Shoot Suppression of *Lonicera* x *heckrottii* 'Goldflame' (Goldflame Honeysuckle) Using Growth Retardants[1]

L.L. Bruner[2], G.J. Keever[3], J.R. Kessler, Jr.[4] and C.H. Gilliam[3]
Department of Horticulture
Auburn University, AL 36849

Abstract

A study conducted in 1999 and 2000 determined the effects of B-Nine/Cycocel (daminozide/chlormequat chloride) tank mixes at 2500/1500, 5000/1500 (1999 only), and 7500/1500 parts per million (ppm) and Cutless (flurprimidol) at 50, 100, and 150 ppm on shoot length and shoot number of pruned and non-pruned *Lonicera* x *heckrottii* 'Goldflame' (Goldflame honeysuckle). In 1999, B-Nine/Cycocel suppressed shoot lengths of pruned plants linearly throughout the study 18–30% 2 weeks after treatment (WAT), 16–28% 4 WAT, 24–35% 6 WAT, 24–34% 10 WAT, and 19–33% 14 WAT compared to untreated controls. Similar shoot length suppression was observed in non-pruned plants from B-Nine/Cycocel treatments in 2000 with shoots 8–24% (2 WAT), 7–24% (4 WAT), 7–20% (6 WAT), 5–19% (10 WAT), and 5–20% (14 WAT) shorter than those of untreated controls. Cutless was ineffective in suppressing shoot length of Goldflame honeysuckle in either experiment, but did increase shoot number compared to controls 6 through 14 WAT in 1999. B-Nine/Cycocel treatments did not consistently increase shoot number in either study.

Index words: growth retardant, plant growth regulator.

Growth regulators used in this study: B-Nine (daminozide), [butanedioic acid mono (2,2-dimethylhydrazide)] and Cycocel (chlormequat chloride), (2-chlorethyl) trimethylammonium chloride tank mixes; Cutless (flurprimidol), α-(1-methylethyl)-α-[4-(trifluromethoxy)phenyl]-5-pyrimidinemethanol.

Species used in this study: *Lonicera* x *heckrottii* 'Goldflame' (Goldflame Honeysuckle).

Significance to the Nursery Industry

Vines, such as honeysuckle, present unique maintenance problems during nursery production due to vigorous shoot growth and twining nature. Pruning is the traditional solution for controlling shoot length in vines and producing a well-branched, compact plant. However, pruning is labor intensive and may detract from a plant's appearance by removing foliage and flowers. Plant growth retardants (PGRs), alone or in combination with pruning, may be a viable option for shoot length control. B-Nine/Cycocel tank mixes at rates of 2500/1500, 5000/1500 (1999 only), and 7500/1500 were effective in suppressing shoot length of Goldflame honeysuckle when applied to pruned, non-flowering shoots (1999) and non-pruned, partially flowering shoots (2000). Cutless, at all rates tested, was ineffective in suppressing shoot length of Goldflame honeysuckle. No PGR treatment resulted in noticeably fuller plants, with more branches.

Introduction

Vining plants fill unique niches in the landscape. Many vines provide quick coverage and color while tolerating a variety growing conditions (5). *Lonicera* x *heckrottii* 'Goldflame' or Goldflame honeysuckle is a semi-evergreen vine characterized by a twining and climbing habit and continuous blooms throughout spring and summer (5). Goldflame honeysuckle shoots can reach 3 to 6 m (10 to 20 ft) long in a growing season (4). Based on observations, the growth habit of Goldflame honeysuckle varies over the growing season. New growth in early spring is supple and twines readily. Increases in shoot length occur rapidly under optimal growing conditions. Once a plant has begun flowering extensively, rate of shoot growth slows. As the season progresses, older growth on the lower portions of the plant becomes woody and rigid. Following pruning, new growth occurring later in the season is less supple and does not twine readily. Often during container production, the plant's rapid growth and twining habit cause problems as plants grow to an undesirable size and intertwine with adjacent plants. Hand pruning is the standard practice for managing honeysuckle shoot length and to increase shoot number. Additionally, early and frequent pruning is necessary to develop compact, full plants. However, pruning is time-consuming, labor-intensive, and often removes foliage and flowers.

B-Nine, Cycocel, and Cutless are plant growth retardants (PGRs) effective in suppressing growth of numerous plant species and may offer benefits in the production, shipping, and marketing of vining crops such as Goldflame honeysuckle (1, 2, 3). B-Nine and Cycocel are labeled for use on numerous woody plant species in the greenhouse environment, but not specifically for Goldflame honeysuckle (10, 11). Only B-Nine is labeled for nursery use (11). Cutless is a turfgrass growth retardant, but has been effective in suppressing growth of woody and herbaceous species (3, 9).

