Table 5. Effect of growth regulators applied in a bulb soak on growth and flowering of Easter Lily cv. Ace (1990).

Chemical	Concentration ($mg \cdot l^{-1}$)	Soak Time (min.)	Plant Height (in.)	Number Days to Flower	Number Flowers
Water	–	1.0	21.7 a[z]	112.5 abc	4.3 ab
Water	–	2.0	22.2 a	115.9 ab	4.2 ab
Ancymidol	20	1.0	16.8 b	118.5 a	3.4 ab
Ancymidol	20	2.0	16.4 bc	112.4 abc	4.2 ab
Uniconazole	1.25	1.0	14.4 cd	110.6 bcd	4.6 a
Uniconazole	1.25	2.0	15.8 bc	104.0 d	4.5 a
Uniconazole	2.5	1.0	12.4 de	109.5 bcd	3.1 b
Uniconazole	2.5	2.0	14.1 cd	106.6 cd	3.4 ab
Uniconazole	5.0	1.0	10.8 ef	107.6 cd	3.4 ab
Uniconazole	5.0	2.0	9.6 f	106.2 cd	3.7 ab

[z]Mean separation within columns by Duncan's Multiple Range Test, 5% level.

bulbs is a gamble that should not be made. Soil or foliar applications are less risky.

Literature Cited

1. Anonymous. 1990. Floriculture crops. 1989 summary. USDA Agr. Stat. Board Circ. SpCr 6-1 (90).
2. Bailey, D. A. and W. B. Miller. 1989. Whole-plant response of Easter lilies to ancymidol and uniconazole. J. Amer. Soc. Hort. Sci. 114(3):393-396.
3. Bearce, B. C. and S. Singha. 1990. Growth and flowering response of Asiatic hybrid lilies to uniconazole. HortScience 25(10):1307.
4. Giafagna, T. J. and G. J. Wulster. 1986. Comparative effects of ancymidol and paclobutrazol on Easter lily. HortScience 21(2):463-464.
5. Erwin, J. E., R. D. Heins, M. Karlsson, R. Berghage, W. Carlson, and J. Bierbaum. 1987. The basics on Easter lilies: light and temperature. Grower Talks 51(7):84-90.
6. Heins, R. D., H. F. Wilkins, and W. E. Healy. 1982. The influence of light on lily (*Lilium longiflorum* Thunb.): II. Influence of photoperiod and light stress on flower number, height, and growth rate. J. Amer. Soc. Hort. Sci. 107:335-338.
7. Jiao, J., M. J. Tsujita, and D. P. Murr. 1986. Effects of paclobutrazol, A-Rest, and gibberellic acid on growth, flowering, leaf carbohydrate and leaf senescence in 'Nellie White' Easter lily (*Lilium longiflorum* Thunb.). Scientia Hort. 30:135-141.
8. Jiao, J., X. Wang, and M. J. Tsujita. 1990. Comparative effects of uniconazole drench and spray on shoot elongation of hybrid lilies. HortScience 25(10):1244-1246.
9. Johnson, C. R. 1973. Effectiveness of ancymidol on reducing height of Easter lilies grown under different environments. Proc. Fla. State Hort. Soc. 86:380-382.
10. Kohn, H. C., Jr. and R. L. Nelson. 1963. Daylength and light intensity as independent factors in determining height of Easter lilies. Proc. Amer. Soc. Hort. Sci. 83:808-810.
11. Larson, R. A. and R. K. Kimmons. 1971. Results with a new growth regulator. Flor. Rev. 148:22-23, 54-55.
12. Larson, R. A. 1986. Bonzi: A new growth regulator for floricultural crops. N. Carolina Flw. Growers Bull. 30(2):1-21.
13. Lewis, A. J. and J. S. Lewis. 1981. Improving ancymidol efficiency for height control of Easter lily. HortScience 16(1):89-90.
14. Lewis, A. J. and J. S. Lewis. 1982. Height control of *Lilium longiflorum* Thunb. 'Ace' using ancymidol bulb dips. HortScience 17(3):336-337.
15. Menhenett, R., W. M. Squires, and L. R. Hanks. 1983. Growth retardants for pot-grown lilies. Rept. Glasshouse Crops Res. Inst. pp. 70-73.
16. Rademacher, W. and J. Jung. 1986. GA biosynthesis inhibitors—an update. Proc. Plant Growth Reg. Soc. of Amer. 13:102-114.
17. Roh, S. M. and H. F. Wilkins. 1973. The influence of day and night temperatures from visible buds to anthesis of the Easter lily (*Lilium longiflorum* cv. Ace). HortScience 8(1):129-130.
18. Roh, S. M. and H. F. Wilkins. 1977. The influence and interaction of ancymidol and photoperiod on growth of *Lilium longiflorum* Thunb. J. Amer. Soc. Hort. Sci. 102(3):255-257.
19. Sanderson, K. C., W. C. Martin, Jr., K. A. Marcus, and W. E. Goslin. 1975. Effects of plant growth regulators on *Lilium longiflorum* Thunb. cv. Georgia. HortScience 10(4):611-612.
20. Shanks, J. B. 1983. Comparative efficiency of ICI compounds PP. 333 and PP-296 on selected ornamental plants. Proc. 9th Ann. Mtg. Plant Growth Reg. Soc. of Amer. 9:68-75.
21. Wang, Y. T. and A. N. Roberts. 1983. Influence of air and soil temperatures on the growth and development of *Lilium longiflorum* Thunb. during different growth phases. J. Amer. Soc. Hort. Sci. 108(5):810-815.
22. White, J. W. 1972. Easter lily height control—progress report III. Pa. Flower Growers Bull. 247:1-3,12.
23. Wilfret, G. J. 1987. Height retardation of Easter lilies grown in containers. Proc. Fla. State Hort. Soc. 100:379-382.
24. Wilkins, H. F. 1980. Easter Lilies. In: Introduction to Floriculture, R. A. Larson, ed. Academic Press (New York). pp. 327-352.
25. Wilkins, H. F., K. Grueber, W. Healy, and A. B. Pemberton. 1986. Minimum florescent light requirements and ancymidol interaction on the growth of Easter lily. J. Amer. Soc. Hort. Sci. 111(3):384-387.
26. Wulster, G. J., T. J. Gianfagna, and B. B. Clarke. 1987. Comparative effects of ancymidol, triadimefon, and Mobay RSW0411 on lily height. HortScience 22(4):601-602.

