Vegetative Growth Responses of Florist Azaleas to Dikegulac, GA₄₊₇, and 6-Benzylamino Purine

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Abstract. Dikegulac, dikegulac + GA₄₊₇, BA, and Promalin (GA₄₊₇ + BA) were evaluated as lateral shoot-inducing agents on greenhouse forcing azalea, *Rhododendron* cultivars Gloria and Prize. The addition of GA₄₊₇ (1000 or 2000 mg·L⁻¹) to a commercial rate of dikegulac (3900 mg·L⁻¹) did not effectively increase plant diameter or leaf width compared to plants sprayed with dikegulac alone. The combination of dikegulac and GA₄₊₇ (3900 + 2000 mg·L⁻¹, respectively) was more phytotoxic than dikegulac alone. Foliar sprays of BA and Promalin at 1000 and 2000 mg·L⁻¹ and 1000 and 1816 mg·L⁻¹, respectively, did not increase lateral shoot count. Neither the addition of GA₄₊₇ to dikegulac nor the use of Promalin is a viable alternative to dikegulac application for inducing lateral branch development of dikegulac-sensitive cultivars. Chemical names used: Na 2,3,4,6-Bis-0-(1-methylethylidene)- α -L-xylo-2-hexulofuranosonic acid (dikegulac), (1 α ,2 β ,4 α ,4 β ,10 β)-2,4a,7-trihydroxy-1-methyl-8-methylenegibb-3-ene-1,10-dicarboxylic acid 1,4a-lactone (GA₄₊₇), N-(phenylmethyl)-1H-purin-6-amine (BA), and Promalin [1:1 (wt/wt) GA₄₊₇ and BA].

In 1975, Bocion et al. reported that dikegulac was very systemically active as a chemical pinching agent. (Dikegulac, originally manufactured by Hoffmann-LaRoche, Basel, Switzerland, under the tradename Atrinal, is now formulated by PBI/Gordon, Kansas City, Mo., as Atrimmec). Dikegulac applied to *Rhododendron* spp. inhibits apical dominance and induces axillary shoot production (Bocion et al., 1975; de Silva et al., 1976; Heursel, 1975). Results of postshearing sprays on azaleas showed dikegulac-treated plants consistently produced more shoots than other chemicals or shearing alone (Shu et al., 1981). Dikegulac, in combination with mechanical shearing, is used in greenhouse azalea production. However, leaf chlorosis (P.F. Bocion and W.H. de Silva, unpublished), delayed plant growth (Heursel, 1975; Sanderson and Martin, 1977), and inhibited morphological development of new leaves and axillary shoots

(Larson, 1978; Sanderson and Martin, 1977) may result from dikegulac treatment, depending on cultivar and environmental conditions, thus raising serious questions concerning its use on certain cultivars in commercial production.

Gibberellic acid can accelerate plant growth and increase leaf area (Phillips, 1975). Starman et al. (1990) reversed growth retardant effects of ancymidol on sunflower leaf anatomy with GA₃ foliar sprays. In addition, Sanderson et al. (1981) reported supplemental lighting or GA sprays of 500 mg·L⁻¹ stimulated growth of azalea shoots treated with dikegulac.

Exogenously applied cytokinins are known to promote lateral bud growth and branch development. However, inconsistent results have been reported for azalea shoot induction with BA (Sanderson and Martin, 1974; Shu et al., 1981). Promalin (Abbott Labs, N. Chicago, Ill.) is a proprietary formulation of BA plus GA₄₊₇. Budbreak of *Rhododendron* x 'Formosa' was promoted by BA at 2000 and 2500 mg·L⁻¹ and Promalin at 2000 to 5000 mg·L⁻¹ (Keever and Foster, 1990). Promalin has not been evaluated as a branching agent on greenhouse forcing azaleas. Our objectives were to 1) determine the effects of the addition of GA₄₊₇ to dikegulac at the time of application on delayed and reduced plant growth and leaf narrowing caused by dikegulac alone and 2) evaluate the effects of foliar sprays of BA and Promalin on induction and development of lateral branches on florist azaleas.