The growing retail market compels growers to extend production later into the spring and summer or hold plants at a marketable size to meet consumer demand. PGRs have been shown to provide shoot length suppression when used alone or in combination with pruning. The objective of our research was to determine the effects of three PGRs (B-Nine/Cycocel combined and Cutless alone) at different rates on pruned and non-pruned Goldflame honeysuckle.

Materials and Methods

On April 2, 1999, and March 14, 2000, Goldflame honeysuckle liners in 5-cm (2 in) containers were repotted into

[1]Received for publication April 23, 2001; in revised form July 13, 2001. We would like to express our gratitude to Hine's Nursery (Houston, TX) and Clinton Nursery (Havana, FL) for their donation of plant material.

[2]Graduate Student.

[3]Professor.

[4]Associate Professor.

Table 1. **Shoot length of *Lonicera* x *heckrottii* 'Goldflame' (Goldflame honeysuckle) 0 through 14 WAT[z] with B-Nine/Cycocel at 2500/1500, 5000/1500, and 7500/1500 ppm in 1999.**

		Shoot length (cm)					
PGR	**Rate (ppm)**	**0 WAT**	**2 WAT**	**4 WAT**	**6 WAT**	**10 WAT**	**14 WAT**
Control		42.2	71.2	77.9	94.2	107.7	111.7
B-Nine/Cycocel	2500/1500	42.0	58.1	65.3	71.2	81.8	90.3
	5000/1500	39.8	53.6	59.1	61.6	74.0	74.7
	7500/1500	41.3	50.0	56.4	61.4	71.1	81.8
Significance[y]		NS	L**	L*	L**	L**	L*

[z]WAT = weeks after treatment.

[y]Nonsignificant (NS) or Linear (L) response at the 5% (*) or 1% (**) level.

3.8-liter (#1) containers. The pine bark:sand (7:1, by vol) substrate was amended per m^3 (yd^3) with 7.2 kg (12 lb) 17N–3P–10K (Osmocote 17–7–12, The Scotts Company, Marysville, OH), 0.9 kg (1.5 lb) Micromax (The Scotts Company), and 3.0 kg (5 lb) dolomitic limestone. Plants were grown outdoors in full sun at a 60-cm (2 ft) spacing under overhead irrigation twice daily for a total of 1.7 cm (0.65 in) per day.

Plant stage of development (flowering vs. non-flowering) at the time of PGR application differed in the two studies as a result from pruning. Prior to treatment and pruning in 1999, plants were physiologically advanced [flowering with shoot lengths > 90 cm (36 in) and lower portions of stems woody]. Plants were pruned uniformly on May 27 to approximately 30.5 cm (12 in) above the substrate and allowed to grow approximately 10 cm (4 in). Plants were flowering extensively when pruned and pruning removed all flowers. On June 5, 1999, initial shoot lengths were measured and plants were blocked by shoot length. Treatments were applied the same day and included B-Nine (daminozide; Uniroyal Chemical Company, Middlebury, CT)/Cycocel (chlormequat chloride; Olympic Horticultural Products, Mainland, PA) tank mixes at 2500/1500, 5000/1500, and 7500/1500 parts per million (ppm); Cutless (flurprimidol; Dow Elanco, Indianapolis, IN) at 15, 30, and 45 ppm; and a non-treated control.

Plants were more uniform in shoot length in the 2000 study and were not pruned before PGR application. Plants were allowed to reach a marketable size [65–75 cm (25.5–29.5 in) in length] and at least half were in flower by the time of PGR application. On May 16, 2000, initial shoot lengths were measured and plants were blocked by shoot length. Treatments were applied the same day and included B-Nine/Cycocel tank mixes at 2500/1500 and 7500/1500 ppm; Cutless at 15, 30, and 45 ppm; and a non-treated control. The PGRs and rates tested have been documented as effective on various crops (1, 2, 3, 6, 9).

During both studies, PGRs were applied as foliar sprays in a volume of 0.2 liters/m^2 (2 qt/100 ft^2) using a CO_2 sprayer with a flat spray nozzle at 1.4 kg/cm^2 (20 psi) in a polyethylene greenhouse. Temperature and relative humidity ranged from 32–37C (90–98F) (1999) and 22.2–27.8C (72–82F) (2000), and 63% (1999) and 47% (2000), respectively, during treatment application. Treated plants were returned to the nursery container area the following day. Plants were staked as needed for support.