Proc. Fla. State Hort. Soc. 103:206-209. 1990.

PREMIER®—A PROMISING AND ENVIRONMENTALLY DESIRABLE HERBICIDE FOR USE IN ORNAMENTAL PLANTINGS

JOHN B. TAYLOR
CIBA-GEIGY Corp.
1400 International Speedway Blvd.
DeLand, FL 32724

MERRILL WILCOX
University of Florida, IFAS
HML, Agronomy Dept.
Gainesville, FL 32611-0731

Florida Agricultural Experiment Station Journal Series No.R-01370. We gratefully acknowledge graphic art by Lyda Toy and manuscript preparation by Susan Durden.

Abstract: **Premier® (fluometralin), a unique chemical hybrid of dinitroaniline chemistry, has exhibited an unusual spectrum of herbicidal activity not normally associated with that chemical class. An unusual high partitioning coefficient value more than eliminates environmental concerns for groundwater contamination due to leaching.**

Any chemical weed control program in Florida has to be tempered with a concern for groundwater contamination caused by excessive leaching. Florida's well-drained sandy soils coupled with high rainfall and irrigation practices mandate a close examination of herbicide chemistry if groundwater contamination is to be avoided. Landscape plantings and ornamental crop production areas offer sites of major concern. Herbicides used in these areas should have low water solubility and/or a high partition coefficient value.

Fluometralin (Premier®) is a hybrid two-ring molecule, one ring being a dinitroaniline, the other ring being a diorthohalobenzemethane. The dinitroaniline ring contributes the powerful binding to the soil which is responsible for the group's characteristic low mobility. The halobenzenemethane ring contributes both an improved spectrum of activity and a diminished water solubility, further reducing the mobility of the fluometralin in the soil. This is the only commercial herbicide containing a second ring in addition to the dinitroaniline ring; all other dinitroanilines have simple, short carbon chains instead.

