This Journal of Environmental Horticulture article is reproduced with the consent of the Horticultural Research Institute (HRI – www.hriresearch.org), which was established in 1962 as the research and development affiliate of the American Nursery & Landscape Association (ANLA – http://www.anla.org).

HRI's Mission:

To direct, fund, promote and communicate horticultural research, which increases the quality and value of ornamental plants, improves the productivity and profitability of the nursery and landscape industry, and protects and enhances the environment.

The use of any trade name in this article does not imply an endorsement of the equipment, product or process named, nor any criticism of any similar products that are not mentioned.

Copyright, All Rights Reserved

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-19 via free access

Plant Growth Retardants Affect Growth and Flowering of *Achillea* × 'Coronation Gold'[1]

J.R. Kessler, Jr.[2] and G.J. Keever[3]
Department of Horticulture
Auburn University, AL 36849

Abstract

An experiment was conducted to determine the effects of several widely used plant growth retardants on plant size and flowering of *Achillea* × 'Coronation Gold'. Plants in 10 cm (4 in) pots were grown in a greenhouse and treated with B-Nine at 0, 2550, 5100, or 7650 ppm; Cycocel at 0, 767, 1534, or 2301 ppm; B-Nine/Cycocel at 0, 1275/1534, 2550/1534, or 3825/1534 ppm; Sumagic at 0, 11, 22, 33, 44, or 55 ppm; Bonzi at 0, 32, 64, 96, 128, or 160 ppm; or Cutless at 0, 40, 80, or 120 ppm as a spray 1 week after vernalization. B-Nine, Cycocel, B-Nine/Cycocel, Sumagic, Bonzi, and Cutless reduced shoot height and growth index by 36 and 26%, 39 and 27%, 61 and 41%, 75 and 52%, 52 and 36%, and 75 and 51%, respectively, with the highest rate of each. B-Nine, Cycocel, B-Nine/Cycocel, and Sumagic, but not Bonzi or Cutless, increased the number of days to open inflorescence by 3–5 days with increasing rate. Sumagic, Bonzi, and Cutless reduced inflorescence diameter by up to 15, 18, and 14%, respectively but not B-Nine, Cycocel, or B-Nine/Cycocel. The highest quality ratings of 2.8 to 3.0 were found with B-Nine/Cycocel at 3825/1534 ppm, Sumagic at 22 and 33 ppm, and Bonzi at 64 ppm. Differences between the results in this study and earlier studies implicate the possible impact of differences in experimental environments, container size, or stage of development when the plant growth retardant treatments were applied.

Index words: pot plant, plant growth regulator, yarrow, herbaceous perennial.

Growth regulators used in this study: B-Nine (daminozide) [butanedioic acid mono (2,2-dimethylhydrazide)], Bonzi (paclobutrazol) [(αR,βR)-rel-β-[(4-chlorophenyl)methyl]-α-(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol], Cutless (flurprimidol) [α-(1-methylethyl)-α- [4-(trifluoromethyoxy)phenyl]-5- pyrimidinemethanol], Cycocel (chloromequat) [(2-chloroethyl) trimethylammonium chloride], and Sumagic (uniconazole-P) [(E)(S)-1(4-chlorophenyl)4,4-dimethyl-2(1,2,4-triazol-1-yl) pent-1-ene-3-01].

Species used in this study: 'Coronation Gold' yarrow (*Achillea filipendulina* Lam. × *Achillea clypeolata* Sibth. & Sm. 'Coronation Gold').

Significance to the Nursery Industry

'Coronation Gold' achillea is a popular herbaceous perennial that is considered by many the best of the *Achillea filipendulina* hybrids. It is widely grown in nursery and greenhouse settings and has been investigated as a possible flowering potted crop for greenhouse production. However, it naturally grows too tall to be aesthetically attractive in small containers. This study found that increasing application rates of B-Nine, Cycocel, B-Nine/Cycocel, Sumagic, Bonzi, and Cutless reduced shoot height and plant size but Sumagic, Bonzi, and Cutless reduced inflorescence size by 14 to 18% and B-Nine, Cycocel, B-Nine/Cycocel increased time to first open inflorescence by 3–5 days. The highest quality ratings were found with B-Nine/Cycocel at 3825/1534 ppm, Sumagic at 22 and 33 ppm, and Bonzi at 64 ppm. These results give growers options for choosing a plant growth retardant and rate effective on 'Coronation Gold' achillea. However, differences between the results of this study and earlier studies highlight the impact of differences in environments, container size, and possible differences in the stage of development when plant growth retardants are applied.

Introduction

Herbaceous perennials have become popular crops for forcing in containers in nurseries and greenhouses (4, 7, 11, 15). However, many herbaceous perennials grow vigorously under optimum conditions and often grow too tall for small size containers. A consumer's perception of product quality and willingness to purchase are related to plant size. A balance between container size and plant size is necessary to achieve that perceived quality. To achieve the proper plant size and improve product quality, much work has been done on the effects of plant growth retardants on herbaceous perennials (5, 6, 8, 9, 10, 11, 12, 14, 18).

