SECTION 9
WEED CONTROL

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Tolerance of Containerized Ferns to Repeated Preemergence Herbicide Applications

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Nature of the Work: Ferns are becoming a popular landscape plant, however nursery production practices including weed management are not clearly defined. The tolerance of ferns to preemergence herbicides varies at different growth stages during the production cycle. Bachman and Whitwell reported that Gallery was the safest herbicide but application timing during February injured certain species. Weeds emerge all year long and become major problems until ferns become fully mature and fill the pots. This study evaluated repeated applications of preemergence herbicides to several fern species. Efforts were made to evaluate phytotoxicity over the year long nursery production schedule to ascertain fern growth problems and bittercress control associated with repeated herbicide use.

Materials and Methods: Seven fern species were evaluated for tolerance to preemergence herbicides applied 918194, 12/31/94 and 4/10/95. Small liners of ferns were treated on 9/8/94 in 4 X 4 inch pots with a 50% peat and 50% perlite media Ferns were moved up to one gallon pots using the same media on 12/20/94 and retreated with the same herbicides on 12/31/94 and 4/10/95. A natural infestation of hairy bittercress developed during the study. Pots were hand weeded between herbicide applications. Visual evaluation of injury by species and bittercress control were made monthly on a scale of 0 to 100 % with 100 = plant death and 0 = no injury.

Results and Discussion: Fern species varied in their response to herbicide application (Table 1). Minimum injury was observed after the first and second applications at the 10/17/94 and 2/10/95 evaluations. *Polystichum polyblepharum* was severely injured by Snapshot TG applications with the other treatments providing less than 20% damage. However, after the third application several species were injured from the herbicides and this injury was in the form of stunted growth. Pendulum and Snapshot TG caused < 20% injury to all species except for *Cyrtomium falcatum* Gallery and Factor were safer on the selected ferns at the rates evaluated with only two species having greater than 20% injury, however, *Dryopteris marginalis* was severely affected by all the herbicides including Factor. Bittercress control ranged from 67 to 93% control for the herbicides. Higher control (80 to 93%) was observed during production cycle for Snapshot TG and Pendulum.

Significance to the Industry: Ferns were sensitive to repeated applications of Pendulum and Snapshot TG at 4 and 5 lb. ai/A, respectively. Lower rates may be less phytotoxic. Gallery and Factor were less injurious to the species evaluated with repeated applications.

Literature Cited

1. Bachman, G. and T. Whitwell. 1994. Weed management in ferns. Proceedings of SNA Research Conference 39:305-308.

Table 1. Visual injury (%) to selected fern species from repeated preemergence herbicide applications over a growing season.

Fern Species	Herbicides % injury 10/17/95				Herbicides % injury 2/10/95				Herbicides % injury 5/3/95			
	Pend 4	SS-TG	Gallery	Factor	Pend.	SS-TG	Gallery	Factor	Pend.	SS-TG	Gallery	Factor
Cyrtomium falcatum	4	11	10	7	0	0	0	0	20	35	18	13
Dryopteris Erythosora	8	6	6	8	9	6	6	13	10	11	5	10
Drypoteris marginalis	8	10	1	5	0	0	0	0	38	86	56	96
Osminda regalis 'P'	5	10	5	8	-	-	-	-	42	47	12	10
Poly 1 acrost	6	17	20	14	0	0	0	0	54	66	36	35
Poly 2 poly	14	2	15	10	19	56	9	7	47	66	11	7
Poly 3 tsus	5	5	4	6	10	12	6	7	36	90	20	12

1 = *Polystichum acrostichoides*, 2 = *Polystichum polyblepharum*, 3 = *Polystichum tsus-sinense*
4 - Pend = Pendulum @ 4lb ai/A, SS-TG = Snapshot TG @ 5 lbs ai/A, Gallery @1.3 lbs ai/A, Factor @ 0.75 lbs ai/A.

