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Growth and Flowering Response of Butterfly-Bush to Cutless[1]

Gary J. Keever and Charles H. Gilliam[2]
Department of Horticulture
Auburn University, Auburn, AL 36849

Abstract

Buddleia davidii Franch. 'Royal Red' (butterfly-bush) was treated with different rates of Cutless (flurprimidol) in two experiments. Growth index, and inflorescence number and index decreased with increasing rates of Cutless. Foliage of treated plants was darker green than that of control plants. Growth inhibition persisted for at least 120 days when plants were treated with rates of 125 to 2000 ppm, but not when treated with 62.5 ppm Cutless. Shoot length measured after the following spring flush was similar among treatments, indicating similar plant vigor.

Index words: flurprimidol, growth retardant, growth regulator.

Growth regulator used in this study: Cutless (flurprimidol), α-(1-methylethyl)-α-[4-(trifluromethoxy)phenyl]-5-pyrimidinemethanol.

Species used in this study: 'Royal Red' butterfly-bush (*Buddleia davidii* Franch. 'Royal Red').

Significance to the Nursery Industry

Rank shoot growth of butterfly-bush necessitates frequent pruning during container production to produce quality, marketable plants. A single foliar application of Cutless (flurprimidol) at 62.5 ppm (0.017 oz Cutless 50 WP/gal) provided short-term control of shoot growth, with no effect on flowering time, inflorescence number or inflorescence size. Rates of 125 or 250 ppm Cutless provided growth control for at least 120 days with no effect on flowering time, inflorescence number, inflorescence index, or shoot length the following season. Rates of 500 ppm or higher resulted in prolonged shoot retardation and reduced inflorescence numbers and size; these rates were considered unacceptable. Cutless may provide nurserymen with a labor-saving tool for managing a vigorous species.

Introduction

Butterfly-bush is a large shrub [1.5 to 3.0 m (5 to 10 ft) high] that is grown in USDA Zones 5–9. It is characterized by rapid growth, long, arching canes, and 10 to 25 cm (4 to 10 in) long fragrant panicles throughout the summer. Rank shoot growth during container production of butterfly-bush necessitates multiple prunings to develop a well-branched, marketable plant. However, most growth inhibitors are either uneconomical or cause undesirable side effects (4, 6). Flurprimidol, registered as Cutless for use on turfgrasses, reduces shoot growth, apparently by inhibiting gibberellin synthesis, without causing overt injury (11). Cutless has effectively suppressed shoot elongation of several tree species when applied as a trunk (1, 11) or subsoil injection (7) and several shrub species when applied as a foliar spray (2, 5). The objective of this study was to determine the effects of Cutless applied as a foliar spray during container nursery production on vegetative growth and flowering of butterfly-bush.

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[2]Professors of Horticulture.

Materials and Methods

Liners of 'Royal Red' butterfly-bush were transplanted on April 28, 1992, into 11.4 l (#3) pots of a pine bark:sand (7:1 by vol) growth medium amended per m^3 (yd^3) with 8.3 kg (14 lb) Osmocote 18N-2.6P-10K (18-6-12), 3 kg (5 lb) dolomitic limestone and 0.9 kg (1.5 lb) Micromax. Addi-

Table 1. Effects of single foliar sprays of Cutless on vegetative growth and flowering of *Buddleia davidii* 'Royal Red', experiment 1.

Cutless rate (ppm)	Foliar color[z]	Growth indices[y] (cm)					Shoot length[x] (cm)	Inflorescence	
		30 DAT	60 DAT	90 DAT	120 DAT	360 DAT		Number	Index[w]
0	1.4	92.8	102.1	104.2	106.7	102.7	60.3	19.4	2.4
500	3.3	67.1	81.8	86.5	90.4	99.6	71.5	16.3	2.1
1000	2.7	67.5	73.7	74.5	74.6	95.3	66.2	14.4	2.0
1500	3.9	65.8	68.1	69.9	76.5	94.5	69.4	11.1	1.8
2000	3.4	67.6	72.6	77.7	77.7	90.2	64.7	12.9	2.0
2500	4.3	68.8	70.1	76.5	76.5	94.7	67.9	11.9	1.9
Significance[v]	C**	Q**	Q***	Q***	Q***	L**	NS	L**	Q**

