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Research Reports

Growth Control of 'Taylortown Red' and 'Homestead Purple' Verbena with Pistill in Nursery Production¹

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Abstract

Verbena canadensis 'Homestead Purple' and 'Taylortown Red' were treated with one or two spray applications of the plant growth regulator (PGR) Pistill (ethephon) at 0, 250, 500, 750, or 1000 ppm. Plants were in 3.8 liter (1 gal) containers under outdoor nursery conditions. Plant widths of 'Homestead Purple' verbena were suppressed linearly with increasing Pistill concentrations up to 24% at 2 weeks after initial treatment (WAT) and up to 18% at 4 WAT. Widths of 'Taylortown Red' verbena were suppressed 22% at 2 WAT with a single application at 500 to 1000 ppm, and linearly up to 33% at 4 WAT with 2 applications. Two applications of Pistill suppressed heights and widths of both cultivars at 7 WAT compared to one application.

Index words: growth regulation, plant growth regulator, herbaceous perennial.

Plant growth regulators used in this study: Pistill (ethephon), (2-chloroethyl) phosphonic acid.

Species used in this study: verbena (*Verbena canadensis* (L.) Britt. = *V. aubletia* Jacq. 'Homestead Purple' and 'Taylortown Red').

Significance to the Nursery Industry

Verbena canadensis cultivars are very popular herbaceous perennials. However, their vigorous spreading growth habit can be a problem during production. Long trailing shoots growing well beyond the rim of the container make maintenance and shipping difficult and expensive. Plants are also more subject to damage during handling and planting. Our research showed that a single spray application of Pistill (ethephon) at 500 to 1000 ppm suppressed plant width of

'Taylortown Red' verbena at 2 WAT and 'Homestead Purple' verbena at 4 WAT. Height and width of both cultivars were suppressed up to 7 WAT with 2 applications. No phytotoxicity symptoms were observed and all treated plants were of marketable quality throughout the study.

Introduction

The cultivars of *Verbena canadensis* are perennial, spreading groundcover plants hardy south of zone 6. 'Homestead Purple' has early, rose-purple flowers while 'Taylortown Red' is a floriferous selection with true red flowers (1, 2). The vigorous growth habit of these cultivars has helped make them very popular herbaceous perennials for home and commercial landscapes. However, this vigorous spreading growth can be a problem for nursery and greenhouse

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growers as the plants can quickly outgrow their containers, increasing maintenance and shipping costs and reducing marketability.

Growth control of several herbaceous perennials has been achieved with plant growth regulators (PGRs) such as Sumagic, Pistill, and a B-Nine/Cycocel tank mix (8). In previous research under nursery conditions (3) we found little control of 'Homestead Purple' verbena with Sumagic or a B-Nine/Cycocel mix but a single application of Florel (ethephon, the same active ingredient as Pistill) at 500 to 1000 ppm provided effective control of 'Homestead Purple' 4 weeks after treatment (WAT). However, Burnett et al. (5) found no control of 'Homestead Purple' verbena with Pistill at these same concentrations under nursery conditions. The authors suggested plant size or age may be the reason for the differences in response. They also suggested multiple applications may increase control under nursery conditions. This research was conducted to investigate this difference in response of *Verbena canadensis* to Pistill, and to compare the response of a range of Pistill concentrations applied once or twice to two vigorous cultivars of *V. canadensis*, 'Homestead Purple' and 'Taylortown Red'.

Materials and Methods

'Homestead Purple' and 'Taylortown Red' verbena liners in 10 cm (4 in) pots were transplanted on June 4, 2004, into 3.8 liter (#1) pots containing a medium consisting of 92% aged pine bark and 8% coarse sand, amended with 5.4 kg/m³ (9 lb/yd³) of a 15N-3.9P-10K controlled-release fertilizer (Osmocote Plus 15-9-12, 8 to 9 month formulation, Scotts-Sierra Horticultural Products Co., Marysville, OH). The plants were placed outdoors in full sun and irrigated overhead twice daily to provide a total of approximately 2.5 cm (1 in) of water. On July 12, plants were sheared to a height of 10 cm (4 in) above the pot rims and to a width even with the pot rims after blocking by size. Plants were then moved into a greenhouse to protect from rain. Pistill treatments were applied as foliar sprays using a CO₂-pressurized sprayer with a TXVS-8 cone-jet nozzle (R&D Sprayers, Opelousas, LA) at 2.8 kg/cm² (40 psi) in volumes of 0.2 liter/m² (equivalent to 2 qt/100 ft²). Treatments included: Pistill at 250, 500, 750, or 1000 ppm, and an untreated control. All Pistill concentrations were prepared with distilled water. At the time of treatment, temperature in the greenhouse was 29°C (85°F) with a relative humidity of 88% under a cloudy sky. The day after treatment, plants were returned to the outdoor beds and arranged in the blocks determined previously, with two plants per treatment per block.