Materials and Methods

Three greenhouse experiments were carried out between Mar. and Oct. 1990 with 6-month-old liners obtained from a commercial

source in mid-Dec. 1989. Two commercially prominent *Rhododendron* cultivars, 'Gloria' and 'Prize', were selected, as they both exhibit poor pinching in response to dikegulac (Shu et al., 1981) but may differ in their growth and development in response to dikegulac as previously mentioned. 'Gloria' with an average of 34 and 'Prize' with 26 actively growing shoots were potted on 5 Jan. 1990 in 0.8-L plastic pots containing 100% peat amended with dolomitic limestone at 3.5 kg·m⁻³. Concurrently, metalaxyl [N-(2,6-dimethylphenyl)-N-(methoxyacetyl) alanine methyl ester (Subdue; Ciba-Geigy, Greensboro, N.C.)] at 240 g·L⁻¹ was applied at 156 μ L·L⁻¹ as a drench to prevent root rot. Plants were fertilized every 2 weeks with a 21N-3.1P-5.8K water-soluble fertilizer (Peters Fertilizer Products, Fogelsville, Pa.) at 1.5 g·L⁻¹, supplying N at 316 mg·L⁻¹ of solution applied.

In all experiments, plants were pruned 24 h prior to application of foliar sprays. After pruning, total number of pruned shoots, initial plant height, and plant diameter were recorded. Using handheld compressed air sprayers, treatments were applied at 204 mL·m⁻² (Tayama and Carver, 1989) to completely wet the stems and foliage. Ten single-plant replications were used. Once dry, plants were arranged in a completely randomized design on greenhouse benches.

In Expt. 1, spray treatments applied on 7 Mar. 1990 were (mg·L⁻¹) 1) distilled water control; 2) GA₄₊₇, 1000; 3) BA, 1000; 4) a combination of GA₄₊₇ and BA, 1000 + 1000; 5) a commercial rate of dikegulac, 3900; and 6) a combination of dikegulac and GA₄₊₇, 3900 + 1000. Plants were placed under artificial long days from 7 Mar. through 2 Apr. (illuminated from 1630 to 2400 hr daily with incandescent lights) to maintain vegetative growth, after which they received natural long days. Natural daylength ranged from 11 h 22 min to 13 h 54 min during the course of the experiment. The glasshouse was shaded with whitewash on 25 Apr. giving $\approx$ 65% light reduction.

In Expt. 2, Promalin replaced the combination GA₄₊₇ and BA. The applied rate of active ingredient (a.i.) in Promalin was slightly less than double the rates of GA₄₊₇ and BA used in Expt. 1. Plants of the same age as those used in Expt. 1 were repotted into 1.7-L plastic pots containing 3 peat : 1 perlite (v/v) amended with dolomitic limestone at 3.5 kg·m⁻³. Spray treatments applied on 19 July 1990 were (mg·L⁻¹) 1) distilled water control; 2) GA₄₊₇, 2000; 3) BA, 2000; 4) GA₄₊₇ and BA (Promalin), 1816 + 1816; 5) dikegulac, 3900; and 6) a combination of dikegulac and GA₄₊₇, 3900 + 2000, respectively. Plants received natural long days ranging from 14 h 17 min to 11 h 25 min during the study.

For Expt. 3, plant age and methods of potting and pruning were identical to those in Expt. 2. Spray treatments applied on 15 June 1990 were (mg·L⁻¹) 1) distilled water control; 2) GA₄₊₇, 2000; 3) BA, 2000; and 4) GA₄₊₇ and BA (Promalin), 1816 + 1816. Plants received natural long days ranging from 14 h 35 min to 13 h 22 min during the study.