Herbicides of the dinitroaniline chemistries normally have high partition coefficient values, i.e. trifluralin at 7,000 and pendimethalin at 24,300. Fluometralin's value is 14,000 ml/g compared to other chemistries such as simazine at 138 and metolachlor at 200. These indices alone are not an absolute measure of potential to contaminate groundwater, but they should trigger a concern for such.

Dinitroaniline herbicides are generally referred to as grass herbicides. With some few exceptions, that can be considered an accurate statement. Fluometralin is one of those few exceptions, and that activity on broadleaf weeds will be presented and examined here as well as crop safety and selectivity.

Materials and Methods

Several experiments were conducted from 1987 through 1990 on woody ornamentals and field-grown leatherleaf fern (*Rumohra and diantiformis*) located in Orange, Lake, Volusia, and Clay Counties. A sprayer delivering 50 gal/A at 20 psi and 2 mph was used.

Experiment No. 1 Fluometralin formulated as Premier® 1.2 E and 2G was applied to established Leatherleaf fern heavily infested with Florida betony (*Stachys floridana*) and other weeds on 17 Jun 1988 and 17 Nov 1988. The 2G formulation was applied with a modified drop spreader to dry foliage and then irrigated. The 1.2E formulation was applied with a B&G plot sprayer to wet foliage and immediately irrigated in to simulate a chemigation application. Treatments were applied to plots of 60 sq ft assigned in a randomized complete block design replicated four times. Treatments were postemergence except preemergence to crabgrass.

Experiment 2. Fluometralin formulated as 1.2E at 2, 3, 6, and 8 lbs ai/acre was applied on 7 Dec 1988 to established Leatherleaf fern as a wet foliage application described in Experiment No. 1 to plots of 60 sq ft replicated four times. The experimental area was heavily infested with Florida betony and, to a lesser extent, common dayflower (*Commelina communis*) at the time of treatment.

Experiment No. 3. Fluometralin formulated as 2G was applied preemergence to weeds to 6-month-old Laurel oaks (*Quercus hemisphaerica*) in 3-gallon containers at 3, 4, and 6 lbs ai/acre and metolachlor 5G and Derby® (metholachlor and simazine, 4:1) 5 G at 5 lbs ai/acre, respectively, on 23 Jun 1988, 10 Nov 1988, 12 Apr 1989, and 13 Jul 1989. The experimental unit consisted of four trees in a randomized complete block design replicated four times.

Experiment No. 4. Fluometralin formulated as 2G was applied preemergence at 2, 4, 6, and 8 lbs ai/acre to Asparagus plumosus fern (*Asparagus setaceus*) in 60 sq ft plots and replicated four times in a randomized complete block design on 17 Jun and 17 Nov 1988. Dayflower and betony were well established before treatment.

Experiment No. 5 Fluometrin formulated as 1.2E was applied postemergence on 12 Sept 1990 at 2, 3, and 6 lbs ai/acre to two year old field grown Laurel oaks, heavily infested with Florida and Brazil pusley (*Richardia scabra* and *R. brasiliensis*) in 60 sq ft plots in a randomized complete block design, replicated three times.

Experiment No. 6. Fluometralin formulated as 1.2E was applied postemergence on 17 Sept 1990 at 2, 3, and 6 lbs ai/acre to one year old Hamlin oranges (*Citrus sp.*), heavily infested with Florida and Brazil pusley, in single tree plots of 16 sq ft, replicated four times.

Results

Experiment No. 1. (Table 1) Control of crabgrass (*Digitaria sp.*) was good to excellent at 2-3 lbs fluometralin ai/acre. One lb ai/acre did not provide acceptable control of any of the weed species. Control of Florida betony is

Table 1. Fluometralin in control of weeds in Leatherleaf fern (*Rumohra andiantiformis* in Expt. 1.

		Control, %[y]					
		15 Aug 1988			16 Feb 1989		
Treatment[z]	lb ai/acre	Phyto	C.G.	D.F.	Phyto	FL.B.	D.F.
Fluometralin 1.2E	1.0	0	65	40	0	78	70
Fluometralin 1.2E	2.0	0	90	70	0	90	75
Fluometralin 1.2E	3.0	0	100	70	0	100	75
Fluometralin 2G	1.0	0	45	40	0	70	40
Fluometralin 2G	2.0	0	80	60	0	80	70
Fluometralin 2G	3.0	0	90	70	0	95	65
Check	–	–	–	–	–	–	–

[z]Application dates: 17 Jun 1988, 17 Nov 1988
Plot size: 60 sq ft x 4 replications
[y]Legend: C.G. = Crabgrass (*Digitaria sp.*)
D. F. = Dayflower (*Commelina communis*)
FL.B. = Florida betony (*Stachys floridana*)
Phyto = Phototoxicity

Table 2. Fluometralin in control of weeds in Leatherleaf fern (*Rumohra andiantiformis* in Expt. 2.

