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Response of Two Florist Azalea Cultivars to Foliar Applications of a Growth Regulator[1]

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Abstract

Bonzi (paclobutrazol) sprays of 100 and 150 ppm controlled bypass shoot development and increased flower number of 'Alaska' azalea compared to the control, while minimally affecting forcing time and bloom size. Sprays of 150 and 200 ppm suppressed bypass shoot development and increased flower number of 'Prize' azalea compared to the control without affecting bloom size. Paclobutrazol was more effective than B-Nine (daminozide) in suppressing bypass shoot development and enhancing flowering. Forcing time decreased and bloom size increased for paclobutrazol-treated plants of both cultivars compared to daminozide-treated plants.

Index words: growth retardant, bypass shoots

Growth regulators used in this study: Bonzi (paclobutrazol) B-[(4-chlorophenyl) methyl]-α-(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol; B-nine (daminozide) butanedioic acid mono (2,2-dimethylhydrazide).

Introduction

Growth retardants are an accepted component of florist azalea production. In addition to suppressing internode elongation (8), growth retardants promote flower bud initiation (3), result in multiple flower buds frequently forming on individual shoots (7), and hasten flower development (3). Stuart (8) suggested that growth retardants inhibit the growth of vegetative shoots that develop below the flowers (bypass shoots) and, more recently, growth retardants were shown to suppress bypass shoot development (9).

Daminozide [butanedioic acid mono(2,2-dimethylhydrazide)] and chlormequat chloride [2,-chloro-N,N,N-trimethylethanaminium chloride] are the principal growth retardants applied to florist azaleas. Delayed flowering and smaller flower size are undesirable side effects of daminozide (1),

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while delayed flowering and smaller plant size are undesirable effects of chlormequat chloride (5). Paclobutrazol, currently labeled as Bonzi® for use on poinsettia, is an effective retardant on chrysanthemums (6), many species of tropical foliage plants (4) and annual bedding plants (2). This study was conducted to determine the effectiveness of paclobutrazol in controlling bypass shoots of florist azaleas relative to daminozide and to evaluate the chemical's effects on flowering.

Materials and Methods

Uniform 8.9 cm (3.5 in) liners of *Rhododendron* × 'Prize' and 'Alaska' were potted in March 1987, into 1.5 l (6 in) containers of peat:softwood shavings (3:2 by vol) growth medium amended with 3.6 kg/m^3 (6 lb/yd^3) SREF 19N-1P-8.3K (19-2-10), 3.6 kg/m^3 (6 lb/yd^3) dolomitic limestone, and 0.4 kg/m^3 (0.75 lb/yd^3) Micromax. Plants were placed in a double polyethylene greenhouse in a commercial azalea nursery in Semmes, Alabama, and maintained according to common commercial practices. Plants were sheared on July 1 and sprayed the following day with 3627 ppm dikegulac [2,3:4,6-bis-0-(1-methylethylidene)-α-L-xylo-2-hexulofuranosonic acid] to increase lateral branching. Plants were transferred to a shaded double polyethylene greenhouse (30% light exclusion, 20°C (68°F) minimum night temperature) 10 weeks after shearing (September 14) and divided into 8 equal groups. The following treatments were applied on September 15 in a volume of 204 ml/m^2 (2 qt/100 ft^2): single paclobutrazol sprays of 0, 50, 100, 150, 200, 250, and 300 ppm and a daminozide spray of 3,000 ppm repeated 1 week later. Sprays were applied using a hand-held sprayer to uniformly wet foliage and stems. Treatments were applied approximately 0800 hours on clear days. Greenhouse temperature was 20°C (68°F) with 82% relative humidity at time of application. There were 5 replicates of 3 plants each completely randomized within a cultivar.

Plants received a weekly application of 150 ppm N from Peter's 20N-4.3P-16.6K (20-10-10) Peat-lite Special through November 16. Plants were sprayed with a Benlate®/Daconil® mixture [2 ml each/l (1.5 tsp each/gal)] on November 23 and subsequently cooled in the dark at 3.3°C (38°F) for 6 weeks. Plants were removed from the cooler on January 4, 1988, and placed under shade (47% light exclusion) in a glass greenhouse (20°C (68°F) minimum night temperature). Upon removal of plants from the cooler, open blooms were removed from all plants; open bloom number did not vary among treatments (data not shown). After 4 days, the shade cloth was removed and plants were forced in full sun. Time until flowering was determined from the time plants were removed from the cooler until flowers were fully open. At this time, flower number and diameter (3 randomly selected blooms per plant) and bypass shoot number and length (mean length of the 3 longest bypass shoots on each plant) were determined. Rate response to paclobutrazol was determined by regression analysis, and Dunnett's test for least significant differences was used to compare daminozide to each of the other treatments.

