

Response of Sun Coleus (*Solenostemon scutellarioides*) ‘Burgundy Sun’ and ‘Solar Storm’ to Paclobutrazol and Uniconazole Foliar Sprays¹.

Todd J. Cavins, Brian E. Whipker, and Ingram McCall²

Abstract - Foliar applications of 40 or 80 mg/L paclobutrazol or 16 or 32 mg/L uniconazole were applied to ‘Burgundy Sun’ and ‘Solar Storm’ as a single application, 7 d, or a double application, 7 and 21 d, after transplanting of rooted cuttings. Uniconazole was more effective than paclobutrazol in controlling plant height and diameter for both cultivars. ‘Burgundy Sun’ required two 32 mg/L uniconazole applications to obtain 31% shorter heights and 24% smaller diameters compared to controls. ‘Solar Storm’ required one 32 mg/L uniconazole application to obtain 44% shorter heights and 30% smaller diameters compared to the control. Two 32 mg/L uniconazole applications were excessive, resulted in ‘Solar Storm’ plants 53% shorter than the control, and produced leaf malformations. Paclobutrazol applications were not effective, regardless of rate or number of applications, in reducing ‘Burgundy Sun’ and ‘Solar Storm’ heights or diameters. Therefore, uniconazole was a more effective plant growth retardant for ‘Burgundy Sun’ and ‘Solar Storm.’

Nomenclature, Sun Coleus, *Solenostemon scutellarioides* (L.) Codd; paclobutrazol, [(±)(R*, R*)-beta-((4-chlorophenyl) methyl)-alpha-(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol]; uniconazole [(E)-(+)-(S)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl)-pent-1-ene-3-ol]. *Additional index words*. plant growth retardant, PGR, triazoles

INTRODUCTION

The popularity of sun coleus [*Solenostemon scutellarioides* (L.) Codd] has recently increased with its use as a bedding plant and in container combinations. Currently, over 200 vigorous sun coleus cultivars are available to consumers (R. Repp, Lakeview Gardens, personal communication). Sun coleus are typically vegetatively propagated, generally considered to be vigorous growers, and tolerate direct sun, compared to conventional seed-propagated cultivars. Sun coleus may require high plant growth retardant (PGR) concentrations to achieve height and diameter control for container production. Several PGRs have been tested on *S. scutellarioides* in-

cluding ethephon [(2-chloroethyl) phosphonic acid] (Florel, Rhone-Poulenc Ag. Co., Research Triangle Park, NC), paclobutrazol (Bonzi, Uniroyal Chemical, Middlebury, Conn.), cimectacarb, [4-(cyclopropyl-aphydroxy-methylene)-3,5-dioxo-cyclohexanecarboxylic acid ethyl ester] (Primo, Novartis Crop Protection, Greensboro, NC), and uniconazole (Sumagic, Valent USA, Marysville, OH). These previously published plant growth retardant trials did not identify the cultivars or seed-propagated shade cultivars were used (Barrett and Nell, 1989; Keever and Olive, 1998; Khosh-Khui et al., 1978; Shanks, 1980). Previous plant growth retardant trials also did not report plant diameter, economic evaluations, or specific rate recommendations.

Plant diameter control is important to *S. scutellarioides* producers to increase plant

¹ Received for publication September 28, 2001 and in revised form February 19, 2002.

² Graduate Research Assistant, Assistant Professor and corresponding author, and Research Technician, respectively. Department of Horticultural Science, Box 7609, North Carolina State University, Raleigh, NC 27695-7609

density per bench, thus decreasing production expenses and potentially increasing profits. Recommended application rates are also needed for different leaf type cultivars. 'Burgundy Sun' has wizard-type foliage, large leaves that develop a dense canopy over the stems; thus, foliar PGR applications do not easily reach plant stems which may result in less effective foliar application of PGRs versus smaller-leafed cultivars (Barrett and Bartuska, 1982). 'Solar Storm' has saber-type foliage with lanceolate leaves, which allows PGR foliar applications to reach the stems. This study was conducted to determine recommended paclobutrazol and uniconazole foliar rates for controlling plant height and diameter on both a large-leafed and a small-leafed cultivar of sun-type *S. scutellarioides*.

