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Growth Response of Selected Container-grown Bedding Plants to Paclobutrazol, Uniconizole, and Daminozide[1]

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Abstract

A study was conducted to compare the growth-retarding effects of paclobutrazol (Bonzi), uniconizole (XE-1019, Sumagic), and daminozide (B-Nine) on container-grown bedding plants. Seedlings of *Begonia semperflorens* 'Olympia', 'Scarletta', and 'Vodka', *Catharanthus roseus* 'Little Bright Eye', *Impatiens sultani* 'Blitz Orange', and *Zinnia elegans* 'Yellow Marvel' were treated with a paclobutrazol spray at 0.15, 0.3 or 0.45 mg ai/plant, or a drench of 0.15 mg ai/pot. Uniconizole was applied as a spray at 0.025, 0.05, or 0.075 mg ai/plant, or a drench of 0.025 mg ai/pot. The daminozide was applied only as a 5000 ppm spray. Paclobutrazol and uniconizole were very effective in controlling the height of begonia, catharanthus (vinca), and impatiens at relatively low rates compared to daminozide. The height of zinnia was controlled by daminozide, but not by the other compounds at the rates tested.

Index words: Growth regulators, growth retardants

Species used in this study: begonia (*Begonia semperflorens*), vinca (*Catharanthus roseus*), impatiens (*Impatiens sultani*), zinna (*Zinnia elegans*)

Growth regulators used in this study: (±)-(R*,R*)-β-((4-chlorophenyl)methyl)-α-(1,1-dimethylethyl)-1*H*-1,2,4-triazole-1-ethanol, Bonzi, paclobutrazol; (E)-(p-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl)-1-penten-3-ol, Sumagic, uniconizole; butanedioic acid mono(2,2-dimethylhydrazide), B-Nine, daminozide

Introduction

Compact container-grown bedding plants are highly desirable because they are more attractive, easier to handle and transport without damage, and tend to have a longer period of marketability than leggy, poorly-conformed plants. Growth control can be achieved with the use of chemical growth retardants. Currently, daminozide (B-Nine) is the growth retardant most frequently used on bedding plants. Recent studies (1, 2, 3, 4, 5) have shown two new gibberellin biosynthesis inhibitors, paclobutrazol (Bonzi) and uniconizole (Sumagic), to be very effective growth retardants on a wide range of plants. Bonzi is currently labeled for poinsettia, and the EPA has recently approved an expanded label including bedding plants. Sumagic does not have a label as this paper is being written, but labelling is expected in the near future. The objective of this study was to evaluate the effects of paclobutrazol and uniconizole on several container-grown bedding plants, and to compare the growth-retarding activity with that of daminozide (B-Nine).

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Materials and Methods

On April 2, 1987, recently-transplanted seedlings of begonias 'Olympia', 'Scarletta', and 'Vodka', and vinca 'Little Bright Eye' were obtained from a wholesale nursery. These plants were growing in 15.3 cm dia × 12.7 cm deep (6 × 5 in) plastic containers in a pine bark:peat medium (19:1 by vol). The vinca had been fertilized at the nursery with Lebanon 18N-1.7P-8.3K (18-4-10) (6 g/container). The begonias were fertilized with Osmocote 18N-2.6P-9.9K (18-6-12) (6 g/container). On April 21, 1987, additional seedlings of zinnia 'Yellow Marvel' and impatiens 'Blitz Orange' were transplanted into 15.3 cm × 12.7 cm (6 × 5 in) containers of pine bark:composted sewage sludge:sand (4:2:1 by vol) and fertilized with Osmocote 18N-2.6P-9.9K (18-6-12) (6 g/container). Treatments were applied to the begonias and vinca on April 23, 1987. The vincas were 5 to 10 cm (2 to 4 in) tall, with 6 to 10 fully-expanded leaves. The begonias had a spread of 10 to 15 cm (4 to 6 in). Treatments were applied to the impatiens on May 4, 1987, when they were 5 to 10 cm (2 to 4 in) high. The weather when all treatments were applied was overcast, with the temperature in the greenhouse 16 to 18°C (60.8 to 64.4°F). All treatments were applied on the basis of amount of active ingredient per plant. Paclobutrazol treatments were applied at rates of 0.15, 0.3, and 0.45 mg/plant with sprays of 30, 60, and 90 ppm resp (5 ml/plant), based on a label rate of

46.9 to 100 ppm for poinsettias. A 0.15 mg drench was applied in 120 ml distilled water. Uniconizole treatments were applied at rates of 0.025, 0.05, and 0.075 mg/plant with sprays of 5, 10, and 15 ppm resp. A 0.025 mg drench was applied in 120 ml distilled water. The daminozide at 25 mg/plant was applied as a 5000 ppm (0.5%) spray. The control was a distilled water spray.