Greenhouse controls were set at 21 °C day/

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Table 1. Effect of foliar-applied plant growth regulators (PGR) on number of days from application to shoot initiation and predetermined shoot length for 'Gloria' and 'Prize' azaleas (Expt. 1).^a

PGR	Active ingredient (mg·L ⁻¹)	Interval between application and shoot response (days)			
		Initiation	Length (cm) ^y		
			1	2.5	5
None	---	12.9 ± 0.3 b	21.5 ± 0.5 c	27.7 ± 0.3 b	34.6 ± 0.7 bc
GA ₄₊₇	1000	13.0 ± 0.5 b	21.6 ± 0.7 c	27.9 ± 0.5 b	34.0 ± 0.7 c
BA	1000	13.6 ± 0.4 ab	23.0 ± 0.6 b	28.9 ± 0.4 b	35.8 ± 0.6 b
GA ₄₊₇ + BA	1000 + 1000	13.3 ± 0.4 b	21.7 ± 0.6 c	27.9 ± 0.5 b	34.6 ± 0.7 bc
Dikegulac	3900	14.2 ± 0.5 a	26.3 ± 0.6 a	31.6 ± 0.4 a	37.6 ± 0.6 a
Dikegulac + GA ₄₊₇	3900 + 1000	13.6 ± 0.5 ab	22.3 ± 0.6 bc	28.6 ± 0.4 b	35.3 ± 0.7 bc

^aMean separation in columns by Student–Newman–Keuls' test at $\alpha = 0.05$. Means of 20 plants $\pm$ SE.

^yMeasured for each plant when 75% of new shoots had achieved specified length.

17 °C night for all experiments; however, actual air temperatures during Expt. 1 were quite different than those of Expts. 2 and 3. With the evaporative cooling system used, limitations in maintaining the designated air temperature existed when the outside air temperature rose above ≈ 27 °C, especially under conditions of high relative humidity (RH). During Expt. 1, the average daily maximum was 21 °C and only 11% of days had a maximum of 29 °C or above, thus the designated day temperature was likely to have been maintained. In contrast, Expt. 2 was conducted when the daily maximum averaged 30 °C and 63% of the days had a maximum of 29 °C or above. Though controls were set at 21 °C day, air temperatures of 29 °C in the greenhouse during many of the daylight hours were not uncommon in Expts. 2 and 3.

Nine weeks after treatment, plant canopy height and diameter were recorded. Newly developed lateral shoots longer than 1 cm were counted on each pruned shoot. Number of days to shoot initiation and when $\approx 75\%$ of lateral shoots reached lengths of 1, 2.5, 5, and 10 cm were recorded in Expt. 1. Lengths of 20 randomly chosen, new shoots for each plant were recorded at the end of the study for Expts. 2 and 3.

Phytotoxicity was evaluated using a visual index of 1 to 9, where 1 = none and 9 = severe. Plants with a phytotoxicity ≥ 5 were considered commercially unacceptable. Symptoms used in phytotoxicity ratings included general chlorosis, narrowing and size reduction of new leaves, and morphological retardation of shoots. Stem and leaf necrosis and leaf abscission were noted separately. Leaf narrowing and reduction was quantified in Expts. 2 and 3. Individual areas of 100 leaves from new shoots of one representative plant from each treatment were measured using a LI-3100 area meter (LI-COR, Lincoln, Neb.) 9 weeks after treatment application in Expt. 2. Final leaf

area in Expt. 3 was measured for 'Prize' only and in the same manner as in Expt. 2 using a LI-3000 portable area meter.

Data were tested by analysis of variance (ANOVA). When the treatment $\times$ cultivar interaction was nonsignificant, results were pooled over cultivars and overall treatment means were separated using Student–Newman–Keuls' test at $P \leq 0.05$. When the treatment $\times$ cultivar interaction was significant, ANOVA was done by cultivar, and treatment means were separated using Tukey's honestly significant difference (HSD) at $P \leq 0.05$.