Hairy Bittercress Seed Production, Dispersal, and Control

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Nature of the Work: Bittercress (Cardamine hirsuta) is a high seed producing weed that germinates all year during propagation of landscape plants. Bittercress produces a great quantity of seeds that are forcefully expelled. Plastic containers are commonly reused during propagation with media residue from previous crops cling to the sides of the containers. The residue in used containers could hold some of these seeds for dissemination during the next crop cycle. The objectives of this study were to (1) investigate seed number and dispersal of hairy bittercress and (2) determine the effectiveness of certain preemergence herbicides for bittercress control.

Methods and Materials: Thirty bittercress seedlings from a population occurring in a greenhouse at Clemson, SC were transplanted into 4" square plastic containers. After 10 days, eight plants were selected for uniformity of growth. Data was collected from these eight plants concerning silique development, seed production, and seed dispersal (distance and pattern).

The second phase was conducted at Carolina Nurseries. Two inch square containers with media residue were collected. These containers had a heavy hairy bittercress population during previous propagation cycle. Half of the containers were rinsed (clean) with a pressure nozzle attached to a water hose and the other half the residue were not rinsed (dirty). This resulted in two container treatments. Propagation media, 50% peat moss and 50% perlite, was sampled at the outdoor storage area from two spots, the top and bottom of the pile, for two media treatments. The containers were placed into 18" square trays holding 64 containers. There were 16 replicates of each container media combination per tray. The trays were placed in the center of 4x 4 square blocks on the gravel floor.

Three uniform plants were selected from the bittercress that emerged from the un-washed containers. Each plant was placed in the center of a five tray (7.5') by five tray (7.5') block and allowed to seed. Each tray contained thirty-six 3" square new uninfested plastic containers with Ilex crenata 'Helleri' cuttings. Bittercress seedlings were counted on 21 Jan 94. The resulting counts were placed in a grid to determine the dispersal density (seedling/inch^2) by distance from the mother plant. All data was analyzed using analysis of variance and regression analysis. Twelve preemergence herbicides at one rate was evaluated for control of bittercress. Liners of Ligustrum lucidrum were potted into one gallon pots and herbicides were applied using either a shaker can or a C02 backpack sprayer. Bittercress seed (-50) were seeded in the pots after herbicide application and 30 days later. Evaluation of control were made at 30 days and 60 days after application.

Results and Discussion: After five weeks, the average number of siliques per plant was 68, however the number of siliques per plant ranged from 27 to 182. The average number of seeds per silique was 29). The total number of seeds ranged from 675 to 4980 per plant.

Hairy bittercress seeds are dispersed by a spring-like action of the locule (sides) of the silique rolling back on both sides perpendicular to each other. The seed are thrown to each side of the silique on the same plane as the rolling locules. The average seed dispersal distance was 19.7". Germination of bittercress seeds was 90% after 13 days. Germination began after five days with no new germination after 13 days. Greatest germination occurred between 6 and 8 days after sowing. Presumably the other 10% of seeds were either not viable or more likely have a dormancy mechanism for later germination.

Emergence of bittercress from unwashed containers in the study at Carolina Nurseries correlated with previous results. All seedlings were within 1 cm of the edge of the container indicating the seed was in the media residue clinging to the container. There were several seedlings that germinated on the outside of the containers where media residue remained, but these seedlings did not survive. There was a difference between the number of weed seedlings emerging from the dirty compared to clean (rinsed) containers. Location of media collection revealed no difference in number of weed seedlings from the media from different locations indicating that the media was not a significant source of hairy bittercress seed.

Seed dispersal was first observed 16 Dec 93 with seedlings emergence beginning 4 Jan 94 . Silique development, seed dispersal and seedling emergence continued until the end of the study 21 Jan 94. There were 3799 and 5128 seedlings produced from the two mother plants, respectively. Seedlings were counted up to 42" away from the mother plant with the mean dispersal distance being 24". Seedling density at the mean dispersal distance was 0.78 seedlings/ in^2. Overall, seedling density was 1.2 seedlings/ in^2 across the total dispersal area of 5542 in^2.

All preemergence herbicides (Table 1.) except Southern Weedgrass Control and Kerb provided greater than 95% control at 30 and 60 days after application.