The times between treatments and evaluation varied depending upon the plants, and were as follows: zinnias—5 weeks, vinca and impatiens—6 weeks, begonia 'Olympia'—7 weeks, begonia 'Scarletta'—8 weeks, begonia 'Vodka'—11 weeks. Plant heights, spread, and dry weights were obtained for all plants. In addition, internode lengths were obtained for the begonias, vinca, and zinnia by measuring the three longest internodes that developed on each plant after treatments were applied. Main stem diameters were obtained for vinca and zinnia.

With all plants, a randomized complete block design was used, with blocks arranged by seedling size in order to adjust for variations in size of seedlings prior to treatment. Four blocks, with 2 plants per treatment per block were used. Data were analyzed using analysis of variance procedures and significant differences were determined by Duncan's multiple range test at the 5% level.

Results and Discussion

Begonia. Paclobutrazol and uniconizole sprays at all rates resulted in significantly shorter plants, shorter internodes, smaller plant spread, and reduced dry weights when compared to the water control and the daminozide treated plants (Table 1). All of these parameters tended to decrease as the rate of the spray increased, and rates above the lowest rate of paclobutrazol and all rates of uniconizole caused excessively suppressed heights and internode lengths. However, the lowest rate (0.15 mg ai/plant) of paclobutrazol produced compact plants that were significantly shorter than the controls without causing them to appear stunted (Fig. 1).

The excessively shortened internodes resulting from the higher spray rates of paclobutrazol and all sprays of uniconizole caused the leaves to closely overlap one another. This appeared to aggravate a botrytis infestation (Fig. 2); therefore, during evaluation, each plant was given a visual rating for foliar damage due to botrytis (Table 1). The paclobutrazol spray treatments above the lowest rate (0.15 mg/plant), and all uniconizole spray treatments resulted in botrytis damage ratings that were significantly higher than for the control.

The drench treatments of both products were less effective in suppressing plant size than comparable rates applied as a spray. This is apparently because of the high proportion of pine bark in the medium, which has been found to reduce the effect of paclobutrazol when it is applied as a drench (1). A pine bark medium apparently reduces the effect of a uniconizole drench as well. Although the uniconizole drench at 0.025 mg ai/pot was less effective than the comparable rate as a spray, it still provided excellent height control, with plants significantly shorter than the water controls and the daminozide treated plants (Fig. 1). Growth suppression with the uniconizole drench did not appear to be as excessive as with the sprays. The plants were compact, well-formed, and did not appear stunted. The daminozide treatment produced no significant reduction in plant height for any of the begonias. Internode lengths were significantly less, however, and plant spread was less for 2 of the 3 varieties.

Vinca. The uniconizole sprays at all rates tested produced significantly shorter plants than the control and the daminozide treatment (Table 2). Plant spread, internode lengths, stem diameters, and dry weights were also less; however, there was no significant effect on numbers of flowers. Paclobutrazol was less effective than uniconizole. Of the spray treatments, only 0.45 mg ai/plant had a significant effect on height, internode length, stem diameter, and dry weight. There was no significant effect on numbers of flowers. The height suppression of the plants without a corresponding reduction in flower numbers gave vinca a more pleasing appearance in that the flowers occurred in a compact mass over the surface of the plants (Fig. 3). The drench treatments of both paclobutrazol and uniconizole were more effective in suppressing growth on vinca than the equivalent spray rates. The daminozide-treated vincas were not significantly different from the control plants in any of the parameters measured.

Impatiens. The two higher spray rates of paclobutrazol, and all rates of uniconizole produced significantly shorter plants with smaller spread than were produced by the other treatments (Table 3). These treatments also delayed flowering slightly, which is reflected in a significant reduction in the number of opened flowers. The total number of flower buds did not appear to be reduced. The daminozide treatment also caused a delay in flowering although it did not produce significantly shorter plants.

Zinnia. None of the paclobutrazol or uniconizole treatments had any significant effect on zinnia 'Yellow Marvel' (Table 4). Apparently, growth suppression of zinnia requires higher rates of these compounds. Cox and Keever (2) demonstrated acceptable height reductions of zinnia 'Scarlet Ruffles' with paclobutrazol sprays in the range of 250 to 1000 ppm, and drenches of 0.5 and 1.0 mg ai/container. Our paclobutrazol spray rates and drenches were much lower (30 to 90 ppm, and 0.15 mg ai/container resp). In this study, the only treatment that promoted significantly shorter plants with shorter internodes was the 5000 ppm (25 mg ai/plant) daminozide spray.

