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Response of 'Prize' Azalea to Sumagic Applied at Several Stages of Shoot Apex Development[1]

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Abstract

'Prize' forcing azalea was treated with 15 or 30 ppm Sumagic at one of 4 stages of shoot apex development (stage 0 = vegetative; 1 = apex broadened; 2–3 = sepals and petals initiated; 4 = stamen initiated) in 2 experiments. Plants were taller and broader as the application was delayed; these parameters decreased with increasing Sumagic rate. Bypass shoot count decreased quadratically with increasing rate, and was not affected by stage of development (SOD) in one experiment but decreased when plants were treated at a later SOD in a second experiment. Time to flower increased and flower count decreased when plants were treated at a later SOD. Plants treated at SOD 0 flowered earlier with more blooms or at a similar time with a similar flower count to control plants.

Index words: growth retardant, growth regulator, pot crop, *Rhododendron*.

Growth regulator used in this study: Sumagic (uniconazole), (E)-1-(p-chlorophenyl)-4-dimethyl-2-(1,2,4-triazol-1-yl)-1-penten-3-ol.

Species used in this study: 'Prize' azalea (*Rhododendron* x 'Prize').

Significance to the Nursery Industry

Results of these two experiments indicate the importance of applying Sumagic to 'Prize' forcing azalea when shoot apexes are at the appropriate stage of development. Application at SOD 0 (vegetative), 4-½ or 5-½ weeks after final pinch in experiments 2 and 1, respectively, resulted in compact plants that flowered earlier and more uniformly with more blooms than plants treated at a later SOD. Sumagic was effective not only in suppressing lateral shoot elongation and hastening flower bud initiation, but also in inhibiting bypass shoot development.

Introduction

Growth retardants (GRs) are applied to forcing azaleas primarily to restrict lateral shoot elongation, hasten flower bud initiation, and promote uniform flower development (2, 9) and secondarily to suppress bypass shoot development (4, 5, 10). Plant response to GRs is dependent upon time of application and other factors. It is recommended that uniconazole, a triazole GR labeled for forcing azaleas as Sumagic (Valent U.S.A., Walnut Creek, Calif.), be applied 4 to 6 weeks after final pinch. However, even when applied according to the label, the desired response may not always occur, due to cultivar differences or variation in light, temperature or cultural conditions. Kohl and Sciaroni (6) described 10 stages of shoot apex development in forcing azaleas, and Larson and Auman (8) later suggested that performing the various cultural practices based on stage of apex development would make allowances for cultivar, seasonal and climatic differences. The objective of this study was to evaluate vegetative and flowering responses of 'Prize' forcing azalea to Sumagic applied at several stages of shoot apex development (SOD).

Materials and Methods

'Prize' azaleas in 16.5 cm (6.5 in) azalea pots of sphagnum 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 (19-3-10), 3.6 kg/m^3 (6 lb/yd^3) dolomitic limestone, and 0.4 kg/m^3 (0.75 lb/yd^3) Micromax micronutrient fertilizer were obtained from a commercial grower in November 1991. Plants were immediately placed in a glass greenhouse with 20°C day/18°C night (68°/64°F) minima, pruned for uniformity on December 2, and topdressed with 3 grams (0.5 tsp)/pot

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of 12N-2P-5K (12-4-6) on December 10, 1991 and January 10, 1992. Beginning when new shoots were 2.5 cm (1 inch) long, 10 terminal buds were dissected every 2 weeks and examined under a light microscope to determine SOD. Stages of shoot apex development were based on those described earlier (6). Sumagic was foliarly applied at 15 or 30 ppm in a volume of 200 ml/m^2 (2 quarts/100 ft^2) when plants were at one of 4 SOD. Stages and dates of application included SOD 0 (vegetative), January 10; SOD 1 (apex broadened), February 10; SOD 2–3 (sepal and petal initiation), March 17; SOD 4 (stamen initiation), March 31. A nontreated control group was included for comparison. There were 8 single-plant replicates in a completely randomized design.

On April 28, plants were placed in a cooler and subsequently held in darkness at 3.3°C (38°F) for 6 weeks. Plants were removed from the cooler on June 9 and forced into flowers in a shaded double polyethylene greenhouse with a 24.4°C (76°F) ventilation setpoint. Time until flowering was determined from the time plants were removed from the cooler until 50% of the flowers were fully open. At that time, plant height, growth index [(height + width at widest point + width perpendicular to first width) ÷ 3], flower count and diameter (three randomly selected flowers per plant), and bypass shoot count and length (mean length of the three longest bypass shoots of each plant) were determined. Data were subjected to analysis of variance. Rate response to Sumagic was determined by regression analysis, which included the control, and a pooled protected Fisher's least significant difference test was used for making planned pair comparisons of interest.