On July 27, one plant in each block received a second application at the same concentration it received initially, providing two applications at an interval of two weeks. At the time of the second application temperature was 28°C (83°F) with a relative humidity of 79%, under scattered clouds. Plants were not irrigated until the following day. Each cultivar was arranged in a randomized complete block design containing factorial combinations of the two application times and the five Pistill concentrations, with 9 single-plant replications for 'Taylortown Red' verbena and 10 single-plant replications for 'Homestead Purple' verbena. Plant heights and widths [(widest width + width perpendicular to it) ÷ 2] were determined at 2, 4, and 7 weeks after the initial treatment application (WAT). The two cultivars were randomized separately and analyzed as separate experiments. Data were analyzed us-

ing the PROC GLM procedure (SAS Institute, Cary, NC) to determine significance of main effects and interactions. Orthogonal contrasts were used when appropriate to test Pistill concentration trend responses.

Results and Discussion

There were no interactions between Pistill application number and concentration for either height or width of 'Homestead Purple' verbena on any of the evaluation days. However, 'Homestead Purple' verbena plant widths were suppressed linearly with increasing Pistill concentrations at 2 and 4 WAT (Table 1). At concentrations from 250 to 1000 ppm, width suppression was from 9 to 24% at 2 WAT and from 10 to 18% at 4 WAT. At 7 WAT the concentration main effect was no longer significant (data not shown). There was no effect on 'Homestead Purple' verbena heights due to Pistill concentration on any of the evaluation days (data not shown). However, both plant height and width were affected by application number at 4 and 7 WAT over all concentrations (Table 2). At 4 WAT, 2 applications suppressed 'Homestead Purple' verbena heights and widths by 13 and 15%, respectively, compared to 1 application. At 7 WAT, 2 applications suppressed heights and widths by 12 and 7%, respectively, compared to 1 application.

At 2 WAT, 'Taylortown Red' verbena widths were suppressed quadratically as Pistill concentration increased, with concentrations of 500 to 1000 ppm providing a width suppression of 22% over the untreated controls (Table 1). This would be a single application effect because the 2 WAT measurements were taken only one day after the second Pistill applications were applied and any growth suppression effects from the second treatment would be highly unlikely so soon. At 4 WAT, 'Taylortown Red' verbena showed an interaction between Pistill application number and concentration for plant width (Table 3). With one application, increasing Pistill concentrations no longer had an effect on plant width. However, 2 applications provided a highly significant linear suppression of width with increasing Pistill concentration. Suppression increased from 16 to 33% as concentration was increased from 250 to 1000 ppm. As with 'Homestead Purple' verbena, there was no effect on 'Taylortown Red' verbena heights due to Pistill concentration on any of the evaluation days (data not shown). However, over all Pistill concentrations, two applications suppressed 'Taylortown

Table 1. Main effects of Pistill (ethephon) spray concentrations on growth (plant widths^a) of 'Homestead Purple' and 'Taylortown Red' verbena.

Pistill concentration (ppm)	'Homestead Purple'		'Taylortown Red'
	2 WAT ^b	4 WAT	2 WAT
0	34	49	36
250	31	44	32
500	29	42	28
750	27	38	28
1000	26	40	28
Significance ^c	L****	L****	Q**

^aWidth = (widest width + width perpendicular) ÷ 2, in cm.

^bWAT = weeks after initial treatment application.

^cResponse linear (L) or quadratic (Q) at the 0.01 (**) or 0.0001 (****) level; control included in the analysis. n = 20 for 'Homestead Purple'; n = 18 for 'Taylortown Red'.

Table 2. Main effects of the number of Pistill (ethephon) applications on growth of ‘Homestead Purple’ and ‘Taylortown Red’ verbena.

Number of applications	‘Homestead Purple’				‘Taylortown Red’		
	4 WAT ^a		7 WAT		4 WAT	7 WAT	
	height (cm)	width ^b (cm)	height (cm)	width (cm)	height (cm)	height (cm)	width (cm)
One	15	45	16	46	23	18	43
Two	13	38	14	43	19	16	38
Significance ^c	**	****	*	**	***	**	****

^aWAT = weeks after initial treatment application.

^bWidth = (widest width + width perpendicular) ÷ 2.

^cDifferences between one and two applications significant at the 0.05 (*), 0.01 (**), 0.001 (***), or 0.0001 (****) levels as determined by analysis of variance (ANOVA). n = 50 for ‘Homestead Purple’; n = 45 for ‘Taylortown Red’.

Red’ verbena heights at 4 WAT, and both heights and widths at 7 WAT compared to 1 application (Table 2).