		Control, %[y]					
		18 Feb 1989			16 Mar 1989		
Treatment[z]	lb ai/acre	Phyto	FL.B.	D.F.	Phyto	FL.B.	D.F.
Fluometralin 1.2E	2.0	0	85	65	0	95	75
Fluometralin 1.2E	3.0	0	100	70	0	100	70
Fluometralin 1.2E	6.0	0	100	70	0	100	70
Fluometralin 1.2E	8.0	0	100	80	0	100	80
Check	–	–	–	–	–	–	–

[z]Application date: 7 Dec 1988
[Y]FL.B. = Florida betony (*Stachys floridana*)
D.F. = Dayflower (*Commelina communis*)
Phyto = Phytotoxicity

Table 3. Fluometralin in control of weeds in Laurel Oaks (*Quercus hemisphaerica*) in Expt. 3.

Treatment[Z]	Rate lb ai/acre	Control, %[Y] 10 Sept 1988 C.P.	C.G.	C.J.	18 Aug 1989 C.P.	E.H.	7 Nov 1989 C.P.	C.J.	Plant height (cm)
Fluometralin 2G	3.0	0	90	80	0	80	0	80	91.2
Fluometralin 2G	4.0	0	100	90	0	90	0	80	96.6
Fluometralin 3G	6.0	0	100	90	0	90	0	100	95.0
Metolachlor 5G	4.0	0	90	40	0	40	0	20	74.2
Metolachlor: Simazine::4:1 (Derby 5G)	5.0	0	95	60	0	50	0	50	74.0
Check	–	0	0	0	0	0	0	0	63.6

[Z]Application dates: 23 Jun 1988, 10 Nov 1988, 12 Apr 1989, 13 Jul 1989
[Y]C.G. = Crabgrass (*Digitaria sp.*)
C.J. = *Crepis japonica*
E.H. = *Euphorbia humistrata*
C.P. = Crop phytotoxicity

limited to the cooler months of winter when the plant is actively growing and the storage tubers are no longer present due to the active vegetative growth of the plant. Fluometralin at 2-3 lbs ai/acre provided very good control of Florida betony and some suppression of dayflower. No phytotoxicity was observed during the experiment.

Experiment No. 2. (Table 2) Fluometralin formulated as 1.2E at 2, 3, 6, and 8 lbs ai/acre premergence to established Leatherleaf fern in a single application provided good to excellent control of Florida betony with no crop phytotoxicity. Suppression of dayflower was evident at all rates, and an increase in the control of this weed might be possible over a period of time with repeat applications. Crop phytotoxicity was not observed.

Experiment No. 3. (Table 3) Containerized Laurel oaks in 3-gallon containers were treated in repeat applications from June 1988 through July 1989 with fluometralin formulated as 2G at 3, 4, 6, and 8 lbs ai/acre. Metolachlor 5G and metolachlor:simazine::4:1 (Derby® 5G) at 4 and 5 lbs ai/acre were also included in the experiment.

Fluometralin 2G at all rates tested provided good to excellent control of crabgrass, *Crepis japonica,* and *Euphorbia humistrata.* Plant heights were greater for the fluometralin treatments when compared to the control, metolachlor or metolachlor:simazine::4:1, probably as a result of less weed competition.

Table 4. Fluometralin in control of weeds in Asparagus plumosus (*Asparagus setaceus*) in Expt. 4.