MATERIALS AND METHODS

'Burgundy Sun' and 'Solar Storm' unrooted cuttings [2.5 in (6.3 cm) long] were propagated under mist in 1204 bedding plant cell packs [5.5 in³/plant (90 cm³/plant)] containing Fafard Super Fine Germinating Mix (Fafard Inc., Anderson, SC) on 23 Mar. 2000 and transplanted into 6 in (15.24 cm) [83.9 in³ (1375 cm³)] plastic pots containing Fafard 4P (Fafard Inc., Anderson, SC) root substrate. Plants were spaced pot-to-pot (pot edges touching) on 7 Apr. and on 15 Apr., plants were spaced at 12 in by 12 in (30.5 cm by 30.5 cm), 12 in (30.5 cm) from center of pot to center of surrounding pots. Plants were fertigated with 150 mg/L N from Excelâ 15N-2.1P-12.5K [15-5-15 Cal-Mag (The Scotts Co., Marysville, Ohio)]. Double-layered polyethylene greenhouse day/night temperatures were set at 82/65°F (28/18°C) and plants were grown un-

der natural daylengths. Paclobutrazol foliar sprays of 40 or 80 mg/L or uniconazole sprays of 16 or 32 mg/L were applied at 1 gal/200 ft² (0.2 L/m²), 7 d (once) or 7 and 21 d (twice) after transplanting. The experiment was a completely randomized design with 10 replications and 9 treatments per cultivar. Data collected 5 weeks after transplanting (2 or 4 weeks after the final PGR application for each treatment) included plant height (measured from the pot rim to the uppermost part of the plant) and plant diameter (an average of two measurements, one at the widest dimension and the other turned 90°). Data were analyzed using analysis of variance for evaluation of treatments and Tukey's HSD ($P \leq 0.05$) for means separation (SAS Institute, Cary, NC).

RESULTS AND DISCUSSION

Plant height - Paclobutrazol was not effective in controlling 'Burgundy Sun' plant height (Table 1) regardless of rate or number of applications. Uniconazole retarded 'Burgundy Sun' plant height with 16 mg/L applied twice and 32 mg/L applied either once or twice. Greatest control of plant height was achieved with 32 mg/L uniconazole applied one or two times with 16 and 31% height retardation, respectively. A 30% retardation in growth is considered to be the desired height control for the floriculture industry (T. Harger, Uniroyal Chemical Co., personal communication). Only the treatment of 32 mg/L uniconazole applied twice achieved that degree of control.

Paclobutrazol was not effective in controlling 'Solar Storm' plant height (Table 1). Uniconazole retarded 'Solar Storm' plant

Table 1. Coleus (*Solenostemon scutellarioides*) ‘Burgundy Sun’ and ‘Solar Storm’ height and diameter affected by paclobutrazol and uniconazole foliar sprays.

Plant growth regulator	Number of applications	Rate (mg/L)	Plant height (cm) ^z	% shorter than control	Plant diameter (cm) ^y	% smaller than control
‘Burgundy Sun’						
Control			39.3 a ^x	0	51.8 a	0
Paclobutrazol	1	40	39.5 ab	0	51.6 a	0
		80	36.7 abc	7	46.7 ab	10
	2	40	39.1 ab	1	50.1 ab	3
		80	37.7 abc	4	50.3 ab	3
Uniconazole	1	16	35.7 abc	9	47.9 ab	8
		32	33.2 c	16	45.1 bc	13
	2	16	34.7 bc	12	45.5 abc	12
		32	27.3 d	31	39.5 c	24
‘Solar Storm’						
Control			52.8 a	0	50.7 a	0
Paclobutrazol	1	40	50.9 a	4	46.8 ab	8
		80	55.3 a	0	48.4 ab	5
	2	40	51.2 a	3	47.8 ab	6
		80	51.3 a	3	44.7 cb	12
Uniconazole	1	16	41.7 b	11	41.1 c	19
		32	29.5 cd	44	35.3 d	30
	2	16	36.8 cb	30	41.4 c	18
		32	24.7 d	53	31.2 d	38

^z Measured from the pot rim to the uppermost part of the plant.

^y Measured at the widest dimension, turned 90° and averaged.

^x Letters indicate mean separation by Tukey’s $P \leq 0.05$ within cultivar.

height with 16 and 32 mg/L applied either once or twice. 'Solar Storm' plant height was retarded 44 or 53% by 32 mg/L uniconazole applied once or twice, respectively, when compared to the control. However, two applications of 32 mg/L uniconazole excessively retarded plant height and caused young-leaf malformations (buckling of tissue near the mid-vein), thus reducing market quality.

Barrett and Nell (1989) noted that uniconazole was more effective in *S. scutellarioides* height retardation than paclobutrazol when applied at the same concentrations. 'Burgundy Sun' height control (31% shorter than the control) obtained with two 32 mg/L uniconazole applications in our study was similar to one 20 mg/L uniconazole application control (33% shorter than control plant height) reported by Barrett and Nell (1989) on *S. scutellarioides* 'Red Wizard'. The differences may be a result of cultivar differences, production temperatures, which were not reported by Barrett and Nell (1989), or potential salt stress caused by the high fertilization concentrations (300 mg/L N constant liquid feed) in their study. Salt stress may make plants more susceptible to other environmental factors, which may have contributed to the increased response to the plant growth regulator.