Previous research by Burnett et al. (5) in Alabama showed that a single application of Pistill suppressed growth of ‘Homestead Purple’ verbena under greenhouse conditions for up to 6 WAT, with additional growth control extending 2 weeks after planting in the landscape for plants treated at the 1000 ppm rate. In that same study, however, Pistill provided no growth suppression for plants in larger (#1) containers under outdoor nursery conditions. The results of our study differ somewhat. Increase in width of ‘Taylortown Red’ and ‘Homestead Purple’ verbena in 3.8 liter (#1) containers was suppressed for at least 2 WAT and 4 WAT, respectively, under nursery conditions with a single Pistill application. Two applications provided suppression of both height and width for up to 7 WAT. Possibly variations in weather conditions between the Alabama and Virginia treatment sites could account for some of these differences as ‘Homestead Purple’ verbena is particularly vigorous in heat and humidity (2). Another possible reason for differences between the two studies may be treatment application timing relative to when the plants were trimmed. We applied our initial treatments on the same day the plants were trimmed while in the previous study (5) treatments were applied 5 weeks after trimming. Gilbertz (6) found that the greatest response of chrysanthemum to PGRs occurred with application on the date of pinching as opposed to 2 or 4 weeks later. A similar response

was seen with petunia (7). In a study with achillea, Burnett et al. (4) found that removal of reproductive shoots just prior to PGR treatments increased height control as opposed to not removing them. They suggested that this changed the plant stage of development, making them more sensitive to PGR application. A similar effect may account for the difference in response of verbena to Pistill that we observed.

In summary, radial growth (plant width) of verbena was increasingly suppressed with increasing concentrations of Pistill; the most effective concentrations being in the range of 500 to 1000 ppm. Single applications in this range controlled ‘Homestead Purple’ verbena for 4 WAT and ‘Taylortown Red’ verbena for 2 WAT. More extended growth suppression (up to 7 WAT) was obtained on both cultivars with 2 applications at an interval of 2 weeks. No adverse effects were noted and the plants were of marketable quality throughout the study. Pistill is a very economical product. The cost of Pistill to provide a single application at 500 ppm over 46.5 m² (500 ft²) would be approximately \$2.00. Sumagic at 40 to 60 ppm has been shown to provide minimal growth control of ‘Homestead Purple’ verbena under nursery conditions (5). However, the cost of Sumagic for a single application at 40 ppm over the same area would be approximately \$33.00.

Literature Cited

1. Armitage, A.M. 1997. *Herbaceous Perennial Plants: A Treatise On Their Identification, Culture, and Garden Attributes*. 2nd Edition. Stipes Publishing L.L.C. Champaign, IL.
2. Armitage, A.M., J.S. Greer, and J.M. Garner. 2001. *Verbena* ‘Homestead Purple’. *HortScience* 36:1139.
3. Banko, T.J. and M.A. Stefani. 1997. Growth control in container production of verbena ‘Homestead Purple’. *Proc. Southern Nurseryman’s Assoc. Res. Conf.* 42:290–291.
4. Burnett, S.E., G.J. Keever, C.H. Gilliam, J.R. Kessler, Jr., and C.H. Hesselein. 2000. Plant growth retardant application to *Achillea* × ‘Coronation Gold’ and *Gaura lindheimeri* ‘Corrie’s Gold’. *J. Environ. Hort.* 18:149–153.
5. Burnett, S.E., G.J. Keever, J.R. Kessler, Jr., and C.H. Gilliam. 2000. Growth regulation of Mexican Sage and ‘Homestead Purple’ verbena during greenhouse and nursery production. *J. Environ. Hort.* 18:166–170.
6. Gilbertz, D.A. 1992. Chrysanthemum response to timing of paclobutrazol and uniconazole sprays. *HortScience* 27:322–323.
7. Gilbertz, D.A. 1988. Response of marigold and petunia to timing of paclobutrazol and XE-1019 foliar spray application. *HortScience* 23:751 (Abstr.).
8. Latimer, J.G., H.L. Scoggins, and T.J. Banko. 2001. Using plant growth regulators on containerized herbaceous perennials. Virginia Cooperative Extension Publication 430-103, pp. 16.

Table 3. Two-way interactions between number of spray applications and spray concentration of Pistill (ethephon) on growth (plant width^a) of ‘Taylortown Red’ verbena 4 WAT^b.

Pistill concentration (ppm)	Number of applications	
	One	Two ^c
0	50	49
250	48	41
500	44	39
750	44	35
1000	47	33
Significance ^d	NS	L****

^aWidth = (widest width + width perpendicular) ÷ 2, in cm.

^bWAT = weeks after initial treatment.

^cSpray applications applied at an interval of 2 weeks.

^dResponse non-significant (NS) or linear (L) at the 0.0001 (****) level. n = 9.