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Control of *Salpiglossis sinuata* Height with Plant Growth Regulators

Douglas C Needham[1] and P. Allen Hammer
Department of Horticulture, Purdue University, West Lafayette, IN 47907

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Abstract. Salpiglossis sinuata R. *et* P., a floriferous member of the Solanaceae, was studied for potential as a flowering potted plant when modified by growth retardants. Seedlings of an inbred line P-5 were covered with black cloth for an 8-hour photoperiod to permit vegetative growth to ≈16 -cm-diameter rosettes. Plants were then exposed to an 18-hour photoperiod for the duration of study. Flowering occurred 40 days after the plants were transferred to long days. Neither spray applications of uniconazole at 10, 20, 40, or 100 ppm, nor chlormequat chloride at 750, 1500, or 3000 ppm significantly retarded plant height. Applications of daminozide, ranging in concentration from 1000 to 5000 ppm, alone and in combination with chlormequat chloride, were effective at retarding plant height; however, concomitant restriction of corolla diameter was frequently observed. Chemical names used: 2-chloro- *N,N,N* -trimethylethanaminium chloride (chlormequat chloride); butanedioic acid mono(2,2-dimethylhydrazide) (daminozide); and *(E)* -1-(p-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl) -1-penten-3-01 (uniconazole).

Height of many flowering ornamental, e.g., poinsettia, hydrangea, chrysanthemum, and lily, has been controlled for floricultural pot production by the application of plant growth regulators (Larson, 1985). Although breeding has genetically reduced the height of some cultivars of these plants, growth retardants account for much of the restricted height and associated enhancement of foliage color.

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[1]Assistant Professor, Floriculture. Current address: Oklahoma State Univ., Dept. of Horticulture and Landscape Architecture, Stillwater, OK 74078-0511.

Salpiglossis express a wide variety of flower colors and patterns, e.g., red, yellow, blue, pink, and orange, with or without striping or dilution. At first flower anthesis, plants not treated with chemical growth retardants are 30 to 45 cm high, which is commercially unacceptable. Thus, if height could be restricted to a size appropriate for a potted plant, the marketability of salpiglossis would be enhanced and the consumers' desires for new and unusual plants could be satisfied. Three separate studies quantified the growth retardant effects of chlormequat chloride (Cycocel), daminozide (B-Nine SP), and uniconazole (Sumagic) on salpiglossis.

The highly inbred, yellow-flowering salpiglossis line P-5 (Erickson, 1982) was selected for its compact, floriferous branches and relatively short stature, in contrast to other salpiglossis inbreds with loosely arranged flowers and greater height. Seeds were sown onto a stratum of 1 cm of commercial peat : lite (Grace Horticultural Products' Vegetable Plug Mix) and 3 cm of greenhouse potting soil, composed of 1 soil : 2 sphagnum

Fig. 1. Multiple applications of daminozide at 2500 or 5000 ppm significantly retarded height of salpiglossis. Plants represent (**left to right**) control, one application at 2500, one application at 5000, two applications at 2500, two applications at 5000, three applications at 2500, and three applications at 5000 ppm.

Table 1. Effects of multiple applications of daminozide on plant height and corolla diameter of salpiglossis.

Daminozide[z,y]		Plant ht		Corolla diam	
Concn (ppm)	Applications (no.)	cm	% Restriction	cm	% Restriction
0	---	37	---	7.6	---
2500	1	37	0	7.1	7
5000	1	36	1	6.8	10
2500	2	34	8	6.6	13
5000	2	32	12	5.6	26
2500	3	31	16	5.3	30
5000	3	24	34	4.3	44
One application					
Linear		NS	NS	*	*
Quadratic		NS	---	NS	---
Two applications					
Linear		**	***	***	***
Quadratic		NS	---	NS	---
Three applications					
Linear		***	***	***	***
Ouadratic		NS	---	*	---

[z]Applied at 0.6 ml·cm^{-2}.
[y]Ten single-plant replications per treatment.
NS,*,**,***Nonsignificant or significant at P = 0.05, 0.01, or 0.001, respectively, via F test.

Table 2. Effects of three applications of daminozide on plant height and corolla diameter of salpiglossis.

Daminozide concn[z,y] (ppm)	Plant ht cm	Plant ht % Restriction	Corolla diam cm	Corolla diam % Restriction
0	33	---	6.5	---
1000	30	8	5.8	10
2000	27	17	5.5	15
3000	26	20	5.1	21
Treatment	***	***	***	***
Linear	***	***	***	***
Quadratic	NS	NS	NS	NS

[z]Applied at 0.6 ml·cm^{-2}.
[y]Twenty single-plant replications per treatment.
NS,*,**,***Nonsignificant or significant at P = 0.05, 0.01, or 0.001, respectively, via F test.