Results and Discussion

Growth. A treatment $\times$ cultivar interaction was observed for plant height increase in Expt. 1. All plant growth regulator (PGR) treatments applied to 'Gloria' azaleas resulted in height increases similar to the control treatment (data not shown), and the average height increase of this cultivar was 10.3 ± 0.2 cm (mean $\pm$ SE). For 'Prize', there were no differences in height increase among treatments (data not shown), and the average height increase of this cultivar was 8.3 ± 0.2 cm. In addition, plant diameter was not affected in either cultivar, and plants had an average diameter increase of 12.7 ± 0.3 cm for both cultivars. Number of days from PGR application to shoot initiation (Table 1) showed little difference among treatments. Dikegulac delayed development of 1-cm-long shoots. BA also delayed shoot growth but not to the same extent. Only dikegulac-treated plants were delayed in developing 2.5- and 5-cm-long shoots, illustrating dikegulac's inhibition of new shoot growth. The addition of GA₄₊₇ to dikegulac overcame the shoot growth delays. There was no treatment effect on time required for plants to develop 10-cm-long shoots, which averaged 48.9 ± 0.7 days (data not shown).

Dikegulac retarded only early shoot growth in this study.

In Expt. 2, growth inhibition by dikegulac was evident for all growth variables measured (Table 2). Plants treated with dikegulac or BA increased less in height and diameter and had shorter shoots than the control plants. Dikegulac + GA₄₊₇ produced larger gains in height, diameter, and shoot length than dikegulac alone and longer shoots than the control. Shoots of plants treated with GA₄₊₇ and GA₄₊₇ + BA were longer than shoots of control plants, though growth in height and diameter of GA₄₊₇ + BA-treated plants was similar to that of control plants. Growth suppression by BA can be attributed to spray burn affecting foliage and stems. Though internode length was similar to that of control plants, shoot development was delayed and, consequently, shoots of BA-treated plants were younger than shoots of plants in the other treatments when final growth characteristics were measured. The accompaniment of GA with BA in Promalin may have served to prevent the phytotoxicity caused by BA alone.

In Expt. 3, PGR treatments did not affect height increase, which averaged 5.4 ± 0.3 cm (data not shown). Diameter increase of plants treated with GA₄₊₇ and GA₄₊₇ + BA were similar to that of control plants, though both treatments stimulated growth in shoot length over the control (Table 3). Again, GA₄₊₇ + BA did not markedly increase general plant growth. As with all three growth variables in Expt. 2, diameter increase and shoot length were less for BA-treated plants than for control plants (Table 3). We can not conclude, however, that spray application with BA decreases growth where spray burn is not a factor.

Shoot count. Dikegulac increased the number of new shoots per pruned shoot for both cultivars in Expt. 1 (Table 4) and Expt. 2 (Table 5). No other treatments affected shoot count in Expt. 1 (Table 4). In Expt. 2, plants of

Table 2. Effect of plant growth regulators (PGR) on growth and phytotoxicity of 'Gloria' and 'Prize' azaleas 9 weeks after foliar application (Expt. 2).^a

PGR	Active ingredient (mg·L ⁻¹)	Plant characteristic			
		Ht increase (cm)	Diam increase (cm)	Shoot length (cm)	Phytotoxicity index ^y
None	---	3.6 ± 0.3 bc	7.3 ± 0.4 b	3.4 ± 0.2 d	1.0 ± 0.0 c
GA ₄₊₇	2000	6.0 ± 0.4 a	9.8 ± 0.7 a	5.6 ± 0.2 a	1.2 ± 0.1 c
BA	2000	1.6 ± 0.4 d	2.5 ± 0.6 d	2.4 ± 0.2 e	---
GA ₄₊₇ + BA	1816 + 1816	4.5 ± 0.3 b	7.3 ± 0.6 b	5.0 ± 0.2 b	1.4 ± 0.1 c
Dikegulac	3900	1.6 ± 0.2 d	2.8 ± 0.4 d	2.3 ± 0.1 e	4.1 ± 0.4 b
Dikegulac + GA ₄₊₇	3900 + 2000	3.2 ± 0.3 c	5.2 ± 0.6 c	4.2 ± 0.2 c	5.7 ± 0.3 a

^aMean separation in columns by Student–Newman–Keuls' test at $\alpha = 0.05$. Means of 20 plants $\pm$ SE.

