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# CHEMICALLY-INDUCED FREEZE RESISTANCE OF AZALEA

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*Abstract.* **Growth on azaleas that occurs during late autumn or winter warm periods is very susceptible to freeze damage. This study was undertaken to evaluate the effectiveness of two plant growth regulators to inhibit winter growth of azaleas. *Rhododendron* x 'Formosa' and *Rhododendron* x 'Mrs. G. G. Gerbing' growing in 3.8-liter containers at Flowerwood Nursery, Bushnell, Florida, were sprayed with either 3750 ppm daminozide (B-NINE SP; Uniroyal) or 25 ppm uniconazole (SUMAGIC 10 WDG; Valent USA) in mid Oct. 1989. Both treatments reduced foliar freeze injury on 'Formosa' azalea resulting from an early Dec. freeze, even though neither treatment significantly reduced growth between mid-Oct. and mid-Dec. Uniconazole and daminozide also inhibited the initial spring growth flush (mid-Feb.) of both varieties.**

Growth on azaleas that occurs during late autumn or warm winter intervals is susceptible to freeze damage. In some nurseries of the southeast U.S., daminozide is applied to azaleas in mid to late autumn so that vegetative growth will be suppressed during any periods of above-normal temperatures. Triazole plant growth regulators (PGR) have been shown to reduce low temperature injury of herbaceous plants, but do not consistently confer the same resistance to deciduous woody species (1, 4 [and ref. within]). This study was undertaken to compare the effectiveness of daminozide (B-NINE SP) and uniconazole (SUMAGIC 10 WDG), a triazole PGR, to inhibit winter growth of azaleas and reduce low temperature injury.

## Materials and Methods

*Rhododendron* x 'Formosa' and *Rhododendron* x 'Mrs. G. G. Gerbing' growing in 3.8-liter containers in full sun at Flowerwood Nursery, Bushnell, Florida, were sprayed with either 3750 ppm daminozide or 25 ppm uniconazole on 20 Oct. 1989; unsprayed plants served as controls. There were 10 plants per treatment per cultivar in a completely randomized design (within cultivar). Height and width, recorded periodically, were used to calculate a growth index (GI = [height + width]/2). Foliar freeze injury (black necrotic areas) was evaluated on 14 Dec 1989, 10 days after the azaleas were exposed to -2.2C. Injury was rated on a 0 to 5 scale, with 0 = all leaves exhibit some degree of damage, and 5 = no leaves exhibit damage. The length of new growth (5 stems per plant) and percentage of fully open blooms on each plant were recorded on 19 Feb. 1990 ($n \geq 6$). Flowering was evaluated on the following scale: 0 = 0 Percent Bloom (PB), 1 = 1-25 PB, 2 = 26-50 PB, 3 = 51-75 PB, 4 = 76-100 PB.

## Results and Discussion

Daminozide and uniconazole did not significantly retard growth between mid-Oct. and mid-Dec. (results not shown), but reduced foliar freeze injury on 'Formosa' azalea resulting from an early Dec. freeze (Table 1). Also, no stem cracking was observed on any unconizole-treated azalea; some stem cracking was observed on untreated and daminozide-treated azaleas. Reduced injury of PGR-treated plants was not due to growth suppression since neither PGR reduced GI from Oct. to Dec. Freeze tolerance of uniconazole-treated 'Formosa' azalea may have been due to reduced cell membrane damage (3, 4). No such effect on cell membranes has been noted with daminozide.

The initial spring growth flush (mid-Feb.) of both cultivars was suppressed by uniconazole and daminozide (Table 2), uniconazole being more effective than daminozide. Uniconazole also delayed flowering of 'Formosa' and 'Mrs. G. G. Gerbing' azalea, but daminozide only inhibited flowering of 'Mrs. G. G. Gerbing' azalea (Table 2). Flowering of 'Gloria' azalea was delayed by daminozide,

Table 1. Effect of daminozide and uniconazole on foliar freeze injury[z] of 'Formosa' and 'Mrs. G. G. Gerbing' azalea 10 days after exposure to -2.2C on 4 Dec. 1989. Treatments were applied as foliar sprays on 20 Oct. 1989.

| | Injury rating[y] | |
|---|---|---|
| Chemical | Formosa | G. G. Gerbing |
| Control | 2.3 c | 3.6 a |
| Daminozide | 3.2 b | 3.8 a |
| Uniconazole | 3.7 a | 4.0 a |

[z]Injury rating scale: 0-5; 0 = all leaves exhibit some injury, 5 = no leaves exhibit injury.
[y]Mean separation, within columns, by Duncan's multiple range test, 5% level.

