Fungicide sprays applied monthly by a concentrate air-blast sprayer are extended beyond their effective residual period. Biweekly sprays are needed to control *Entomosporium* leaf spot on Fraser photinia (*Photinia* × *fraseri*), and anthracnose scab caused by *Colletotrichum* spp. on *Euonymus japonica* 'Silver King', *E. japonica* 'Gold Spot', and 'Gracilis' [syn. *E. fortunei* var. *radicans* 'Argenteo-variegata']. Other seasonal diseases requiring additional fungicide treatments are *Rhizoctonia solani*, web blight, on *Ilex crenata* 'Helleri' and gumpo azalea (*Rhododendron* 'Gumpo'); and *Botrytis cinerea*, gray mold, on *Gardenia jasminoides* 'Mystery', and various azaleas.

Spray application by hand gun in tightly-packed overwintering houses is time consuming and semi-effective in controlling various foliar diseases. A biweekly fungigation has demonstrated improved disease control.

In summary, fungigation is an excellent labor-saving method to apply soil drenches. We have reduced disease problems in overwintering houses with biweekly applications. Large areas may be covered quickly when weather conditions are unfavorable to spray applications over long intervals. Fungicide residues may be effectively supplemented between scheduled sprays. Phytotoxicity of some fungicides to susceptible plants also appears to have been reduced in fungigation. It is also possible to make foliar applications. However, it is difficult to get even distribution over large areas due to differences in the distance from the source. This method can be used on concentrated small blocks of plants.

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POSTEMERGENCE HERBICIDES — WHAT WORKS?

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Weed control from preemergence herbicides is often unacceptable for numerous reasons including improper timing and rate of application, weather conditions, or excessive

volatilization loss. Hand labor is normally used to remove escape weeds. If weeds are not removed, they compete with ornamental plants for water, nutrients, and light. Weed competition can reduce growth of container-grown plants by 50% or more (4). An alternative to hand weeding of escape grass weeds is now available with the labeling of Fusilade (fluazifop-butyl) and Poast (sethoxydim) herbicides for postemergence application in ornamentals. Fusilade is produced by ICI Americas Inc., Wilmington, Delaware, and Poast by BASF Wyandotte Corp., Parsippany, New Jersey. Both materials control annual and perennial grasses (including quackgrass). Neither of these materials has any activity on nutsedge.

The first symptom of Fusilade and Poast activity is growth cessation, followed by death of the terminal growth points and interveinal reddening of the grass blades. Under ideal growing conditions this may take 5 to 10 days, depending on the grass species, size of the grass plants, application rate, and environmental conditions. With less than optimum conditions it may require 2 weeks for initial symptoms to appear. Grass treated with effective rates of Fusilade or Poast are generally dead no sooner than 2 to 4 weeks after treatment.

APPLICATION RATES AND NUMBER OF APPLICATIONS

In 1982 we compared split applications with single applications of Poast and Fusilade on *Taxus cuspidata* infested with common Bermuda grass. Herbicides were applied on July 29 and August 11 when Bermuda grass runners were 6 to 12 in long. Both herbicides included 1% crop oil concentrate by volume, and spray solution was applied at 20 gpa.

Grass control and phytotoxicity were evaluated 14, 30, 45, and 70 days after application. Rating for phytotoxicity was: 10 = no damage to 1 = dead plant.

For 90% control after 70 days the minimum rates of Fusilade and Poast were ½ and 1 lb/A ai (active ingredient), respectively (Table 1). A single application of ½ lb/A ai of Fusilade, or 2 applications of ¼ lb/A ai, resulted in greater than 95% control of common Bermuda grass. Lower rates resulted in initial dieback, but regrowth occurred. There appeared to be no advantage to applying a higher rate than that required for 90% control after 70 days. Cultivating several weeks after the first application will also help prevent regrowth of perennial grass (6).

Table 1. A comparison of single and split applications of Poast and Fusilade on percent control of Bermuda grass.

The effects of varying application rates				
	Pecent control			
	Days after application			
Treatments	14	30	45	70
Fusilade (single applications)				
¼ lb/A ai	38fg[z]	90a	78b	63ab
½ lb/A ai	42efg	90a	93ab	97a
1 lb/A ai	88ab	100a	98a	100a
2 lb/A ai	90a	98a	100a	100a
Fusilade (split applications)				
¼, ¼ lb/A ai	33g	100a	100a	100a
½, ½ lb/A ai	52defg	100a	100a	100a
1, 1 lb/A ai	62cdef	100a	100a	100a
Poast (single applications)				
¼ lb/A ai	28g	38c	13d	3c
½ lb/A ai	52defg	63b	58c	58b
1 lb/A ai	68abcd	90a	90ab	95a
2 lb/A ai	77abc	92a	95a	95ab
Poast (split applications)				
¼, ¼ lb/A ai	35g	97a	85ab	72ab
½, ½ lb/A ai	52defg	93a	95a	98a
1, 1 lb/A ai	65bcde	98a	100a	98a
Crop oil concentrate				
1% by volume	3h	8d	0d	0c

[z] Figures with the same letters in the same columns are not significantly different from each other at the 5 percent level by Duncan's multiple range test. There was 0 percent control in a check plot.