Significance to the Nursery Industry

This study demonstrates that paclobutrazol (Bonzi) and uniconizole (Sumagic) are very effective in controlling the height of begonia, vinca, and impatiens at relatively low rates compared to daminozide (B-Nine). At the appropriate rates, attractive, compact plants of these species were produced. Zinnia did not show a significant response to paclobutrazol or uniconizole at the rates tested, which were apparently too low for this species.

Uniconizole was generally the more active of the two new growth retardants, producing more compact plants even though lower rates of active ingredient were used. The three varieties of begonia were particularly sensitive to uniconizole, with the three spray rates tested all appearing to produce excessive growth retardation.

The effectiveness of the drench treatments was dependent upon the container media used and the species being evaluated. For begonias, acceptable height retardation was obtained with a 0.15 mg ai/plant paclobutrazol spray (30 ppm)

Table 1. Effect of paclobutrazol, uniconizole, and daminozide on growth of 3 Begonia cultivars, and on severity of Botrytis infestation.

Treatment and rate (mg ai/container)	Plant height (cm)	Plant spread (cm)	Internode length (cm)	Plant dry wt (g)	Botrytis rating[y]
			'Olympia'		
Water spray	15.8 ab[z]	20.1 a	1.73 a	8.63 a	1.1 a
Daminozide spray					
25	16.4 a	20.5 a	1.28 b	8.26 a	1.3 a
Paclobutrazol drench					
0.15	14.9 b	18.3 b	1.03 c	8.13 a	1.1 a
Paclobutrazol spray					
0.15	13.1 c	16.8 c	1.09 bc	6.84 bc	1.5 a
0.3	10.7 d	14.3 d	0.58 de	7.01 b	2.1 b
0.45	10.6 d	14.5 d	0.60 de	5.94 cd	2.1 b
Uniconizole drench					
0.025	10.8 d	18.1 b	0.74 d	7.11 b	1.3 a
Uniconizole spray					
0.025	11.3 d	13.9 de	0.63 de	6.17 bcd	2.5 b
0.05	9.1 e	13.1 de	0.43 e	5.49 d	2.5 b
0.075	8.7 e	12.9 e	0.44 e	5.57 d	2.3 b
			'Scarletta'		
Water spray	22.6 a	23.0 a	3.36 a	5.55 a	1.0 a
Daminozide spray					
25	21.1 a	20.9 b	2.81 b	5.15 a	1.0 a
Paclobutrazol drench					
0.15	18.0 b	19.3 c	2.16 c	4.45 b	1.0 a
Paclobutrazol spray					
0.15	15.1 c	15.9 d	1.51 d	3.54 c	1.3 ab
0.3	11.5 d	14.0 e	0.96 e	3.01 cd	1.6 bc
0.45	10.0 d	13.1 e	0.75 e	3.05 cd	1.8 bcd
Uniconizole drench					
0.025	13.9 c	16.9 d	1.89 c	4.21 b	1.5 ab
Uniconizole spray					
0.025	9.9 e	12.9 e	0.79 e	2.71 d	2.4 e
0.05	9.1 e	12.9 e	0.80 e	3.05 cd	2.3 de
0.075	8.3 e	13.0 e	0.61 e	2.72 d	2.1 cde
			'Vodka'		
Water spray	23.0 a	28.1 a	3.0 a	8.6 a	1.0 a
Daminozide spray					
25	21.4 a	25.9 b	2.5 b	7.4 b	1.0 a
Paclobutrazol drench					
0.15	20.6 a	25.1 b	2.3 b	6.7 bc	1.0 a
Paclobutrazol spray					
0.15	17.7 b	19.3 cd	1.5 c	4.5 d	1.3 ab
0.3	17.3 b	17.9 de	1.2 cd	3.8 de	1.4 b
0.45	16.3 b	17.1 e	1.0 de	4.0 de	2.0 c
Uniconizole drench					
0.025	15.6 b	20.5 c	1.4 c	5.8 c	1.3 ab
Uniconizole spray					
0.025	11.9 c	14.4 f	0.7 ef	3.3 ef	1.3 ab
0.05	9.5 cd	12.8 f	0.6 f	2.6 f	2.9 e
0.075	9.0 d	12.6 f	0.4 f	2.7 f	2.9 e.