Fungicides were applied repeatedly in both 1999 and 2000 in an attempt to control powdery mildew. Fungicide applications of Cleary's 3336 WP (Cleary Chemical Corporation, Dayton, NJ) at a rate of 1.2 g/liter (0.2 oz/gal) were applied as needed in 1999. In 2000, plants were treated with alternating fungicide applications of Terraguard 50W (Uniroyal Chemical Corporation, Middlebury, CT) 0.45 g/liter (0.06 oz/gal), Cleary's 3336 WP 1.2 g/liter (0.2 oz/gal), and Heritage (Zeneca Agricultural Products, Wilmington, DE) 0.15 g/liter (0.02 oz/gal) applied to the foliage at approximate 2-week intervals.

The experimental design was a randomized complete block, with 10 single plant replications. Shoot length and shoot number were measured at 2-week intervals through 6 WAT; subsequent measurements were at 4-week intervals through 14 WAT in both 1999 and 2000. Shoot length was measured from the substrate surface to the furthest extended shoot tip. Shoot numbers were determined by counting axillary and basal shoots. Only shoots longer than 1 to 2 cm (0.4 to 0.8 in) were counted. Basal shoots contributed more to a fuller appearing plant. However, because the location of

Table 2. **Shoot length of *Lonicera* x *heckrottii* 'Goldflame' (Goldflame honeysuckle) 0 through 14 WAT[z] with B-Nine/Cycocel at 2500/1500 and 7500/1500 ppm in 2000.**

		Shoot length (cm)					
PGR	**Rate (ppm)**	**0 WAT**	**2 WAT**	**4 WAT**	**6 WAT**	**10 WAT**	**14 WAT**
Control		69.5	110.3	118.7	122.5	123.2	126.4
B-Nine/Cycocel	2500/1500	73.9	101.9	109.9	114.2	117.6	119.9
	7500/1500	63.0	84.3	89.8	97.8	99.9	101.7
Significance[y]		NS	L***	L***	L***	L***	L***

[z]WAT = weeks after treatment.

[y]Nonsignificant (NS) or linear (L) response at the 0.1% (***) level.

Table 3. **Shoot number of *Lonicera* x *heckrottii* 'Goldflame' (Goldflame honeysuckle) 0 through 14 WAT[z] with B-Nine/Cycocel at 2500/1500, 5000/1500, and 7500/1500 ppm and Cutless at 50, 100, and 150 ppm in 1999.**

		Shoot number					
PGR	**Rate (ppm)**	**0 WAT[z]**	**2 WAT**	**4 WAT**	**6 WAT**	**10 WAT**	**14 WAT**
Control		9	10	12	15	17	25
B-Nine/Cycocel	2500/1500	10	13	14	16	21	30
	5000/1500	10	10	17	20	25	31
	7500/1500	11	12	17	19	23	29
Significance[y]		NS	L*	NS	NS	NS	NS
Cutless	50	10	13	13	21	24	31
	100	13	14	14	25	28	37
	150	9	12	14	21	25	38
Significance		NS	NS	NS	Q*	L*	L**

[z]WAT = weeks after treatment.

[y]Nonsignificant (NS), linear (L), or quadratic (Q) response at the 5% (*) or 1% (**) level.

counted shoots (axillary or basal) was not recorded, increases in shoot number did not necessarily indicate a fuller plant. Data were analyzed using orthogonal contrasts to test rate responses within a PGR (P = 0.05); the control treatment was included in regression analyses.

Results and Discussion

In 1999, B-Nine/Cycocel was effective in suppressing shoot length in pruned Goldflame honeysuckle throughout the study (Table 1). Shoot length decreased linearly with increasing B-Nine/Cycocel rate; 18–30% (2 WAT), 16–28% (4 WAT), 24–35% (6 WAT), 24–34% (10 WAT), and 19–33% (14 WAT). Overall, growth rate of plants across treatments slowed dramatically following 2 WAT. Based on observations, the reduction in growth rate following 2 WAT coincided with the onset of flower bud formation and subsequent flowering. In 1999, plants treated with Cutless were similar in shoot length to untreated controls throughout the study (data not shown).