The experiment was repeated in 1992 with the following changes. Sheared azaleas in 12.7 cm (5 in) azalea pots received from a commercial grower in July were repotted into 16.5 cm (6.5 in) azalea pots of pine bark:sphagnum peat (3:1 vol) growth medium amended per m^3 (yd^3) with 3.6 kg (6 lb) Osmocote 14N-6P-11.6K (14-14-14), 1.2 kg (2 lb) gypsum, 3.6 kg (6 lb) dolomitic limestone and 0.9 kg (1.5 lb) Micromax. Supplemental liquid fertilizer of 200 ppm N from Peters Peatlite Special 20N-4.3P-16.6K (20-10-20) was applied weekly through August 1992. Plants were grown outdoors under 47% shade fabric and were irrigated from overhead impact sprinklers. Sumagic was applied at SOD 0 on August 17, SOD 1 on September 18, SOD 2–3 on September 24, and SOD 4 on October 6. Plants were held in darkness at 3.3°C (38°F) from November 9 until December 14 prior to forcing into flower in a nonshaded glass greenhouse with 20°C day/18°C night (68/64°F) minima.

Results and Discussion

Because of similar responses in the two experiments, results from only the first test are reported in detail. Where responses varied between the experiments, results of the second experiment also are presented. Plant height and growth index increased when Sumagic was applied at a later SOD; control plants were the tallest and had the highest growth

Table 1. Stage of development of shoot apexes and plant growth retardant effects on plant size and bypass shoot and flower development of *Rhododendron* x 'Prize', Expt. 1.

Treatment				Bypass shoots			Flower	
Stage of development (SOD)	Sumagic concn (ppm)	Height (cm)	Growth index[z] (cm)	No.	Length[y] (cm)	Time to open flowers[x] (days)	No.	Diam.[w]
0	15	23.0	30.8	5.9	5.5	32	58	6.3
	30	16.1L***[v]	23.9L***	0.0NS	—[u]	35L***Q***	45L**Q***	6.1NS
1	15	24.3	31.4	8.0	6.0	38	41	6.2
	30	21.8L**	28.6L***Q*	0.0NS	—	41L*Q*	39L*	5.7NS
2–3	15	26.9	33.8	5.4	6.9	51	23	6.0
	30	21.8L**	32.8L***	0.0NS	—	65L***	5L***	4.1L***Q**
4	15	25.1	36.8	7.0	6.6	58	17	5.2
	30	25.3NS	34.6L***	0.0NS	—	64L***	10L**	5.3L*
Control	0	28.9	39.7	6.8	8.7	48	27	6.1
LSD[t]		4.6	2.9	6.5	1.9	6.3	11	0.7
SOD[s]	**	***	NS	NS	***	***	***	
Concn								
linear		***	***	NS	—	NS	NS	**
quadratic		NS	*	*	—	**	**	NS
SOD x Concn[s]		NS	*	NS	—	*	NS	**

[z]Growth index = (height + width at widest point + width 90° to first width) ÷ 3.

[y]Mean length of three longest bypass shoots on each plant.

[x]Days to full bloom beginning when plants moved from cooler to greenhouse determined when 50% of flowers were fully opened.

[w]Mean of three randomly selected, fully opened blooms per plant.

[v]Significance of regression analysis at P = 0.05 (*), 0.01 (**) or 0.001 (***) : L = linear, Q = quadratic, NS = nonsignificant. Control included in regression analysis.

[u]Insufficient data to determine significance.

[t]LSD for comparing individual means of combinations of stage of development and concentration, including the control.

[s]Control treatment not included in test for significance.

Table 2. Stage of development of shoot apexes and plant growth retardant effects on plant size and bypass shoot and flower development of *Rhododendron* x 'Prize', Expt. 2.

Stage of development (SOD)	Sumagic concn (ppm)	Bypass shoots		Time to open flowers[y] (days)	Flower no.
		No.	Length[z] (cm)		
0	15	4.4	9.7	41	75
	30	0.9L**[x]	9.0[w]	38L*	92L***
1	15	4.9	5.0	46	41
	30	0.9L***	3.5[w]	48L***	26L***
2–3	15	0.9	3.3	44	40
	30	0.5L***	3.0[w]	46L**	19L***
4	15	0.5	3.0	44	37
	30	0.5L***	2.3[w]	46L**	25L**
Control	15	12.6	13.2	42	67
LSD[v]		2.7	2.3	2.8	11
SOD[u]		*	***	***	***
Concn					
linear		***	NS[w]	*	***
quadratic		***	NS	NS	NS
SOD x Concn[u]		NS	NS	*	***

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

[y]Days to full bloom beginning when plants moved from cooler to greenhouse determined when 50% of flowers were fully opened.

[x]Significance of regression analysis at P = 0.05 (*), 0.01 (**) or 0.001 (***): L = linear, NS = nonsignificant. Control included in regression analysis.

[w]Insufficient data to determine significance.

[v]LSD for comparing individual means of combination of stage of development and concentration, including the control.