[z]Means within columns followed by the same letter or letters are not significantly different using Duncan's multiple range test at the 5% level, n = 8.
[y]Botrytis foliar injury rating based on a scale of 1 to 3, where 1 = no injury, 3 = unacceptable injury.

or drench, and a 0.025 mg ai/plant uniconizole drench (pine bark medium). Acceptable height suppression for vinca was obtained with 0.45 mg ai paclobutrazol/plant as a spray (90 ppm) and as a drench at 0.15 mg ai/plant. A uniconizole spray (5 ppm) or drench at 0.025 mg ai/plant also promoted acceptable levels of height control for vinca. Acceptable height retardation for impatiens was obtained with paclobutrazol sprays of 0.3 and 0.45 mg ai/plant (30 and 60 ppm), and with uniconizole sprays of 0.025 to 0.075 mg ai/plant (5 to 15 ppm), and a 0.025 mg ai/plant drench.

Paclobutrazol and uniconizole are very effective growth retardants that should soon become available for use on bedding plants, but care should be exercised when trying them. Their high level of activity and variations in response from one species to another make it imperative that trials are first conducted on small numbers of plants, that the rates be carefully calculated, and that the application is uniform.

(*Ed. Note:* This paper reports the results of research only, and does not imply registration of a pesticide under amended

Fig. 1. **Begonia 'Scarletta' eight weeks after growth regulator treatments. Left to right: distilled water control; daminozide spray 25 mg/plant; paclobutrazol spray 0.15 mg/plant; paclobutrazol drench 0.15 mg/plant; uniconizole spray 0.025 mg/plant; uniconizole drench 0.025 mg/plant.**

Fig. 2. **Begonia 'Olympia' showing foliar injury due to Botrytis infestation aggravated by excessively compact growth following spray with uniconizole at 0.075 mg/plant (15 ppm).**

Table 2. Effect of paclobutrazol, uniconizole, and daminozide on growth of Vinca 'Little Bright Eye'.

Treatment and rate (mg ai/container)	Plant height (cm)	Plant spread (cm)	Internode length (cm)	Stem dia (cm)	Dry wt (g)	No. open flowers
Water spray	26.3 a[z]	16.4 ab	3.14 a	6.4 a	5.75 a	12.1 a
Daminozide spray						
25	24.4 a	16.1 ab	2.71 a	5.7 abc	4.98 ab	9.1 a
Paclobutrazol drench						
0.15	20.5 b	15.8 abc	2.25 b	5.4 abcd	4.29 bcd	10.5 a
Paclobutrazol spray						
0.15	25.6 a	17.5 a	2.99 a	5.8 ab	4.36 abc	10.5 a
0.3	24.5 a	16.8 a	3.09 a	5.6 abc	4.37 abc	9.0 a
0.45	18.6 bc	15.5 abc	2.18 b	5.1 bcd	3.92 bcd	12.9 a
Uniconizole drench						
0.025	16.6 bcd	13.1 bcd	1.51 cd	4.9 bcd	3.98 bcd	11.3 a
Uniconizole spray						
0.025	18.6 bc	14.6 abcd	1.90 bc	5.1 bcd	3.80 bcd	9.6 a
0.05	14.9 cd	11.4 d	1.24 de	4.6 cd	3.20 cd	9.1 a
0.075	12.9 d	12.4 cd	0.91 e	4.5 d	2.85 d	8.9 a

[z]Means within columns followed by the same letter or letters are not significantly different using Duncan's multiple range test at the 5% level, n = 8.