Hairy bittercress has the potential to quickly become a problem in a nursery. There were six times more bittercress seedlings in the unwashed containers compared to the washed containers. The problem is amplified by not being able to use preemergence herbicides in propagation.

Significance to the Industry: Hairy bittercress is a prolific seed producer and disperses them efficiently in the propagation areas of nurseries. In trying to control the hairy bittercress, the cycle of seed production must be interrupted. Once this is accomplished a program of hairy bittercress prevention and sanitation should be followed.

Table 1. Preemergence Herbicides, rates and % bittercress control 30 and 60 days after treatment.

Herbicide	Rate (Ibsai/A)	% Bittercress Control 30 DAT	% Bittercress Control 60 DAT
Gallery	0.5	99	100
Snapshot DF	2.0	100	100
Snapshot TG	2.5	97	99
Ronstar	2.0	100	100
Predict	2.4	100	100
OH-2	3.0	95	98
Factor	1.0	100	100
Rout	3.0	100	100
Stakeout	1.0	100	100
Surflan	3.0	100	100
Kerb	1.0	82	87
So. Weed Grass Control	3.0	78	83
LSD (P +0.05)		8.5	13.5

Horizontal Application of BioBarrier for Landscape Weed Control

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Nature of Work: Weed control in landscape beds is major landscape maintenance expense. Repeated chemical applications are also becoming more complicated with increased worker protection and environmental issues. Landscape fabrics, with and without preemergence herbicides, under decorative mulch have long been a standard weed control measure for landscape beds. However, herbicide longevity is limiting and difficult to reapply. BioBarrier, a long-term root control product, has been adapted for horizontal applications for use as a landscape weed control product (1). It uses a unique slow release technology that releases trifluralin herbicide from a polyethylene bead fastened to a non-woven polypropylene fabric, Typar. Trifluralin (Treflan), a preemergence herbicide, is released and forms a chemical barrier. BioBarrier has been previously demonstrated to be an effective means of preventing root encroachment under sidewalks and structures as well as preventing root escape from nursery containers (1, 2). The objective of this study was to determine if BioBarrier can be used as a weed control fabric under decorative landscape mulches.

During May 1994 1-m2 (10.8 ft^2) plots were established on freshly tilled weed-free ground. Five weed control treatments were applied to this plots: control, no treatment; woven polypropylene weed control fabric, non-woven polypropylene weed control fabric, Typar; Typar with slow release trifluralin, BioBarrier; and trifluralin (Treflan 5G) applied at 8.78 g/m^2 (1.8 lb/1000 ft^2). To each of these weed conkol treatments, landscape mulch treatments were applied in a factorial arrangement. The weed control treatments included a control, no mulch; shredded hardwood bark mulch 10 cm deep; shredded hardwood bark mulch 15 cm deep; washed gravel; and decorative lava rock. Each weed control and mulch treatment combination was replicated three times. Winter weedcounts were made in March, 1995 and summer weed counts were made in May 1995.

Results and Discussion: The following winter weeds were identified in the plots: *Allium vineale,* field garlic; *Apium leptophyllum,* marsh parsley; *Capella bursa-pastoris,* shepardspurse; *Cerasium glomeratum,* sticky chickweed; *Erigeron* spp., fleabane; *Geranium carolinianum,* Carolina geranium; *Lamium amplexicaule,* henbit; *Medicago* spp., medicago; *Oenothera lanciniata,* cutleaf evening primrose *Ranunculus* spp., buttercup; *Setaria* spp., foxtail; *Sheradia arvensis,* field madder; *Sonchus arvensis,* sow thistle; *Stellaria media,* common chickweed; *Trifolium repens,* white clover; *Veronica* spp., speedwell; *Vicia* spp., vetch; and *Viola* spp., wild pansy. The following summer weeds were identified in the plots: *Bromus tectorum,* downy brome; *Cuperus rotundus,* purple nutsedge; *Digitaria sanguinalis,* large crabgrass; *Leptochloa* spp., sprangletop; and *Sida spinosa,* prickly sida.