For annual grasses ¼ lb/A ai of either material provided excellent control when applied once at the correct stage of growth (4 to 8 inches). Fusilade has been reported to be more effective against quack grass than Poast (1) and Poast better than Fusilade against crabgrass (3). Fusilade at 2 lb/A ai provided excellent quack grass control (1).

FACTORS AFFECTING ACTIVITY

Fusilade and Poast are most effective when applied to grasses that are growing rapidly. Generally grass should be treated when 4 to 8 in high, although Johnson grass up to 18 to 24 in can be controlled with the ½ lb/A ai rate. Annual grass larger than 4 to 8 in should be treated with ½ lb/A ai. Applications to grass under stress caused by problems such as drought or excessively high temperature will result in erratic control. Also, mature weeds are more difficult to control than young, actively growing weeds.

Low spray volumes of water have been more effective than large amounts. In our research a volume of 20 gpa was used. For tall or relatively dense grass the spray pressure

should be increased, which would also result in increased volume and rate/acre if all other factors are held constant. Spray pressure of about 40 psi is adequate. With Poast the addition of a crop oil concentrate at the rate of 1% by volume is necessary for optimum activity (1¼ oz/gal, 1 qt/25 gal or 1 gal/100 gal). With Fusilade either a crop oil concentrate at this rate or a non-ionic surfactant should be added. For sensitive species the non-ionic surfactant is recommended. The non-ionic surfactant should be applied at half the rate of the crop oil concentrate or 0.5% by volume.

Fusilade and Poast are rapidly absorbed by the weed's foliage, and under ideal conditions almost complete uptake may occur within an hour. After absorption the chemicals are translocated to both root and shoot growing points. Recent work by Willis (9) showed that uptake of Poast was greater at 95°F with 100% relative humidity (RH) compared to 65°F with 100% RH. At 65°F accumulation of Poast was confined almost completely to the stem and leaves of the treated branch, while at 95°F Poast was translocated throughout all branches of the shoot. These data show that application of both Fusilade and Poast at environmental conditions that favor absorption and translocation will result in increased grass control.

PHYTOTOXICITY

Fusilade and Poast are generally safe when applied over-the-top of ornamentals. Table 2 lists many plants reported in current literature and gives their response to Fusilade and Poast. Most of the plants showing injury from Fusilade were tested with a 1% crop oil concentrate.

Some azaleas have been reported to be sensitive to Fusilade (2,5). After extensive testing it appears that the Hino group of azaleas is the most sensitive of the azaleas commonly grown. Included in this group are 'Hino-crimson', 'Hexe', and 'Hinode-giri'. In 1983 a study was conducted to characterize the effects of Fusilade 4E on growth of 'Hino-crimson' azalea. Application of Fusilade 4E resulted in phytotoxicity symptoms ranging from death of the terminal bud (¼ lb/A ai) to stem dieback 1 to 3 cm in length (1 lb/A ai) (Table 3).

Within 60 days azaleas treated with the ¼ lb/A rate were similar to the untreated plants. Also the non-ionic surfactant, Activate, enhanced the activity of Fusilade 4E. While data are not presented, the increased phytotoxicity with 0.5% Activate occurred mainly at the 1 lb/A rate. Death of the terminal buds resulted in an effect similar to pruning of the plants. Plant height and growth index were suppressed with rates as low as ¼ lb/A ai. Also application of Fusilade at ¼ lb/A resulted in

Table 2. Tolerance of some woody ornamentals to the herbicides, Fusilade and Poast.

Plant species	Fusilade		Poast	
	Safe	Injury	Safe	Injury
Information from literature citation 8[a].				
Buxus sempervirens, Common boxwood	x		x	
Chamaecyparis lawsoniana 'Allumii,'Allum lawson cypress	x		x	
Cotoneaster salicifolius, Willowleaf cotoneaster	x		x	
C. sp , 'Coral Beauty' cotoneaster	x		x	
Euonymus alata, Winged euonymus	x		x	
E flortunei 'Emerald Gaity,' Emerald gaity euonymus	x		x	
Forysythia sp , Weeping forsythia	x		x	
Ilex crenata 'Green Luster,' Green luster Japanese holly	x		x	
Ilex glabra 'Compacta,' Compact inkberry	x		x	
Juniperus horizontalis 'Hughes,' Hughes juniper	x		x	
J sp., 'Blue Pacific,' Blue Pacific juniper	x		x	
Pinus mugo, Dwarf mugo pine	x		x	
Pyracantha coccinea 'Lalandii,' Laland firethorn	x		x	
Pyracantha 'Mohave', Mohave firethorn	x		x	
Rhododendron 'Gibralter', Gibralter azalea	x		x	
R 'Herbert', Herbert azalea (Gable hybrid)	x		x	
R. yedoense var. poukhanense, Korean azalea	x		x	
R. sp , Girard's rose Exbury				
R sp., Mother's Day azalea	x		x	
Syringa patula, Korean lilac	x		x	
Taxus sp., Dense yew	x		x	
Thuja occidentalis 'Techny', Techney American arborvitae	x		x	
Information from literature citation 3[b].				
Acer rubrum, red maple	x	x (slight)	x	
Forsythia sp., Golden bells forsythia	x		x	
Hedra helix, English ivy	x		x	