Results and Discussion

Bypass shoot number and length of both cultivars decreased as paclobutrazol rate increased (Tables 1 and 2). At or above the 150 ppm rate, essentially no bypass shoots developed on either cultivar. Daminozide was ineffective in controlling bypass shoot number, with daminozide-treated plants forming more bypass shoots than the control plants and plants treated with all rates of paclobutrazol. Daminozide did suppress bypass shoot elongation of 'Alaska' but not of 'Prize'.

Increasing rates of paclobutrazol from 0 to 300 ppm resulted in linear increases in days to flowering, from 50.3 days to 55.5 days for 'Alaska' plants and from 42.9 days to 48.5 days for 'Prize' plants. Daminozide-treated plants of both cultivars requied longer to reach full bloom than untreated plants and plants treated with all rates of paclobutrazol (Fig. 1). There was a quadratic effect of increasing paclobutrazol rate on flower number per plant. Flower number of 'Alaska' increased from 194.7 for the control to 225.1 for plants treated with 100 ppm paclobutrazol but decreased to 201.4 for plants receiving a 300 ppm paclobutrazol spray. Flower number of 'Prize' increased from 138.2 for the con-

Table 1. Paclobutrazol effects on bypass shoot and flower development of *Rhododendron* × 'Alaska'.

Treatment		Bypass shoots			Flowers	
Growth retardant	Concentration (ppm)	Number	Length[z] (cm)	Days to open flower[y]	Number	Diameter[x] (cm)
Paclobutrazol	0	7.5*[w]	7.9*	50.3*	194.7	6.7*
	50	3.0*	4.3	52.4*	217.7*	6.4*
	100	0.9*	4.5	52.0*	225.1*	6.6*
	150	0.0*	0.0*	53.0*	220.1*	6.5*
	200	0.0*	0.0*	55.0*	216.5*	6.2*
	250	0.0*	0.0*	54.2*	199.1	6.3*
	300	0.0*	0.0*	55.5*	201.5	6.2*
Significance of rate[v]		c	c	l	q	l
Daminozide	3000	9.2	4.3	67.1	177.7	5.5

[z]Mean length of 3 longest bypass shoots on each plant.

[y]Days to full bloom beginning when plants moved from cooler to greenhouse.

[x]Mean of 3 randomly selected blooms per plant.

[w]Dunnett's test for least significant differences; means followed by an asterisk differ significantly from the mean of the daminozide treatment at the 5% level.

[v]Control included in regresssion analyses; l = linear, q = quadratic, c = cubic.

Table 2. **Paclobutrazol effects on bypass shoot and flower development of *Rhododendron* × 'Prize'.**

Treatment		Bypass shoots			Flowers	
Growth retardant	Concentration (ppm)	Number	Length[z] (cm)	Days to open flower[y]	Number	Diameter[x] (cm)
Paclobutrazol	0	5.7*[w]	6.4	42.9*	138.2	7.2*
	50	3.0*	3.9	44.6*	139.1	7.1*
	100	1.3*	3.6	44.6*	144.2	7.1*
	150	0.9*	0.0*	44.3*	147.1*	7.1*
	200	0.0*	0.0*	46.6*	157.0*	7.1*
	250	0.1*	0.0*	46.7*	143.6	7.1*
	300	0.0*	0.0*	48.5*	139.2	7.2*
Significance of rate[v]		q	c	l	q	ns
Daminozide	3000	7.5	5.1	56.5	129.1	6.2

[z]Mean length of 3 longest bypass shoots on each plant.

[y]Days to full bloom beginning when plants moved from cooler to greenhouse.

[x]Mean of 3 randomly selected blooms per plant.

[w]Dunnett's test for least significant differences; means followed by an asterisk differ significantly from the mean of the daminozide treatment at the 5% level.

[v]Control included in regression analyses; l = linear, q = quadratic, c = cubic.

trol to 157.0 for plants treated with 200 ppm paclobutrazol but dropped to 139.2 at the highest rate of paclobutrazol. Flower number of daminozide-treated 'Alaska' plants was similar to untreated plants and to plants sprayed with 250 and 300 ppm paclobutrazol, but less than that of plants receiving 50, 100, 150, and 200 ppm sprays. Flower number of daminozide-treated 'Prize' plants was less than that of plants treated with 150 and 200 ppm paclobutrazol; flower number of control plants and plants receiving other rates of paclobutrazol was similar to flower number of daminozide-treated plants.