^yVisual rating using an index of 1 to 9 (none to severe). Plants treated with BA evaluated separately.

Table 3. Effect of plant growth regulators (PGR) on diameter gain, shoot length, and shoot count of 'Gloria' and 'Prize' azaleas 9 weeks after foliar application (Expt. 3).^a

PGR	Active ingredient (mg·L ⁻¹)	Plant characteristic		
		Diam increase (cm)	Shoot length (cm)	Shoots per pruned shoot (no.)
None	---	9.4 ± 0.7 a	4.6 ± 0.3 b	1.9 ± 0.1 a
GA ₄₊₇	2000	10.9 ± 0.9 a	6.1 ± 0.3 a	1.8 ± 0.1 ab
BA	2000	5.8 ± 0.8 b	3.8 ± 0.3 c	1.6 ± 0.1 b
GA ₄₊₇ + BA	1816 + 1816	10.1 ± 0.6 a	5.7 ± 0.2 a	2.0 ± 0.1 a

^aMean separation in columns by Student–Newman–Keuls' test at $\alpha = 0.05$. Means of 20 plants $\pm$ SE.Table 4. Effect of plant growth regulators (PGR) on shoot count and phytotoxicity of 'Gloria' and 'Prize' azaleas 9 weeks after foliar application (Expt. 1).^a

PGR	Active ingredient (mg·L ⁻¹)	Plant characteristic	
		Shoots per pruned shoot (no.)	Phytotoxicity index ^b
None	---	1.9 ± 0.1 b	1.0 ± 0.0 b
GA ₄₊₇	1000	1.8 ± 0.1 b	1.1 ± 0.1 b
BA	1000	2.0 ± 0.1 b	---
GA ₄₊₇ + BA	1000 + 1000	1.9 ± 0.1 b	1.2 ± 0.1 ab
Dikegulac	3900	2.3 ± 0.1 a	1.4 ± 0.1 ab
Dikegulac + GA ₄₊₇	3900 + 1000	2.0 ± 0.1 b	1.6 ± 0.2 a

^aMean separation in columns by Student–Newman–Keuls' test at $\alpha = 0.05$. Means of 20 plants $\pm$ SE.^bVisual rating using an index of 1 to 9 (none to severe). Plants treated with BA evaluated separately.

both cultivars treated with dikegulac + GA₄₊₇ gained no additional shoots over the controls. Furthermore, dikegulac + GA₄₊₇ and dikegulac alone produced similar new shoot counts for 'Prize', but dikegulac + GA₄₊₇ produced fewer for 'Gloria'. For both cultivars, shoot count among plants treated with GA₄₊₇, GA₄₊₇ + BA and the control were similar, and plants treated with BA produced fewer new shoots than the control in Expt. 2 (Table 5) and Expt. 3 (Table 3). As with the growth results, the negative impact of BA at 2000 mg·L⁻¹ on shoot count may readily be attributable to phytotoxicity; here again, the combination of GA with BA in Promalin avoided the detrimental effects of BA.