[z]Foliar color rating where 1, 3 and 5 = light, medium and dark green, respectively; plants rated 30 DAT.
[y]Growth index = (height + $width_1$ + $width_2$) ÷ 3, where $width_2$ was 90° to $width_1$.
[x]Shoot length = mean of three longest shoots per plant, measured 360 DAT.
[w]Inflorescence index = (length + width 1 cm from top + width 1 cm from bottom) ÷ 3, in cm; five terminal inflorescences per plant were measured.
[v]Regression response linear (L), quadratic (Q) or cubic (C) at P ≤ 0.05 (*), 0.01 (**) or 0.001 (***), or not significant (NS) at P ≤ 0.05.

tionally, plants were topdressed with 36 g (2 Tbsp) of 25N-1.7P-13.3K (Polyon 24-4-16) on April 13, 1993. Plants were placed in full sun with overhead irrigation. On May 16, 1992, plants were pruned to a uniform height of 15 cm (6 in), and five days later a single foliar spray of 0, 500, 1000, 1500, 2000 or 2500 ppm Cutless was applied to runoff. An average of 15 ml (0.5 oz) of solution per plant was applied. Thirty days after treatment (DAT), growth index [(height + $width_1$ + $width_2$) ÷ 3], foliar color rating (1, 3, 5 = light, medium, dark green), and inflorescence number, stage of development (1 = no open flowers; 2 = > 0–½ flowers opened; 3 = ½–all flowers opened; 4 = > 0–½ flowers faded; 5 = ½–all flowers faded) and index [(length + width at top + width at bottom) ÷ 3] were determined. Growth indices also were determined 60, 90 and 120 DAT. At termination of the experiment (360 DAT), growth indices and lengths of the three longest shoots per plant were measured. Treatments were completely randomized with seven single-plant replicates. Data were subjected to an analysis of variance, and rate response to Cutless was determined by regression analysis.

A second experiment was initiated in 1992 to evaluate the response of butterfly-bush to lower rates of Cutless, as well as rates that provided effective growth suppression in the first experiment. Liners of 'Royal Red' butterfly-bush were transplanted on June 30, 1992, and topdressed on April 13, 1993, in the same manner as in experiment 1. Plants were pruned to 15 cm (6 in) on July 10, 1992, and tip-pruned for uniformity on August 13. The following day Cutless was applied as a foliar spray at 0, 62.5, 125, 250, 500, 1000 or 2000 ppm (15 ml (0.5 oz) per plant). Growth index, and inflorescence number, stage of development and index were determined 45 DAT. Growth index also was measured 120 DAT and at the termination of the experiment following the 1993 spring growth flush (286 DAT). At this time the lengths of the three longest shoots per plant were measured. Treatments were completely randomized with six single-plant replicates.

Results and Discussion

Experiment 1. Foliar color of plants treated with Cutless was noticeably darker than that of control plants 30 DAT (Table 1). This response is common in plants treated with growth retardants, and in most cases the darker green appearance has been correlated with increased chlorophyll content (10, 12). Darker green foliage of treated plants was apparent throughout the 1992 season, although foliar color was rated only 30 DAT.

Growth indices of plants treated with 500 ppm Cutless were 28%, 20%, 17% and 15% less than those of control plants 30, 60, 90 and 120 DAT, respectively, while the difference between growth indices of plants treated with 500 and 2500 ppm Cutless was only 2.5% 30 DAT. The decrease in the difference between mean growth indices of control plants and plants treated with the lowest rate of Cutless over time indicates a more rapid growth rate of treated plants. Accelerated growth of retardant-treated plants has been observed after growth suppression effects have dissipated (8) and may relate to the accumulation of large reserves of carbohydrates during the period of growth inhibition. These large reserves stimulate rapid growth as effects of growth retardant lessens (3). Plants treated with Cutless were more compact and uniform than control plants and were considered more marketable (Fig. 1.). Because of similar size and foliar color of plants treated with Cutless, there appeared little reason to use rates above 500 ppm. Lower rates than those tested may provide shorter periods of growth inhibition. Growth indices collected following the 1993 spring growth flush (360 DAT) indicated a slight linear decrease with increasing Cutless rate, 3% lower with 500 ppm and 8% lower with 2500 ppm. Lengths of the three longest shoots, which typically originated deep within the plant canopy, were similar among treatments, indicating similar plant vigor. There were no obvious differences in plant size at this time. This response may be due to a dissipation of growth suppression of treated plants, growth inhibition of control plants from being potbound or both.