peat : 2 perlite (by volume), having a pH of 6.2 with soluble salts of 1.64 dS·m^{-1}, and (all in mg·liter^{-1}) 120 NO_3, 12 NH_4, 53 P, and 130 K, in flats with a light dusting of plug mix over the top. Seeds were germinated under intermittent mist (on for 6 sec every 8 min during daylight hours). The day maximum was 27C and the night minimum was 21C. Seedlings emerged in 10 days and were transplanted 20 days later into greenhouse potting soil in 13-cm azalea pots (0.8 liters). They were covered for 5 weeks with black cloth from 1600 to 0800 HR for an 8-hr photoperiod to encourage vegetative growth to ≈16–cm-diameter rosettes. Irrigation supplied 200 ppm N and 200 ppm K in water acidified with H_3PO_4 to pH 6.3. The plants were then moved onto a greenhouse bench with 50 µmol·s^{-1}·m^{-2} supplementary lighting from 0600 to 2400 HR for an 18-hr photoperiod from eight Sylvania F96T12/CW/VHO fluorescent lamps and four 100-W incandescent bulbs per 457 × 152-cm bench. Plants were positioned on 25-cm centers in a completely randomized design to minimize nontreatment effects.

Plants were assembled for each treatment. Growth regulators were evenly applied in 189-ml aliquots over a 305-cm^2 spraying area (0.5 gal/100 ft) as a coarse mist from a Super Polyspray 2 (Hoze Lock-ASL Sprayers, Haddenham, Aylesbury, England). Plants were then returned to the completely randomized configuration. Where one application of a treatment was specified, it was applied the morning following the first long-day. Where two and three applications of a treatment were specified, they were applied in the morning 7 and 14 days after the first application, respectively.

Height of each plant was measured from the soil surface and corolla diameter was recorded when the plant's first flower dehisced pollen (≈15 weeks after sowing).

Uniconazole was applied once at 10, 20, 40, or 100 ppm, and chlormequat chloride was applied once at 750, 1500, or 3000 ppm. Neither uniconazole nor chlormequat chloride was effective at retarding plant height. Hammer (1987) determined that 20 ppm of uniconazole was effective at retarding plant height of Easter lilies; however, on salpiglossis it had no effect, even at the relatively high concentration of 100 ppm. In preliminary experiments, chlorosis and necrosis of leaf tissue were observed with applications of chlormequat chloride exceeding 3000 ppm.

The effects of one, two, and three applications of daminozide were examined at 2500 and 5000 ppm. Two and three applications of daminozide at 5000 ppm and three applications at 2500 ppm (Table 1 and Fig. 1) retarded plant height by 12%, 34%, and 16%, respectively. However, the restriction of plant height afforded by these treatments was accompanied by a restriction of corolla diameter. Three applications of daminozide at 5000 ppm resulted in a 44% restriction of corolla diameter, which was greater than that caused by the three applications at 2500 ppm or two applications at 5000 ppm (Table 1). Thus, it became evident that the concentration of daminozide and the number of applications needed to be coordinated so that optimal restriction of plant height would be obtained with minimal restriction of corolla diameter. An attempt to accommodate this goal was made by reducing the concentrations of daminozide while holding the number of applications constant at three (Table 2).

Form of poinsettia and other potted ornamentals has been improved with multiple applications of growth retardant at reduced concentrations when compared with fewer applications at higher concentrations (Larson, 1985). Three applications of daminozide at 1000, 2000, or 3000 ppm retarded plant height by 8%, 17%, or 20%, respectively. Although corolla diameter also was retarded by these three treatments, the largest mean restriction was only 21%, which is not commercially detrimental, with three applications at 3000 ppm.

Chlormequat chloride and daminozide have been reported to act synergistically in poinsettia (Larson and Thorne, 1987; Larson, 1986; Barrett and Nell, 1984; Shanks, 1981). In order to test for synergism in salpiglossis, a single application of each of three tank-mixtures was applied. These included 1500 ppm chlormequat chloride plus 1250, 2500, or 5000 ppm daminozide. Plant height was not different among the three treatments, and it was only 10% less than that of the control group.

Salpiglossis is native to southern Argentina and Chile (Hunziker et al., 1979) and

grows prolifically under warm (27 C/day and 18 C/night) conditions. Since the first study began in March, the second in June, and the third in July, the plants of the first study had the benefit of cooler greenhouse conditions and, thus, grew taller with dense foliage and abundant large flowers. Nontreated plants transplanted in March were 42 cm at first flower anthesis, those transplanted in June were 37 cm, and those transplanted in July were 33 cm. The increased light intensity (1000-1500 $\mu mol \cdot s^{-1} \cdot m^{-2}$ in summer vs. 500-800 $\mu mol \cdot s^{-1} \cdot m^{-2}$ in winter) and temperature (37C/day and 21 C/night in summer vs. 27C/day and 18 C/night in winter) of summer appeared to limit the vigor of the plants in the second and third studies. Therefore, one needs to adjust growth regulator applications to the requirements of the plants under the given greenhouse conditions. Less growth regulator is needed in summer than in the cooler and less light-intensive other seasons.

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