrigation water from the riser, well, collection pond, container effluent, container bed effluent, and effluent leaving the property. Container effluent samples were collected by cutting holes in styrofoam boards that fit tightly around the three gallon containers to form a water tight seal. The styrofoam boards suspended and supported the container over a plastic collecter. Twelve containers were used to collect each sample. Subsequent to the initial sampling, Rout herbicide (Goal 2% + Surflan 1%) was applied with a cyclone seeder at the recommended rate (100 pounds of product/acre). Samples were collected during 1st, 3rd, 6th, and 12th irrigations after herbicide application. Fifteen rain gauges were placed in a grid system- to measure irrigation. Irrigation output was about 0.4 inches (1.0 cm) application. Immediately after sample collection, samples were packed in ice for transportation to the lab for analysis of Goal.

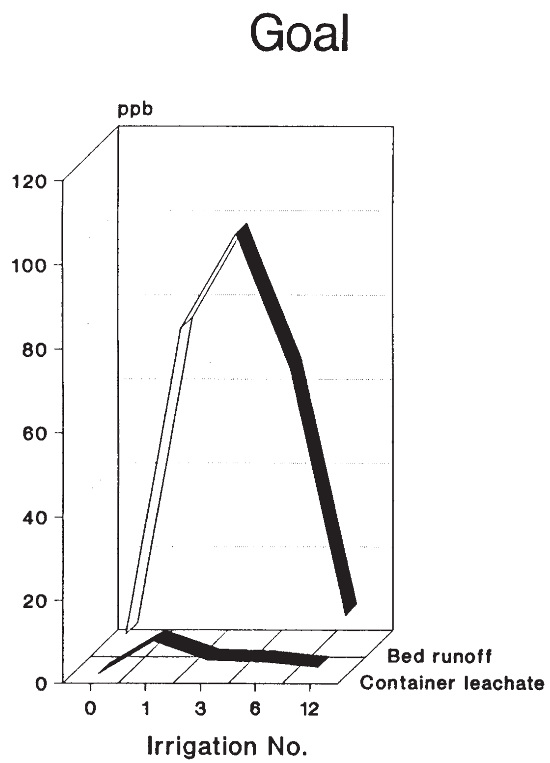
Results and Discussion: Minimal or little Goal herbicide moved through the container medium. For example, with the first irrigation after herbicide application the Goal level was 8.3 parts per billion (ppb), and declined to 2.0 ppb by the 12th irrigation (Figure 1). Goal reached a maximum level in the container bed effluent at the 3rd irrigation and declined thereafter. The levels of Goal in container bed effluent were about l0X greater than the container effluent levels. Most likely this occurred because of the Goal falling to the container bed between the pots and into the walkways.

The well at the nursery is within 30 feet of the lower end of the container bed sampled and has a depth of 35 feet. There was no Goal herbicide detected at anytime during the study in the well. This nursery has been in operation for 12 years, and has used Rout for several years. From these data one would conclude that the Goal portion of Rout herbicide is not moving into the groundwater.

Other sample points included the collection pond, irrigation water and leaving the property. The collection pond was about 50 feet from the lower end of the sampled container bed. Well water was frequently added to the collection pond and the irrigation water pumped from the collection pond. Therefore, one would assume that the levels of the irrigation and the collection pond would be similar. Goal levels ranged from 0.00 (not detected) to 0.49 ppb from irrigation 1 through 12.

Goal levels in water leaving the property ranged from a maximum of 2.9 ppb on the 6th irrigation to a minimum of 0.3 ppb. Goal levels in the holding pond and leaving the property may have been influenced by applications of Rout herbicide made elsewhere on the nursery.

Significance to the Nursery Industry: When Goal is used according to the recommended rate, very low levels (ppb range) are present in effluent from container nurseries. Goal was not detected in the well sampled at anytime even though this nursery has used this herbicide for the past several years.