Treatment[Z]	Rate lb ai/acre	Control, %[Y] 15 Aug 1988 CG	FL.P	CT	16 Feb 1989 DF	CD.W	CH.W	CT
Fluometralin 2G	2	82	85	0	60	83	85	0
Fluometralin 2G	4	95	100	0	73	100	100	0
Fluometralin 2G	6	100	95	0	75	100	100	0
Fluometralin 2G	8	100	100	0	80	100	100	0
Check	–	–	–	–	–	–	–	–

[Z]Application dates: 17 Jun 1988, 17 Nov 1988
[Y]CG = Southern crabgrass (*Digitaria ciliaris*)
DF = Dayflower (*Commelina communis*)
FL.P = Florida pusley (*Richardia scabra*), Brazil pusley (*R. brasiliensis*)
CD.W = Cudweed (*Gnaphalium spp.*)
CH.W = Tropical chickweed (*Drymaria cordata*)
CT = Crop tolerance: 0-10 0 = No phytotoxicity

Experiment No. 4. Preemergence control of southern crabgrass, Florida pusley, cudweed and tropical chickweed was good to excellent at all rates tested, with no observed phytotoxicity with the Asparagus fern (Table 4). Suppression of dayflower was evident, especially at the higher rates and this activity has been observed in earlier tests on leather leaf fern.

Experiment No. 5 and No. 6. Postemergence control of Florida and Brazil pusley by fluometralin was excellent at all rates (Tables 5 and 6). Herbicidal symptoms exhibited by the pusley closely resembled that of phenoxy herbicides.

Table 5. Fluometralin in control of weeds in Laurel Oaks (*Quercus hemisphaerica*) in Expt. 5.

Treatment[Z]	Rate lb ai/acre	Control, %[Y] 15 Oct 1990 FL.P.	C.T.	30 Oct 1990 FL.P.	C.T.
Fluometralin 1.2E	2	75	0	95	0
Fluometralin 1.2E	3	90	0	98	0
Fluometralin 1.2E	6	90	0	100	0
Check	–	0	0	0	0

[Z]Application date: 12 Sept 1990, Cherry Lake Tree Farm, Lake County, FL
Plot size: 60 sq ft x 3 replications
[Y]FL.P. = Florida pusley (*Richardia scabra*), Brazil pusley (*R. brasiliensis*)
C.T. = Crop tolerance: 0-10, 0 = No phytotoxicity

Table 6. Fluometralin in control of weeds in Young Citrus (*Citrus sp.*) in Expt. 6.

Treatment[Z]	Rate lb ai/acre	Control, %[Y] 20 Oct 1990 FL.P.	C.T.	29 Oct 1990 FL.P.	C.T.
Fluometralin 1.2E	2	73	0	85	0
Fluometralin 1.2E	3	78	0	85	0
Fluometralin 1.2E	6	85	0	90	0
Check	–	0	0	0	0

[Z]Application date: 17 Sept 1990, Faryna Groves, Lake County, FL
Plots were single trees (Hamlin/Swingle) 16 sq ft, 4 replications, less than one year old.
[Y]FL.P. = Florida pusley (*Richardia scabra*), Brazil (*R. brasiliensis*)
C.T. = Crop tolerance: 0-10, 0 = No phytotoxicity

No phytotoxicity was observed on the Laurel oaks or young citrus.

Herbicide experiments conducted from 1987 through 1990 have demonstrated that fluometralin is a unique dinitroaniline herbicide exhibiting unusual pre and post-emergence activities. Relatively low water solubility, coupled with a high partition coefficient makes fluometralin a product of choice where sandy soils, frequent irrigation and high rainfall contribute to groundwater contamination concerns.

Proc. Fla. State Hort. Soc. 103:209-212. 1990.

HANDLING, STORAGE, AND GERMINATION OF FORMOSAN LILY SEED

William J. Carpenter
AND
Eric R. Ostmark
University of Florida, IFAS
Environmental Horticulture Department
Gainesville, FL 32611

Additional index words. lily seed germination, seed storage and handling, temperature and relative humidity.