Phytotoxicity. Phytotoxicity symptoms of BA were very different from phytotoxicity symptoms induced by dikegulac treatment and, therefore, were evaluated separately and not included in phytotoxicity ratings. Damage from BA was negligible in Expt. 1. However, growth and new shoot initiation were impacted by foliar burn, extreme defoliation and stem injury in Expts. 2 and 3. In Expt. 2, 2 weeks after BA application, defoliation ranged from 75% to 90% for 'Gloria' and 5% to 75% for 'Prize', (data not shown). For 'Gloria', death of one plant, necrosis of entire branches of others and some burning of the pruned stem tips on all plants were caused by treatment with BA,

whereas 'Prize' plants showed only tip burn. Spray burn was equally severe in Expts. 2 and 3. Very few GA₄₊₇ + BA-treated plants were injured having only minor stem tip burn. That the combination of GA with BA in Promalin precluded the detrimental effects of BA alone was evident also by growth and shoot initiation data previously shown. No spray injury was apparent for plants treated with GA₄₊₇ alone. Since the same carrier solution was common to the BA, the GA₄₊₇, and the GA₄₊₇ + BA (Promalin) formulations, it is assumed that the carrier solution was not responsible for the phytotoxicity.

Apart from phytotoxicity associated with BA, Expt. 1 showed that only treatment with dikegulac + GA₄₊₇ gave a mean phytotoxicity rating different from the control (Table 4). In Expt. 2, plants treated with dikegulac + GA₄₊₇ exhibited the greatest phytotoxicity followed by those in the dikegulac alone treatment; only these groups were significantly different from the control (Table 2). That GA₄₊₇ and GA₄₊₇ + BA did not cause phytotoxicity was further substantiated in Expt. 3 where there was no effect of PGR treatment on phytotoxicity (data not shown).

Most plants in the dikegulac + GA₄₊₇ and the dikegulac treatments exhibited uniform leaf chlorosis which persisted past the ninth week after application. Narrow leaves were

observed on new shoots on 80% of each cultivar in the dikegulac alone treatment and on all plants of each cultivar in the dikegulac + GA₄₊₇ treatment (data not shown). Fifty percent of 'Gloria' and 30% of 'Prize' in the dikegulac treatment and 60% of 'Gloria' and 90% of 'Prize' plants in the dikegulac + GA₄₊₇ treatment were rated a 5 or above, and thus, were commercially unacceptable. These plants exhibited some new shoots with very small, slender, and chlorotic leaves; a growth habit that was more vertical, running parallel with the pruned shoot; and brittle and fragile point of attachment to the main axis. These shoots on dikegulac + GA₄₊₇ plants had longer internodes than those on dikegulac plants but were stunted compared to new shoots on control plants. Plants of the dikegulac + GA₄₊₇ treatment were considered commercially unacceptable as a group because of mean ratings of 5 for 'Gloria' and 6.3 for 'Prize'. When these ratings were considered along with overall legginess and nonuniformity of plants due to the presence of normal with abnormal shoots, no plant of either cultivar in the dikegulac + GA₄₊₇ treatment was commercially acceptable.

Leaf area. A treatment $\times$ cultivar interaction necessitated separate analysis of the cultivars in Expt. 2 (Table 5). Leaf areas of 'Gloria' plants treated with dikegulac + GA₄₊₇ and dikegulac alone were similar and were smaller than those of plants in other treatments, including the control. 'Prize' plants treated with GA₄₊₇ had less leaf area than controls but more than plants that received only dikegulac. 'Prize' plants treated with dikegulac + GA₄₊₇ had the smallest leaves. The effects of treatment with dikegulac and dikegulac + GA₄₊₇ on leaf area were consistent with the phytotoxicity ratings and qualitative observations. The addition of GA₄₊₇ to dikegulac did not increase leaf width and may have actually decreased 'Prize' leaf width compared to treatment with dikegulac alone. Results from Expt. 3, which included only the control, GA₄₊₇, BA, and GA₄₊₇ + BA treatments, showed no treatment effect on leaf area (data not shown).