The fewest weed species were found in weed control treatment plots covered with BioBarrier and the most weed species were found in those not covered with fabric (Table 1). Weed control treatments not mulched and not covered with a fabric had more weed plants than those covered with a fabric. All treatments mulched with shredded bark had similar amounts of weed species. Plots mulched with gravel had the fewest weed plants when covered with BioBarrier and Typar compared to the control weed control treatment. Plots mulched with lava rock and treated with trifluralin had the greatest number of weed plants.

Shredded bark, 4 or 6-inches deep, provided satisfactory weed control regardless of the weed control treatment under it. All the fabrics also provided adequate weed control under gravel and lava rock, but BioBarrier, Typar fabric with slow-release trifluralin beads attached, provided the most consistent weed control under the mulches tested. However, it must be noted that the Typar fabric and the BioBarrier fabric plots not covered with mulch had begun to deteriorate with exposure to the elements.

Significance to the Industry: Trifluralin impregnated fabric, BioBarrier, applied horizontally under landscape mulch is effective in controlling weed establishment. Under thin, non-organic decorative mulches, BioBarrier has superior weed control capacities compared to traditional landscape fabrics. However, due to the lack of ultraviolet light stability of the polypropylene Typar fabric, it must be covered by some form of mulch.

Literature Cited

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2. Newman, S.E. and J.R. Quarrels. 1994. Chemical root pruning of container-grown trees using trifluralin and copper impregnated fabric. Proc. SNA Res. Conf. 39:75-77.

Table 1. Total number of weed plants found on plots treated covered with various weed control treatments and decorative landscape mulches.

	Landscape Mulch Treatment				
Weed Control Treatment	Control	Shredded Bark (4")	Shredded Bark (6")	Gravel	Lava
	Number of weed plants				
Control	47.00a[z]	0.33 a	0.67a	26.70a	3.33a
Polypropylene	2.67 b	0.33 a	0.33 a	15.70 ab	1.33 a
BioBarrier	0.00 b	0.33 a	0.67 a	0.00 c	0.00 a
Trifluralin	34.70 a	1.33 a	0.00 a	15.00 ab	13.00 a
Typar	0.00 b	0.33 a	0.00 a	10.30 bc	0.33 a

[z] Means followed by the same letter are not significantly different at the 5% level of probability comparing least-squares means.

Tolerance of *Buddleia davidii* 'Charming Summer' to Preemergence Herbicides

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Nature of Work: Butterfly-bush (*Buddleia davidii*) is a common shrub in the nursery/ landscape industry. Hardy to zone 5, butterfly-bush offers durability and an extended floral display throughout the summer months (1). As its namesake suggests, butterfly-bush attracts butterflies and other nectar-feeding insects. In a quantitative comparison of 10 *B. davidii* cultivars for floral nectar and sugar content (2), 'Charming Summer' ranked highest, justifying wider use in butterfly gardens and insectaries.

The nursery production of butterfly-bush may require the use of herbicides to control weed infestations. However, limited information is available on the tolerance of *B. davidii* to preemergence herbicides. Also, little is known about herbicide tolerance of butterfly-bush relative to container size or rooting volume.

A study was initiated to evaluate the tolerance of 'Charming Summer' butterfly-bush (*B. davidii* 'Charming Summer') to selected preemergence herbicides grown in 2 in. x 2 in. propagation pots and 1 gallon containers. The experimental design was a randomized complete block with six replications per treatment. On August 20, 1993, rooted cuttings were potted up in containers of both sizes at the SC Botanical Garden in Clemson, SC. The potting medium was composed of a 9:1 pine bark: sand mixture with the addition of a slow-release fertilizer (Osmocote 17-6-12, 3-4 month plus minors). The granular herbicides tested were Snapshot 2.5TG (6 lb/A), Stakeout 1G (2 lb/A), Southern Weedgrass Control (SWGC) 2.68G (6 lb/A), Scotts OH2 (6 lb/A), and Pennant (6 lb/A). The sprayable formulation was Gallery 75 DF (1 lb/A). All herbicides were applied at twice the maximum use rate. Granular formulations were applied using a shaker jar. The sprayable herbicide was applied over the top of the nursery plants using a CO_2-pressurized backpack sprayer delivering 40 gallons per acre and 40 psi. Pots were treated on September 8, 1993 in the afternoon under sunny skies and 85°F air temperature and 46% RH. Pots were irrigated one hour after the herbicide applications.