Table 2. Tolerance of some woody ornamentals to the herbicides, Fusilade and Poast. (continued)

	Fusilade		Poast	
Plant species	Safe	Injury	Safe	Injury
Juniperus chinesis 'Pfitzerana,' Pfitzer juniper	x		x	
Rhododendron sp., Hershey red azalea	x		x	
R 'Roseum Elegans', Roseum elegans rhododendron	x		x	
Taxus × *media* 'Hicksii', Hicks yew	x		x	
Thuja occidentalis 'Globosa' Globe arborvitae	x		x	
Viburnum plicatum, Japanese snowball	x		x	
Information from tests at Auburn University				
Acuba sp , Aucuba	x		x	
Buxus sp , Wintergreen boxwood	x		x	
Cercis canadensis, Eastern redbud		x (marginal leaf burn)		x (marginal leaf burn)
Cornus sp., White dogwood	x			x (some burn)
Cotoneaster sp , Cotoneaster	x		x	
Euonymus sp , Burning bush euonymus	x		x	
Gardenia sp., Gardenia	x		x	
Hydrangea sp., Snowflake hydrangea	x		x	
Ilex crenata 'Hetzii,' Hetz holly	x		x	
Ilex crenata 'Rotundifolia,' Rotundifolia holly	x		x	
Juniperus chinensis 'Pfitzerana Compacta' Nick's compact juniper	x		x	
Juniperus horizontalis 'Plumosa', Andorra juniper	x		x	
J. sp., Blue Pacific juniper	x		x	
Photinia × *fraseri*, Fraser photinia	x		x	
Prunus serrulata 'Kwanzan', kwanzan cherry	x			x
Pyrus calleryana 'Bradford', Bradford pear	x		x	
Rhododendron 'Coral Bells', Coral bells azalea	x		x	
R. 'Hexe', Hexe azalea		x (terminal death	x	
R. 'Hino-crimson', Hino-crimson		x (terminal death)	x	

Table 2. Tolerance of some woody ornamentals to the herbicides, Fusilade and Poast. (continued)

	Fusilade		Poast	
Plant species	Safe	Injury	Safe	Injury
R. 'Hinodegiri', Hinodegiri azalea		x (terminal death)		
R. sp , Deleware Valley white azalea	x		x	
R. sp., Gulf pride azalea	x		x	
R sp., Pride of Mobile azalea	x		x	
R. sp., White gumpo azalea	x		x	
Taxus × *media* 'Hicksii', Hicks yew	x		x	
Vaccinium sp., Blueberry	x			x (marginal leaf burn)

[a] A crop oil concentrate at 190 V/V was used.
[b] Tolerance rating based on use of 1% crop oil concentrate.

increased shoot numbers when evaluated 12 weeks after applications, and consequently, in increased flower number the following spring. Even though azaleas treated with the 1 lb/A rate had greater shoot numbers in late October, there were fewer flowers in April. This is primarily attributed to the delayed shoot flush as a result of the stem dieback. Lateral shoots developed rapidly on plants treated with ¼ lb/A of Fusilade while plants treated with the 1 lb/A rate broke much later. As a result flower bud formation did not occur because of the late developing shoots. These data would suggest that even ¼ lb/A, if applied too late in the season, could potentially reduce flower number.

In summary, phytotoxicity of Fusilade on 'Hino-crimson' azalea has an affect similar to pruning. In fact, the symptoms are similar to a commonly used chemical pruning agent, Off-Shoot-O. If used at the proper rate, growers should not be hesitant to use Fusilade in azalea production. Timing of late season applications is under evaluation.

FUTURE MATERIALS

Fusilade and Poast are among the most recently labeled herbicides for ornamental crops, but what does the future hold for postemergence grass herbicides? Currently, there are about 8 postemergence grass herbicides in the development channels. All these new materials have the common property of rapid absorption by the plant within a few hours. Generally, absorption is equal in target and nontarget plants, but herbicidal effects are evident only in grasses. As with Fusilade and Poast, the moisture status of the targeted grass species is criti-

Table 3. Effects of Fusilade 4E on growth and flowering of container-grown 'Hino-crimson' azalea.