[u]Control treatment not included in test for significance.

index (Table 1). These results were expected since earlier application of Sumagic should result in a more pronounced retardation. Plant height and growth index increments decreased with increasing rate of Sumagic, except for height at SOD 4 (NS). Treated plants were visually observed to be compact and uniform, particularly those treated at SOD 0 and 1, while control plants were loose, open and irregular in growth habit.

Treatments affected bypass shoot number (BSN) and length (BSL) differently in the two experiments. In the first experiment, BSN or BSL was not influenced by SOD. In the second experiment, BSN and BSL were less for plants treated at a later SOD (Table 2). In both experiments, BSN decreased with increasing Sumagic rate and was zero and less than one in the first and second experiments, respectively, when plants were treated with 30 ppm Sumagic. There were insufficient data in either test to determine rate effects on BSL.

Time to flower (TTF) and flower number (FN) varied with SOD and experiment. In the first experiment, plants treated at SOD 0 or 1 flowered earlier and with more blooms than control plants or plants treated at a later SOD. Plants treated with 15 ppm Sumagic at SOD 2–3 flowered at the same time as control plants, and FNs were similar. Plants treated with 30 ppm Sumagic at SOD 2–3 or at SOD 4 flowered after control plants with fewer blooms (30 ppm rate only). In the second experiment TTF was less and FN was higher when plants were treated at SOD 0, but not SOD 1, than when treated at a later SOD; TTF and FN were similar for control plants and plants treated with 15 ppm Sumagic at SOD 0 but plants receiving 30 ppm Sumagic at SOD 0 flowered earlier with more blooms. Time to flower tended to be greater and FN lower than those of control plants when plants were treated at SOD 1, 2–3, or 4.

The response of TTF and FN to Sumagic rate also varied with SOD and experiment. In the first experiment when plants were treated at SOD 0 or 1, TTF decreased quadratically and FN increased quadratically (SOD 0) or linearly (SOD 1) with increasing rate. At later stages, TTF increased linearly and FN decreased linearly with increasing rate. In the second experiment, similar trends to those observed on plants treated at either SOD 0 or 1 in the first experiment occurred when plants were treated at SOD 0, but not SOD 1.

Flower diameters (FD) of plants treated at SOD 0 or 1 were similar to those of control plants and greater than those of plants treated at SOD 2–3 (30 ppm) or SOD 4. In the first experiment, Sumagic rate did not affect FD at SOD 0 or 1 but decreased FD of plants treated at SOD 2–3 or 4. In the second experiment, FD decreased with increasing Sumagic rate, from 8.1 cm (3.2 in) with control plants to 7.4 cm (2.9 in) and 6.6 cm (2.6 in) with 15 and 30 ppm Sumagic, respectively.

In the first experiment, flowering of 7 of 8 plants treated at SOD 2–3 with 30 ppm Sumagic, 2 or 8 of 8 plants treated at SOD 4 with 15 or 30 ppm Sumagic, respectively, and 2 of 8 control plants was very late and inconsistent (a few blooms opened at a time with no pronounced peak). These plants were considered unmarketable. Plants in the second experi-

ment receiving these same treatments flowered earlier and more consistently, although flower counts were still relatively low.

Similar results generally were obtained in the two experiments. Differences that were observed probably relate to seasonal variability in environmental conditions. For example, in the first experiment when Sumagic was applied in January, February and March, flower counts were lower and flowering was less concentrated than in the second experiment. Larson (7) reported that 'Redwings' azalea final pinched in November-December and May-June produced fewer flowers than plants pinched at other times of the year. Lower light intensities, common along the Gulf Coast during the winter months, throughout the initiation period can result in fewer flowering terminals (3) due to less carbohydrate being available for both shoot growth and flower initiation. In the second experiment, plants were final pinched in July, vegetative growth developed under long daylengths and high intensities, and flower bud initiation and development occurred under shortening daylengths and reduced light intensities; these conditions favored rapid flower bud development (1). The uneven flowering and low flower counts in the first experiment were particularly apparent when Sumagic was applied at SOD 2–3 or 4; response was probably due to flower buds being too immature to respond to cooling.

Results of this study indicate the importance of applying Sumagic when shoot apexes are vegetative (SOD 0) to produce compact plants, hasten flower initiation, and promote uniform flower development. Treatment at a later SOD resulted in less compact plants that flowered later with fewer blooms. Applied at SOD 0, 30 ppm Sumagic resulted in more compact plants than the 15 ppm rate, whereas time to flower and flower counts varied between the two experiments. Sumagic applied at 30 ppm essentially suppressed all bypass shoot development, while plants treated with 15 ppm Sumagic formed fewer bypass shoots (experiment 2 only) that were shorter than those of control plants. These results of bypass shoot suppression agree with earlier research with Sumagic (4, 5, 10) and emphasize the multiple role this plant growth regulator may play in the production of forcing azaleas, both the promotion of flower bud initiation and development, and the suppression of bypass shoot development.

(*Ed. note*: This paper reports the results of research only and does 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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