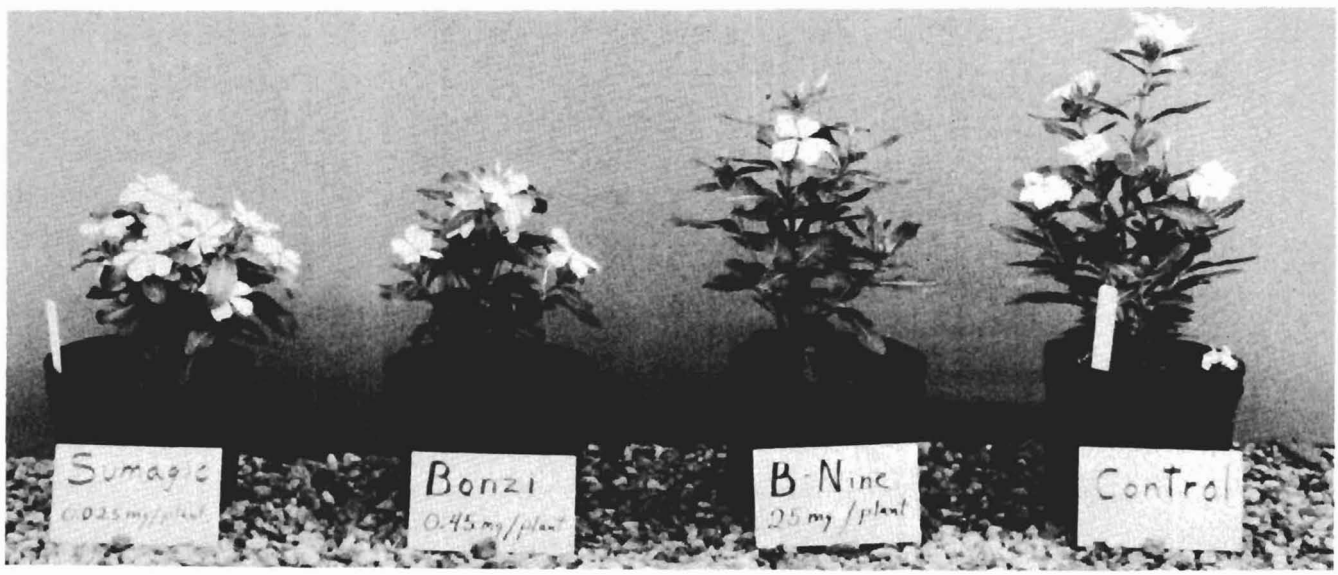

Fig. 3. Comparison of growth control of vinca 'Little Bright Eye' treated with uniconizole (Sumagic), paclobutrazol (Bonzi), daminozide (B-Nine) or water (control).

Table 3. Effect of paclobutrazol, uniconizole, and daminozide on growth of Impatiens 'Blitz Orange'.

Treatment and rate (mg ai/container)	Plant height (cm)	Plant spread (cm)	Dry wt (g)	No. open flowers
Water spray	21.0 a[z]	29.7 a	2.31 a	5.0 a
Daminozide spray				
25	20.7 a	27.5 abc	2.21 ab	2.7 bc
Paclobutrazol drench				
0.15	19.7 ab	28.5 a	1.96 abc	4.5 a
Paclobutrazol spray				
0.15	21.2 a	27.8 ab	2.06 abc	3.3 ab
0.3	18.0 bc	24.2 cd	1.67 c	1.0 cd
0.45	16.9 cd	21.5 de	1.79 abc	0.5 d
Uniconizole drench				
0.025	18.0 bc	24.5 bcd	1.81 abc	3.7 ab
Uniconizole spray				
0.025	14.8 de	23.3 d	2.23 ab	0.2 d
0.05	15.3 d	21.3 de	1.94 abc	0.0 d
0.075	12.8 e	19.5 e	1.75 bc	0.0 d

[z]Means within columns followed by the same letter or letters are not significantly different using Duncan's multiple range test at the 5% level, n = 6.

Table 4. Effect of paclobutrazol, uniconizole, and daminozide on growth of Zinnia 'Yellow Marvel'.

Treatment and rate (mg ai/container)	Plant height (cm)	Plant spread (cm)	Internode length (cm)	Stem diameter (cm)	Plant dry wt (g)
Water spray	31.9 a[z]	18.8 ab	2.6 ab	5.3 a	5.32 ab
Daminozide spray					
25	24.4 b	18.5 b	1.3 c	5.4 a	4.61 b
Paclobutrazol drench					
0.15	33.8 a	21.5 ab	2.4 b	5.8 a	5.83 ab
Paclobutrazol spray					
0.15	36.4 a	21.4 ab	2.2 b	5.8 a	6.42 ab
0.3	38.4 a	22.4 ab	2.2 b	5.8 a	6.41 ab
0.45	38.0 a	22.1 ab	2.7 ab	5.9 a	7.06 a
Uniconizole drench					
0.025	34.6 a	21.6 ab	2.8 ab	5.7 a	7.29 a
Uniconizole spray					
0.025	33.4 a	23.1 a	2.3 b	5.6 a	6.67 ab
0.05	33.1 a	21.4 ab	2.8 ab	5.5 a	6.25 ab
0.075	33.0 a	19.3 ab	3.1 a	5.5 a	5.54 ab

[z]Means within columns followed by the same letter or letters are not significantly different using Duncan's multiple range test at the 5% level, n = 8.

FIFRA. Before using any of the products mentioned in this research paper, be certain of their registration by appropriate state and/or federal authorities.)

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