'Charming Summer' plants were evaluated visually during the course of the study and rated on a scale from 0 to 100%, where 0 = no injury and 100% = completely killed. Growth index ([width 1 + width 2 + height/3) was measured 42 days after treatment (DAT). Shoots and roots were harvested 42 DAT and dried in a forced air oven at 158 °F for 2 weeks for determination of dry weights.

Results and Discussion: Gallery caused extensive visible injury to 'Charming Summer' in the 2 x 2 and 1 gallon pots (Table 1). In a previous study, the same rate of Gallery killed *B. davidii* 'Harlequin' growing in 1 gal. containers (3). Although Snapshot (isoxaben + trifluralin) contains one of the same active ingredients found in Gallery (isoxaben), no significant injury was observed. No significant injury was observed with the other herbicide treatments.

The growth index and shoot and root dry weights was reduced by the Gallery treatment in both container sizes (Tables 2 and 3). No growth reduction was observed with the other preemergent herbicides.

Significance to Industry: To reduce the labor costs associated with hand-weeding, the granular preemergent herbicides evaluated in this study can be applied to 2 in. x 2 in. propagation pots or 1 gallon containers of ‘Charming Summer.’ Other *Buddleia* species and cultivars must be evaluated for tolerance to these and other preemergent herbicides prior to application.

Literature Cited

1. Dirr, M. A. 1990. Manual of Woody Landscape Plants: Their identification, ornamental characteristics, culture, propagation and uses. Stipes Pub. Co. Champaign, IL. 1007 p.

2. Culin, J. D. Summary of 1994 Buddleia davidii nectar data. J. D. Culin, Department of Entomology, Clemson University, Clemson, SC 29634 (unpublished data).

3. Whitwell, T. et al. 1992. 1991-92 Turf and ornamental weed research report. Department of Horticulture, Clemson University, Clemson, SC 29634 (unpublished data).

Table 1. Visual injury ratings[z] of *B. davidii* ‘Charming Summer.’

Treatment	% Injury 5 DAT[y]		% Injury 42 DAT	
	2 x 2	1 gal.	2 x 2	1 gal.
Snapshot 2.5 TG	0	3	3	18
Stakeout .25G	3	2	5	3
SWGC 2.68G	1	3	1	0
Scotts OH2 3G	1	3	4	1
Pennant 5G	4	2	3	1
Gallery 75 WP	23	31	50	32
LSD (0.05)	4	4	17	23

[z]0 = no injury and 100% = completely killed.
[y]DAT = days after treatment

Table 2. Growth index[z] of *B. davidii* 'Charming Summer' 42 days after treatment.

Treatment	Growth Index	
	2 x 2	1 gal
Untreated	15.1	36.3
Snapshot 2.5 TG	14.9	28.2
Stakeout .25G	12.0	37.4
SWGC 2.68G	14.9	37.5
Scotts OH2 3G	15.8	35.1
Pennant 5G	13.8	40.5
Gallery 75 WP	9.6	24.2
LSD (0.05)	3.8	9.4

[z](width 1 + width 2 + height)/3

Table 3. Shoot and root dry weights of *B. davidii* 'Charming Summer' 42 days after treatment.

Treatment	Shoot dry weight (grams)		Root dry weight (grams)	
	2 x 2	1 gal.	2 x 2	1 gal.
Untreated	0.92	5.43	0.45	3.60
Snapshot 2.5 TG	1.04	3.69	0.43	2.28
Stakeout .25G	0.56	6.00	0.30	2.93
SWGC 2.68G	0.90	6.08	0.44	3.56
Scotts OH2 3G	1.13	5.13	0.59	2.99
Pennant 5G	0.75	6.79	0.52	3.58
Gallery 75 WP	0.29	2.54	0.13	1.36
LSD (0.05)	0.48	2.55	0.22	1.84