The effect of paclobutrazol on flower diameter varied with cultivar. Flower diameter of 'Alaska' decreased linearly from 6.7 cm (2.6 in) for the untreated control to 6.2 cm (2.4 in) for plants receiving the highest rate of paclobutrazol; flower diameter of 'Prize' was not affected by paclobutrazol rate. Daminozide reduced flower size of 'Alaska' and 'Prize' to less than that of the control and paclobutrazol-treated plants.

Fig. 1. ***Rhododendron* × 'Alaska' treated with 0, 50, 100, and 150 ppm Bonzi (paclobutrazol) [labeled PP 333] and 3000 ppm daminozide (B-nine). Note the bypass shoots on the check plant and the delayed flowering of the B-nine treated plant.**

Paclobutrazol rates of 100 and 150 ppm applied 5½ weeks before cooling effectively controlled bypass shoot development and increased flower number of 'Alaska' compared to an untreated control, while minimially influencing days-to-flower and flower diameter. Rates of 150 and 200 ppm were most effective in controlling bypass shoots and increasing flower number of 'Prize', while not reducing flower diameter. Days-to-flower was greater at the 200 ppm rate compared to 150 ppm (46.6 vs 44.3). Daminozide was less effective than paclobutrazol in controlling bypass shoot development and enhancing flower number. Daminozide also delayed flowering and reduced flower size relative to paclobutrazol and the untreated control. The delay in flowering and smaller flower size of daminozide-treated plants has been reported previously (1), while the control of bypass shoots with paclobutrazol concurs with recent results by Whealy *et al.* (9).

Significance to the Nursery Industry

Bonzi (paclobutrazol) has the potential of becoming the standard growth retardant for florist azaleas due to superior bypass shoot control and enhanced flowering compared to daminozide. Paclobutrazol-treated plants flowered sooner and had larger blooms than B-Nine (daminozide) treated plants. Optimum Bonzi (paclobutrazol) rates ranged from 150 to 200 ppm for 'Alaska' and 'Prize', but may differ for other cultivars.

(**Ed. note:** This paper reports the results of research only, and does not imply registration of a pesticide under amended 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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Evaluation of Nursery Container Designs for Minimization or Prevention of Root Circling[1]

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Abstract

Six different container designs were evaluated for their effectiveness in minimizing or preventing the development of circling roots around the sides and/or bottoms of containers. While both shrub and tree species were tested, the roots of the shrubs were generally small and fibrous enough that selection of a container to minimize or prevent circling roots was not an important consideration. For the tree species, the greatest amount of circling reduction was achieved with the soft polybags and the rigid stepped-pyramid containers. Because considerable difference exists in the cost of the newly-designed containers, both cost and root-modifying effectiveness should be considered if root modification is deemed important.

Index words: root modification, girdling roots, container-grown trees, poly bags, stepped-pyramid pot, low profile container, ribbed container

Species used in this study: goldenraintree (*Koelreuteria paniculata*); black willow (*Salix nigra*); white pine (*Pinus strobus*); American boxwood (*Buxus microphylla*); azalea (*Rhododendron obtusum* 'Hershey's Red'); honeysuckle privet (*Lonicera pileata*).

Introduction

Design and appearance are factors considered when a grower selects containers for nursery stock production, although the three major selection criteria are generally ease-of-handling, rugged construction and price (5, 10). In addition, features receiving considerable attention lately include color (4), pot lip shape (15), and design for improved winter protection (11).

All aspects of container design influence plant development and growth (and possibly sales). The number of different containers introduced onto the market in recent years has raised the questions of whether standardization of containers is needed, and whether standardization would be beneficial to both wholesale growers and retailers (1, 2, 3, 7). If an effort to standardize is started it could influence the willingness of growers to purchase containers with special design features unless these features are shown to be beneficial to the production of high quality nursery stock.

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An additional reason container design, and more specifically side wall configuration, is considered by growers is because of the circling and potentially girdling roots that may develop on certain plants when they are grown in conventional round, smooth, straight-walled rigid containers. Circling roots formed during production have the potential, especially on trees, to enlarge to the point that they may shorten a plant's life span by girdling its stem (6). In addition, circling roots may fail to adequately anchor plants, and may restrict water and nutrient absorption (13).

Research has demonstrated that certain modifications of the container side wall will minimize or prevent circling roots (5, 13, 14). The purpose of this research was to compare the ability of several new container designs to minimize or prevent root circling.

Materials and Methods

Rooted liners of American boxwood (*Buxus microphylla*), black willow (*Salix nigra*), 'Hershey Red' azalea (*Rhododendron obtusum* 'Hershey Red'), and privet honeysuckle (*Lonicera pileata*), and seedlings of goldenraintree (*Koelreuteria paniculata*) and Eastern white pine (*Pinus strobus*),