Treatment	lb/A ai	Phytotoxicity — days after treatment 15	30	60	Height (cm)	GI[z]	Per plant shoot numbers 1°	2°	Number of flower buds per plant	Degree of flower opening
Control	0	10.0[y]	10.0	9.9	28.9	31.0	3.6	10.0	85[x]	3.7
Fusilade 4E	¼	8.8	8.7	9.6	23.0	28.7	4.6	12.1	106	3.5
Fusilade 4E	1.0	5.0	5.3	4.9	22.3	26.2	4.3	13.6	45	2.8
Significance Linear		NS	NS	**	**	**	NS	NS	*	NS
Quadratic		**	**	**	*	NS	*	**	*	NS
Activate .25%		8.2	8.5	8.8	24.3	29.1	4.4	7.3	73	3.0
Activate .50%		7.6	7.4	7.5	25.0	28.2	4.6	8.8	88	3.6
Significance		**	**	**	NS	NS	NS	*	*	NS
Fusilade × activate		**	**	**	NS	NS	NS	NS	NS	NS

[z] Plants were treated August 2, 1983. Height, growth index $\frac{\text{height} + \text{width 1} + \text{width 2}}{3}$ and shoot number data were taken October 28, The number of flower buds and degree of flower opening data were taken April 10, 1984.

[y] Phytotoxicity rating scale used was 1 = dead plant, 2 = 3-6 cm stem die back, 4 = 1-3 cm stem dieback, 6 = necrotic leaves and dead terminals, 8 = dead terminals, 10 = normal plant growth.

[z] Degree of flower opening was rated on April 10, 1984, on a scale of 1 to 5 where 1 = no color showing, and 5 = full flower opening.

cal with respect to achieving total control. These products were initially developed for control of Johnson grass and Bermuda grass in cotton and soybean; however, with Fusilade and Poast an ornamental label was given at the same time as the cotton and soybean labels.

During 1983 and 1984 we evaluated several of these new materials with respect to grass control, phytotoxicity, and preemergence activity. Of the materials tested, Assure, Verdict, and SC 1084 have shown good grass control and some limited preemergence activity. In a 1983 test, SC 1084 provided about 4 weeks of preemergence activity; Verdict resulted in similar activity in a 1984 test.

PREEMERGENCE ACTIVITY

Fusilade and Poast are generally recognized as providing no preemergence activity (7). However, Bhowmik (1) reported that both Fusilade and Poast showed residual preemergence activity in controlling annual grasses. In 1983 Fusilade, Poast, and SC 1084 were compared for grass control and duration of any preemergence activity. *Euonymus alata* 'Compacta' plants in containers were overseeded with equal amounts of goosegrass and large crabgrass one month prior to, and again 2 weeks after, herbicide application. Grass seedlings were 4 to 6 inches in height at the time of treatment. This experiment was conducted in July and again in September. SC 1084 provided about 4 weeks of preemergence activity in each experiment, while Fusilade provided about 5 weeks of preemergence activity in Exp. 2. In Exp. 1, Fusilade provided both poor postemergence grass control and no preemergence activity. These results are contrary to subsequent work and probably reflect improper application rates.

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NURSERY MECHANICAL SYSTEMS

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Polk Nursery is located in the heart of peninsular Florida, midway between Tampa and Orlando. The operation was started in 1916 as an *Asparagus setaceus* 'Nanus' [syn. *A. plumosus* 'Nanus'] fernery and was converted 30 years ago to a wholesale woody-stem container nursery. The production today occupies 130 acres. Heated polyhouses cover 15 acres and 80 acres are irrigated for 32°F cold protection. The woody stem production is 85% blooming or showy plants in 6-, 8-, and 10-inch containers. Plants are delivered on company trucks within 200 miles. Over half of the plants are delivered within 72 hours after they are sold. The intensive care and warmth of Florida affords two turns of production with 140 employees and 130 pieces of mechanical equipment. The selection of mechanical equipment that we use was based on a 5-year payout of initial cost and maintenance. The savings may be in reduced labor, increased speed or production, improved quality, lower maintenance, or measurable job dependability. For this to be accomplished, we find that it is most important to build or purchase maintenance-free equipment, have parts and service dependability, get a machine larger than you think the job requires, and use only operators that will care for equipment.

One of the loaders and sprayers that we use has been operating for over 20 years. Our employees show more concern for equipment that does not look neglected. The Bouldin and Lawson flat filler does an excellent job. Our only wish is that this company would build heavy-duty models. It is mandatory that the 28 miles of roadways be maintained for all of the equipment. Water control also is never-ending with 50 in. of rain plus 150 in. of supplemental irrigation.