Tolerance of Ornamentals to Basagran

Chris Wilson and Ted Whitwell
South Carolina

Nature of Work: Basagran T/O is used in turf and recently received a label for certain ornamentals to control yellow nutsedge and broadleaf weeds. Nineteen containerized ornamentals were evaluated in May, 1989 and June, 1991 for tolerance to Basagran applications applied over the top ot the plants. Basagran was applied at 1 and 2 lb ai/Acre using a $C0^2$ backpack sprayer calibrated to deliver 20 gallons per acre at 40 psi using 11002 tips. Dash (crop oil concentrate) was added at the rate of 1.25% v/v. A randomized complete block design was used with 3 replications in 1989 and 5 replications in 1991. Visual injury was rated weekly and growth measurements taken after 6 weeks. Rapid screening techniques are also being investigated.

Species evaluated were established in #1 (3.8L) containers in a 80% pine bark,10% peat, and 10% sand media. They were fertilized and irrigated for optimum growth and grown in full sun. Species evaluated include:

Azalea 'Amagasa' (Satsuki)	Amagasa Azalea
Berberis thunburgii 'Crimson Pygmy'	Crimson Pygmy Barberry
Camellia sasanqua 'Cleopatra'	Cleopatra Camellia
Cotoneaster dammeri 'Coral Beauty'	Coral Beauty Cotoneaster
Ilex cornuta 'Dwarf Burford'	Dwarf Burford Chinese Holly
Ilex cornuta 'Rotunda'	Rotunda Chinese Holly
Ilex crenata 'Helleri'	Hellers Japanese Holly
Ilex vomitoria 'Shellings'	Shellings Dwarf Yaupon Holly
Juniperus chinensis 'Armstrongii'	Armstrong Chinese Juniper
Juniperus chinensis 'Hetzi Glauca'	Hetz Blue Chinese Juniper
Juniperus conferta 'Blue Pacific'	Blue Pacific Shore Juniper
Juniperus davurica 'Expansa'	Parsons Juniper
Juniperus virginiana 'Grey Owl'	Grey Owl Juniper
Lagerstroemia indica 'Carolina Beauty'	Carolina Beauty Crape Myrtle
Ligustnum japonicum	Wax Leaf Ligustrum
Nandina domstica	Nandina
Pachysandra terminalis	Japanese Pachysandra
Pieris japonica	Japanese Pieris
Thuja occidentalis 'Holmstrup'	Holmstrup Arbovitae

Results and Discussion: Basagran caused leaf yellowing and necrosis around leaf margins of injured plants. Both rates severely injured the Azalea, Barberry, and Nandina at two weeks aHer application. Only the 2 lb/A rate caused ,20% injury to the Crape Myrtle and Arbovitae. Slight injury (<10%) occurred on Hellers Holly, Ligustnum, Pachysandra, Burford Holly, Hetzi and Grey Owl Junipers, Pieris, and Arbovitae. Cleopatra Camellia, Coral Beauty Cotoneaster, Rotunda Holly, Shellings Yaupon Holly, Armstrong Juniper, Blue Pacific Shore Juniper, and Parsons Juniper were not injured.

The Azalea, Barberry, and Nandina did not recover from the earlier injury by 45 days after treatment. Arbovitae was injured only by the high rate. The following plants were slightly injured by Basagran: Cotoneaster, Burford, Rotunda, and Hellers Hollies, Parsons Juniper, Pachysandra, Pieris, Hetzi and Grey Owl Juniper, Crape Myrtle, Arbovitae, Ligustrum, and Yaupon Holly.

While Basagran is not yet labeled for Shellings Dwarf Yaupon Holly, Carolina Beauty Crape Myrtle, Wax Leaf Ligustrum, Japanese Pieris, or Parsons and Grey Owl Junipers, this study indicates that these plants can tolerate low rates applied over the top. Care should be taken when using Basagran as a directed spray around Azalea, Barberry, and Nandina as foliage damage will occur from spray contact. Over the top applications to Azalea, Barberry, and Nandina should be avoided.