In 2000, B-Nine/Cycocel was effective in suppressing shoot length in non-pruned Goldflame honeysuckle beginning 2 WAT and lasting through the remainder of the study (Table 2). Shoot length decreased with increasing B-Nine/Cycocel rate linearly 8–24% (2 WAT), 7–24% (4 WAT), 7–20% (6 WAT), 5–19% (10 WAT) and 5–20% (14 WAT). As in the 1999 study, the most rapid increase in shoot length for all treatments occurred between 0 and 2 WAT. However, the increase in shoot length was greater in 2000 with increases of 41 cm (16 in) in control plants compared to 29 cm (11.5 in) in 1999. At the time of PGR application in the 2000 study around 50% of the plants had begun flowering. By 2 WAT, all plants in the study were in flower. Shoot lengthening slowed dramatically and consistently across treatments following 2 WAT and throughout the remainder of the study. As in 1999, Cutless treatments were not effective in suppressing shoot length in the 2000 study (data not shown).

Shoot number in the 1999 study was inconsistently affected by B-Nine/Cycocel and Cutless treatments (Table 3). Significant effects from B-Nine/Cycocel treatments on shoot number were limited to one data collection (2 WAT). At 2 WAT, shoot number of B-Nine/Cycocel treated plants increased linearly 20–30%, for a mean increase of 2 to 3 shoots per plant. For the remainder of the study shoot numbers of control plants and B-Nine/Cycocel treated plants were similar. In the 1999 study, there was a quadratic response to Cutless resulting in increases in shoot numbers of 40–67% (6 WAT) followed by linear increases of 41–65% (10 WAT) and 24–52% (14 WAT). Based on observations, new shoots produced on Cutless treated plants were developed on existing shoots and did not result in a fuller plant appearance. Shoot number was not affected by PGR application in 2000.

In summary, shoot length suppression from B-Nine/Cycocel treatments was successful throughout the 1999 and 2000 studies, while suppression from Cutless treatments was not. These results indicate B-Nine/Cycocel combinations are effective when applied to pruned or non-pruned Goldflame honeysuckle of different physiological stages (non-flowering vs. partially flowering) at treatment. In 1999, B-Nine/Cycocel was applied to pruned, non-flowering plants and in 2000 to non-pruned, partially flowering plants. Suppression from B-Nine/Cycocel treatments in pruned plants ranged from 16–35%. Suppression in non-pruned, partially flowering plants was 5–24%. By pruning reproductive shoots in Goldflame honeysuckle, plant stage of development was changed and plants were less advanced and smaller. Based on the results, the pruned Goldflame honeysuckle appeared more sensitive to B-Nine/Cycocel treatments and shoot length suppression was more pronounced. Similar responses have been documented in chrysanthemums and petunias where PGRs applied to less developed plants resulted in a greater response (7, 8). Therefore, B-Nine/Cycocel combinations could be used effectively to suppress Goldflame honeysuckle shoot length when applied to both pruned and non-pruned shoots allowing growers to extend the production window to meet consumer demand or hold plants at a flowering, marketable size.

Literature Cited

1. Banko, T.J. and M.A. Stefani. 1995. Cutless and Atrimmec for controlling growth of woody landscape plants in containers. J. Environ. Hort. 13:22–26.

2. 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.

3. Bruner, L.L., G.J. Keever, C.H. Gilliam and J.R. Kessler. 2000. Growth regulation of *Canna* x *generalis* ‘Florence Vaughan’. J. Environ. Hort. 18:171–174.

4. Dirr, M.A. 1998. Manual of Woody Landscape Plants. Stipes Publishing, L.L.C., Champaign, IL. p. 578–579.

5. Eisener, L. 2000. Simply divine. American Nurseryman 191(11):26–46.

6. Elanco. 1983. Technical Report on EL-500. Research Report, Indianapolis, IN.

7. Gilbertz, D.A. 1992. Chysanthemum response to timing of paclobutrazol and uniconazole sprays. HortScience 27:322–323.

8. Gilbertz, D.A. 1988. Response of marigold and petunia to timing of paclobutrazol and XE-1019 foliar spray application. HortScience 23:751 (Abstr.).

9. Keever, G.J. and C.H. Gilliam. 1994. Growth and flowering response of butterfly bush to Cutless. J. Environ. Hort. 12:16–18.

10. Olympic Horticultural Products. 1996. Cycocel Plant Growth Regulant. Specimen Label, Mainland, PA.

11. Uniroyal Chemical Co. 1999. Growth Regulators in Perennial Crops. Tech. Information Bull., Middlebury, CT.