Abstract. **Temperature governs the days required for propagation and total percent germination of Formosan lily seed. High temperatures cause the poor germination from fall outdoor seed propagation in Florida. Highest total germination, exceeding 90%, occurred at constant 15°C or 12 hour alternating 10°-15°C, 15°-20°C or 15°-25°C. Only 24% and 43% of seeds germinated at alternating temperatures of 10°-30°C or 15°-30°C respectively. Seed germination was 4 to 8 days earlier and more uniform at 15°C constant or alternating 15°-20°C, while other temperatures reduced and delayed germination. Total germination was unchanged by seed dehydration that reduced moisture contents from 36% to 12%, however, more days were required to 50% of final germination as seed moisture contents decreased. Formosan lily seeds were tolerant of low temperature storage. Total germination was not affected when seed storage temperatures declined from 10°C to −15°C, but germination was 4 days earlier and 3 days shorter between 10% and 90% germination following low temperature seed storage. Seeds were stored without reduction in total germination for 9 months at 5°C and 11%, 52%, or 75% relative humidity, but only storage at 5°C and 52% RH did not increase the numbers of days required for 50% of final germination or the germination span as storage durations were increased.**

Formosan lily (*Lilium formosanum* L.)(Fig. 1) grow in the partial shade of Florida's landscapes and have gained use as a greenhouse plant for cut flowers and occasionally as potted plants (8). Flowering can be scheduled for any period during the spring months under greenhouse conditions (9), but in the landsape flowering normally occurs in early August. Propagated from seed, plants generally flower the first year. Seed pods should be harvested when mature and beginning to split, but before seed is shed (6). Spraying the plants with a fungicide during wet periods is recommended to prevent botrytis infection of the pods. Botrytis can spread during seed handling and curing, which reduces seed viability. Emsweller (4) reported that lily seed maturity at harvest affects the time required for germination. Formosan lily seed has been reported to have a thermodormancy requiring 5°C for 3 to 4 weeks before sowing, and a maximum germination temperature of 21°C (3). Other researchers (10) classified the Formosan lily as a species requiring germination temperatures below 25°C. Highest total germination has been reported shortly after seed harvest, because of a rapid loss in seed viability during storage (3). No recommendations for seed storage temperature of relative humidity were found in the literature. Our research objectives were to measure the effect on germination of reduced seed moisture content or temperature during seed handling, and to compare the interactions of temperature and relative humidity (RH) during long-term seed storage.

Florida Agricultural Experiment Station Journal Series No. N-0259.

Materials and Methods

Formosan lily seeds from open and controlled crosses were collected in a Florida bulb production nursery as mature capsules dehised in Oct. 1989. With all studies, seeds were germinated in 9-cm petri dishes on Anchor blue blotter paper 100 (Anchor Paper Co., Charlotte, NC) wet with 5 ml of distilled water (dw). Treatments of four 50 seed replications were placed in dark incubators at constant 10°, 15°, 20°, 25°, or 30°C. Germination data were recorded daily during 42 days and treatment means for days to 50% of final germination and span of germination (days between 10% and 90% germination) were calculated as recommended by Furutani (5). The experimental design was a split plot with data analyzed by an analysis of variance (ANOVA) with mean separation by Duncan's multiple range test (P = 0.05) and multiple regression analysis.

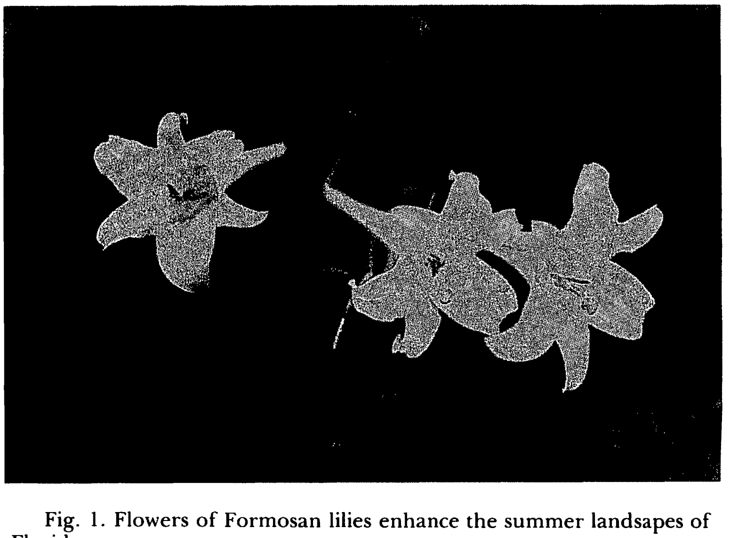

Fig. 1. Flowers of Formosan lilies enhance the summer landsapes of Florida.