Possible environmental effects. Though the applied rate of GA₄₊₇ was doubled in Expt. 2, phytotoxicity ratings for the GA₄₊₇ and GA₄₊₇ + BA treatments increased by no more than 19% over Expt. 1 ratings. In marked contrast, though the rate of dikegulac was the same in both experiments, phytotoxicity ratings for

Table 5. Effect of plant growth regulators (PGR) on azalea shoot count and leaf area 9 weeks after foliar application (Expt. 2).

PGR	Active ingredient (mg·L ⁻¹)	Shoots per pruned shoot (no.) ^a		Leaf area (cm ²) ^b	
		Cultivar			
		Gloria	Prize	Gloria	Prize
None	---	2.1 ± 0.1 b	2.5 ± 0.1 bc	2.2 ± 0.1 b	2.7 ± 0.2 a
GA ₄₊₇	2000	1.9 ± 0.1 bc	2.3 ± 0.1 c	2.4 ± 0.1 ab	1.9 ± 0.1 b
BA	2000	1.3 ± 0.1 c	1.1 ± 0.1 d	2.3 ± 0.1 ab	2.6 ± 0.1 a
GA ₄₊₇ + BA	1816 + 1816	1.8 ± 0.1 bc	2.4 ± 0.1 bc	2.7 ± 0.2 a	2.6 ± 0.1 a
Dikegulac	3900	3.3 ± 0.3 a	3.4 ± 0.3 a	1.0 ± 0.1 c	1.3 ± 0.1 c
Dikegulac + GA ₄₊₇	3900 + 2000	2.3 ± 0.2 b	3.0 ± 0.2 ab	1.1 ± 0.1 c	0.8 ± 0.1 d

^aChemical treatment $\times$ cultivar interaction significant at $P \leq 0.05$. Mean separation in columns by Tukey's test; HSD ($\alpha = 0.05$) = 0.7. Means of 10 plants $\pm$ SE.^bChemical treatment $\times$ cultivar interaction significant at $P \leq 0.001$. Mean separation in columns by Tukey's test; HSD ($\alpha = 0.05$) = 0.5. Means of 100 leaves from one representative plant $\pm$ SE.

the dikegulac and dikegulac + GA₄₊₇ treatments in Expt. 2 represent an increase of ≈200% and 250%, respectively, over Expt. 1 ratings. Similarly, dikegulac-induced shoot count was higher in Expt. 2, representing an increase over the control plants of 57% for 'Gloria' and 36% for 'Prize' vs. an increase of only 21% for both cultivars in Expt. 1.

Temperature effects on dikegulac activity (P.F. Bocion and W.H. de Silva, unpublished) may have exacerbated phytotoxicity and increased shoot induction in Expt. 2. Another possibility may be differences in RH at the time of application, perhaps leading to differential absorption. RH in the greenhouse during foliar application in Expt. 1 was <33%, whereas in Expt. 2 RH was at 87%.

In summary, GA₄₊₇ + BA (Promalin) did not increase the number of lateral shoots of 'Gloria' or 'Prize' azaleas when applied at 1000 and 1816 mg·L⁻¹. Addition of GA₄₊₇ at 1000 or 2000 mg·L⁻¹ to dikegulac at the time of application was ineffective in curtailing the growth delays, reduced diameter, or leaf narrowing typically exhibited by dikegulac-sensitive cultivars. Additions of GA₄₊₇ to dikegulac negated dikegulac's effectiveness in increasing lateral budbreak. Moreover, the 2000 mg

GA₄₊₇ + dikegulac combination was more phytotoxic than dikegulac alone and failed to produce a saleable plant. The addition of GA₄₊₇ to dikegulac or the use of GA₄₊₇ + BA (Promalin) are not viable alternatives to dikegulac application for inducing lateral branch development of dikegulac-sensitive cultivars.

BA sprays caused leaf necrosis and abscission as well as stem necrosis. Though treatment with BA at 2000 mg·L⁻¹ decreased growth and shoot count, further investigation is needed to determine its activity on lateral shoot induction when applied in an environment that does not induce a phytotoxic response.

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