Plant diameter - Paclobutrazol treatments, irrespective of rate or number of applications, were not effective in controlling 'Burgundy Sun' plant diameter (Table 1). One or two applications of 32 mg/L uniconazole retarded 'Burgundy Sun' plant diameter. Plant diameters were retarded 13 or 24% by 32 mg/L uniconazole applied once or twice, respectively, compared to the control. A 30% retardation in growth is considered to be the desired diameter control for the floriculture in-

dustry (T. Harger, Uniroyal Chemical Co., personal communication). The 32 mg/L uniconazole foliar spray applied twice achieved a similar degree (24% smaller than control plants) of control to that desired by the industry.

Two applications of 80 mg/L paclobutrazol retarded 'Solar Storm' plant diameter by 12%, compared to the control (Table 1). Although statistically smaller than the control plants, this small degree of control is not sufficient for commercial production practices. However, 'Solar Storm' plant diameter was retarded by uniconazole regardless of rate or number of applications. Desirable production diameters were obtained with 32 mg/L uniconazole applied once or twice, which retarded plant diameter by 30 or 38%, respectively, compared to the control.

In conclusion, results varied by cultivar; however, 32 mg/L uniconazole applications were most effective in retarding plant height and diameter. 'Burgundy Sun', having larger leaf area than 'Solar Storm,' required increased application of PGR to allow sufficient contact of the chemical with the plant stem to attain desirable growth control. 'Burgundy Sun' was effectively controlled with two applications of 32 mg/L uniconazole. 'Solar Storm' height and diameter were retarded by one or two applications of 32 mg/L uniconazole; however, young-leaf distortion occurred with the double application. Therefore, a single 32 mg/L uniconazole application is recommended for 'Solar Storm'. The degree of height control achieved with the single 32 mg/L uniconazole application was 44% shorter plants. Therefore, rates between 16 and 32 mg/L may be sufficient for height control; albeit, diameter control would likely be compromised with a uniconazole concentration below 32 mg/L.

Based on cost of \$113.00/0.95 L, a single 32 mg/L uniconazole foliar spray application would cost \$15.54 per 10 m² (108 ft²) of bench area. A single 32 mg/L uniconazole application was required for control of 'Solar Storm'. The cost per plant (\$0.07/pot) is low due to the pot-to-pot spacing during the single application.

A double 32 mg/L uniconazole foliar spray application would cost \$31.08 per 10 m² (108 ft²) of bench area. Due to the high amount of PGR required for 'Burgundy Sun', double uniconazole applications would be cost prohibitive (\$0.29/pot). Increased plant spacing [12 in by 12 in (30.5 by 30.5 cm)], to allow for lateral shoot growth, during the second spray application resulted in high spray cost per plant. Cultural practices such as pinching, cool temperatures, or scheduling may be better alternatives to high cost PGR applications for 'Burgundy Sun', to control plant height and diameter.

These results indicate that efficacy of PGRs vary among sun coleus cultivars. Further studies are warranted to determine relative PGR rates needed for various sun coleus cultivars as well as a comparison to shade coleus cultivars.

ACKNOWLEDGEMENTS

This research was funded in part by the North Carolina Agricultural Research Service (NCARS), Raleigh, NC. Use of trade names in this publication does not imply endorsement by NCARS of products named nor criticism of similar ones not mentioned. Thanks is expressed to Lakeview Gardens, Waynesville, NC for plant materials, Fafard Inc. for supplying root substrate, The Scotts Co. for supplying fertilizer, and Uniroyal Chemical Co. for grant support.

LITERATURE CITED

- Barrett, JE and CA Bartuska 1982 PP333 effects on stem elongation dependent on site of application. *HortScience* 17:737-738
- Barrett, JE and TA Nell 1989 Comparison of paclobutrazol and uniconazole on floriculture crops. *Acta Hort* 251:275-280
- Keever, GJ and JW Olive 1998 Effects of Primo rate and application volume on selected herbaceous and woody landscape plants. *J Envir Hort* 16:114-117
- Khosh-Khui, M, I Rouhani, and B Shaybany 1978 Axillary shoot stimulation and plant development of coleus treated with certain plant growth regulators. *Can J Plant Sci* 58:971-976
- Shanks, JB 1980 Chemical dwarfing of several ornamental greenhouse crops with PP333. *Proc of the Plant Growth Regulator Working Group* 7:46-51