Inflorescence number and index decreased linearly and quadratically, respectively, with increasing Cutless rate, while inflorescence stage of development was not affected by treatment (data not shown). The decrease in inflorescence numbers ranged from 16 to 43%, while inflorescence indices decreased 14 to 27%. Inflorescences of treated plants were noticeably shorter, narrower at the base and more rounded at the apex than those of control plants, although lengths were not statistically compared. Ruter (9) noted a similar reduction in inflorescence number and size when butterfly-bush was treated with granular paclobutrazol, a triazole growth retardant.

Table 2. Effects of single foliar sprays of Cutless on vegetative growth and flowering of *Buddleia davidii* 'Royal Red', experiment 2.

Cutless rate (ppm)	Growth index[z] (cm)			Shoot length[y] (cm)	Inflorescence	
	45 DAT	120 DAT	286 DAT		Number	Index[x]
0	105.9	106.7	118.3	76.7	21.7	2.7
62.5	96.0	104.6	115.3	82.5	22.2	2.8
125	84.9	95.4	111.3	84.7	21.2	2.4
250	85.8	89.9	108.2	90.3	20.3	2.6
500	80.4	80.3	107.7	86.1	16.3	2.6
1000	60.3	65.3	105.9	89.4	14.3	2.2
2000	56.7	57.2	94.5	78.7	13.5	2.1
Significance[w]	Q***	Q***	Q***	C*	L**	Q***

[z]Growth index = (height + $width_1$ + $width_2$) ÷ 3 where $width_2$ was 90° to $width_1$.

[y]Shoot length = mean of three longest shoots per plant, measured 286 DAT.

[x]Inflorescence index = (length + width 1 cm from top + width 1 cm from bottom) ÷ 3, in cm; five terminal inflorescences per plant were measured 45 DAT.

[w]Regression response linear (L), quadratic (Q) or cubic (C) at P≤ 0.05 (*), 0.01 (**) or 0.001 (***), or not significant (NS) at P≤ 0.05.

Fig. 1. 'Royal Red' butterfly-bush 90 days after treatment with 1500 ppm Cutless (right).

Experiment 2. Three rates lower than those used in the first experiment (62.5, 125, 250 ppm), as well as 3 rates previously tested (500, 1000, 2000 ppm), were used in the second experiment. Growth suppression, as indicated by growth index, decreased quadratically with increasing Cutless rate 45 and 120 DAT. Growth indices were 9% and 20% less 45 DAT and 2% and 11% less 120 DAT with 62.5 ppm and 125 ppm Cutless, respectively, indicating a lessening of growth retardation over time. Growth index of plants treated with 2000 ppm Cutless was 46% less than that of control plants 45 and 120 DAT. This compares to a reduction in growth index for plants treated with the same rate in the first experiment of 27, 29 and 27% at 30, 60 and 120 DAT, respectively. Following the spring 1993 growth flush (286 DAT), growth indices decreased quadratically with increasing rate. Growth indices were 2.5%, 8.5%, and 20% lower for plants treated with 62.5, 250 and 2000 ppm Cutless, respectively. Similarities in plant height (data not shown) but a decrease in growth indices indicated a decrease in plant width with increasing Cutless rate. Much of the new growth that developed in spring 1993 was upright, rank shoots formed near the base of the plant. As indicated by lengths of the three longest shoots per plant, shoots of treated plants tended to be as long or longer than those of control plants, suggesting similar or greater vigor.

As in the first experiment, inflorescence number and index decreased with increasing Cutless rate, while inflorescence stage of development was not affected by treatment (data not shown). However, in the second experiment most of the decrease in inflorescence index or number occurred with plants treated with the two or three highest rates of Cutless, respectively.

Findings of these 2 experiments indicate that Cutless can effectively retard shoot elongation of butterfly-bush, resulting in compact plants with dark green foliage. Magnitude and duration of growth suppression was rate dependent, with rates of 500 ppm or higher being considered excessive for container production. Inflorescence number and size decreased with increasing Cutless rate; however, rates of 250 ppm or less minimally affected these characteristics.

(*Ed. note*: This paper reports the results of research only and does not imply registration of a pesticide and/or growth regulant 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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