Table 2. Effect of daminozide and uniconazole on spring growth flush[z] and early flowering[y] of 'Formosa' and 'Mrs. G. G. Gerbing' azalea. Observations were recorded on 19 Feb. 1990. Treatments were applied as foliar sprays on 20 Oct. 1989.

| | New growth (cm)[x] | | Bloom rating[x] | |
|---|---|---|---|---|
| Chemical | Formosa | G. G. Gerbing | Formosa | G. G. Gerbing |
| Control | 3.6 a | 3.3 a | 1.4 a | 1.7 a |
| Daminozide | 2.6 b | 1.8 b | 0.8 ab | 0.6 b |
| Uniconazole | 0.5 c | 0.6 c | 0.3 b | 0.6 b |

[z]Length of new growth; 5 stems per plant; n = 6.
[y]Flowering was rated on a 0-5 scale as the percent of plant with fully open blooms 0 = 0 Percent Bloom (PB), 1 = 1-25 PB, 2 = 26-50 PB, 3 = 51-75 PB, 4 = 76-100 PB; rating value was the consensus of 2 observers; n = 6.
[x]Mean separation, with columns, by Duncan's multiple rante test, 5% level.

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but not by paclobutrazol, a PGR similar to uniconazole (5). In contrast, daminozide did not delay flowering of 'Hummingbird' rhododendron nor did it confer any freeze tolerance to the flower buds (2).

In conclusion, while neither daminozide nor uniconazole suppressed late fall or early winter growth, both PGR's provided some degree of freeze protection. Freeze protection was manifested through a reduction in foliar freeze injury and/or elimination of stem cracking. The degree of freeze protection was cultivar specific.

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# COMPARATIVE EFFECTS OF FOLIAR SPRAYS OF GROWTH REGULATORS ON POTTED CHRYSANTHEMUMS

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*Abstract.* **Single and multiple sprays or single soil drench applications of uniconazole were compared with daminozide, ancymidol, and paclobutrazol sprays for height control of *Dendranthema* x *grandiflorum* (Ramat.) Kitamura (*Chrysanthemum* x *moriflorum* Ramat.). Four cvs. were treated in 1989 and 5 were treated in 1990. All cvs. responded to the growth retardants, but the response was variable and dependent upon concentration and cultivar. In 1989 plants were treated with a directed spray of 0.7 oz (20 ml)/plant or an area spray of 2 or 3 quarts/100 ft². Differences due to volume of area sprays were not significant but 3 qt/100 ft² generally produced shorter plants than 0.7 oz/plant. Short and medium height cvs. exhibited a similar height response when treated with a single uniconazole spray at 20 ppm applied 2 weeks after pinching compared to two daminozide applications of 2500 ppm. A single drench at 1.7 ppm (0.25 mg ai/pot) was as effective as the daminozide sprays. In 1990, single sprays of uniconazole at 10 ppm or 100 ppm of paclobutrazol were as effective as two daminozide applications at 2500 ppm on the short and medium height cvs. Taller cvs. required 20 to 30 ppm of uniconazole or 200 ppm of paclobutrazol to produce marketable plants. Two daminozide sprays at 2500 ppm did not retard plant growth of the tall cultivars to a commercial height.**

Production of multi-plant potted chrysanthemums (*Dendranthema* x *grandiflorum* (Ramat.) Kitamura (*Chrysanthemum* x *moriflorum* Ramat.) was an important component of the floriculture industry in Florida during 1989, with more than 3.6 million 5-inch or larger pots sold (1). Most of these units consisted of 4 or 5 plants grown in 6 or 6.5 inch diameter pots which were sold locally or exported outside of Florida to florist shops, garden centers, and chain stores. The majority of production consisted of center-disbudded plants in order to produce multiple flowers per lateral shoot and required single or multiple applications of chemical growth retardants to prevent excessive internode elongation. These growth-retarding chemicals are applied as soil drenches or foliar sprays when the laterals are 1 to 2 inches long. A second application is often required for the medium and tall growing cultivars (16). Daminozide (SADH, B-Nine, butanedionic acid mono (2,2-dimethylhydrazide) ) applied as a foliar spray at 2500 to 5000 ppm as single or multiple applications is used generally because it is inexpensive and effective (7,14,16). Paclobutrazol (Bonzi®,(2RS,3RS)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl)pentan-3-01), one of the new triazol pyrimidine growth regulators, has growth retarding properties with chrysanthemums (2,3,4,5,6,8,10,12,13). Single paclobutrazol sprays of 100 to 400 ppm were as effective as two applications of daminozide at 2500 or 5000 ppm (5,6,8,10,13), but plant growth within a multi-plant pot was not as uniform as with daminozide (8). Irrigation 2 to 3 hours after application had little influence on the effect of paclobutrazol but did for daminozide (4), indicating a rapid absorption of the chemical into the plant. Because paclobutrazol is poorly translocated from the leaves to the rest of the plant (3) and caused delay in flowering (9), medium drenches are more effective than foliar sprays, with 0.125 to 0.5 mg ai/pot of paclobutrazol as effective as multiple sprays of daminozide (5,6,10). However, medium composition has been shown to affect the efficacy of paclobutrazol drenches (2). An analog of paclobutrazol, uniconazole (Sumagic®, E-(p-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-l-yl)-1-pentan-3-ol) has similar properties but is more effective in retarding plant growth (4,5,6,9,11,14,15). Uniconazole sprays are up to eight times as effective as paclobutrazol and uniconazole drenches are up to ten times as effective. Foliar sprays of 5 to 25 ppm and soil drenches of 0.025 to 0.1 mg ai/pot have been effective depending upon cultivar and location (5,6,9,11,14,15).

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