Achillea × 'Coronation Gold' was developed by R.B. Pole of Lye End Nursery in southern England and was first offered in 1953 to commemorate the coronation of Elizabeth II (20). This *Achillea filipendulina ×clypeolata* hybrid produces flat inflorescences, 7.6 cm (3 in) to 10 cm (4 in) across, and composed of golden yellow florets. In a garden, it may grow 0.8 m (2.5 ft) to 0.9 m (3ft) tall and has finely dissected, gray-green, aromatic foliage. Several different species and cultivars have been investigated for their cultural requirements as pot crops, including 'Coronation Gold' achillea (13).

Achillea filipendulina 'Cloth of Gold' had an obligate requirement for long photoperiods and for vernalization to flower, but must attain a minimum age or number of leaves (nodes) to be responsive to flower-induction treatments (2, 3). *Achillea* × 'Moonshine', *Achillea* × 'Anthea', and several *Achillea millefolium* cultivars had an obligate requirement for long photoperiods but a facultative requirement for vernalization to flower (4). *Achillea* × 'Coronation Gold' flowered fastest when provided at least a 16 hr photoperiod or 4 hr night-interrupted lighting while vernalization resulted in an increase in the number of lateral shoots in greenhouse production (13). Application of night-interrupted lighting to 'Coronation Gold' achillea grown outdoors in a nursery setting accelerated flowering by 2–12 days (7).

Nausieda et al. (13) recommended a plant growth retardant for tall-growing achillea species and cultivars and in a preliminary experiment on *Achillea millefolium* 'Summer

[1]Received for publication April 2, 2007; in revised form August 9, 2007.

[2]Associate Professor. <kessljr@auburn.edu>.
[3]Professor. <keevegj@auburn.edu>.

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-19 via free access

Pastels' found that A-Rest, B-Nine, and Sumagic were effective but not Cycocel or Bonzi though methods and rates tested were not reported. Latimer (12) reporter that plant growth retardants should be applied to perennials about 2 weeks after transplanting plugs in the spring and, for overwintered material, when new growth is 2.5 cm (1 in) to 7.6 cm (3 in) long. Re-application may be required every 2 to 4 weeks depending on the species and geographic location. In a plant growth retardant summary chart, Latimer (9, 10) reported that *Achillea* × 'Moonshine' responded to four applications of B-Nine at 5000 ppm, one application of Bonzi at 240 ppm, or one application of Sumagic at 60 ppm, *Achillea millefolium* 'Summer Pastels' responded to four applications of B-Nine at 5000 ppm, one application of Bonzi at 120 ppm or 30 ppm in four applications, one application of Cycocel at 4000 ppm, or one application of Sumagic at 60 ppm (9), and *Achillea millefolium* 'Paprika' responded to multiple applications of B-Nine at 5000 ppm, one application of B-Nine/Cycocel at 5000/1500 ppm, or one application of Sumagic at 15 ppm (10), but details on treatments and methods were not reported. Yet, when four species and cultivars of *Achillea* were examined, *Achillea* × 'Coronation Gold' and *Achillea millefolium* 'Paprika' responded to 15 ppm Sumagic or less while *Achillea* × 'Moonshine' and *Achillea millefolium* 'Summer Pastels' showed no growth reductions when treated with 60 ppm Sumagic (8). Vršek et al. (19) treated *Achillea filipendulina* with 0.3% (3000 ppm) or 0.5% (5000 ppm) Alar 85 (85% daminozide) two or four times and found no effect on plant height in 1993 or 1994 or number of shoots in 1993 but the largest number of shoots occurred in 1994 with four applications at 0.3%. Plant diameter was reduced in both years by 0.5% Alar 85 applied two or four times. Number of inflorescences was highest after two applications of 0.3% Alar 85 in 1993 but not different in 1994. Burnett et al. (1) applied B-Nine at 2500, 5000, or 7500 ppm; Bonzi at 33, 66, or 99 ppm; Cutless at 50, 100, or 150 ppm; or Pistill at 500 or 1000 ppm to *Achillea* × 'Coronation Gold' in a nursery setting over 2 years. The largest plant size reductions were found with Bonzi at 99 ppm and Cutless at 150 ppm. B-Nine at 7500 ppm provided good growth suppression in 1998 but much less in 1999. Pistill suppressed growth but was the only plant growth retardant to delay flowering while Bonzi and Cutless accelerated flowering. The objective of this study was to examine the effects of several widely used plant growth retardants on plant size and flowering of *Achillea* × 'Coronation Gold' when grown in small containers.

Materials and Methods

Offsets of *Achillea* × 'Coronation Gold' were removed from vegetative stock plants on October 16, 1996, and stuck in 36-cell flats [6.0 cm deep (2.4 in), 110 cm^3 per cell (6.7 in^3)] containing germinating medium (Fafard Super fine Germinating Mix, Conrad Fafard, Anderson, SC). Offsets were rooted under intermittent mist propagation set initially to 5 sec on every 5 min from 8:00 am to 5:00 pm in a shaded, glass covered greenhouse under natural photoperiods. Adjustments for changing environmental conditions were made to the mist intervals as needed to maintain turgid foliage. Bottom heat was provided at 29.4C (85F) during propagation using electric heating mats. Rooted offsets were removed from mist on November 4, 1996, and placed in a plastic covered greenhouse with a heating set point of 18.3C (65F) and ventilation began at 25.6C (78F).

Offsets were transplanted to 10 cm (4 in) square plastic pots [8.3 cm deep (3.3 in), 485 cm^3 per pot (29.6 in^3)] containing growing medium (Fafard Mix No. 4-P, Conrad Fafard) on November 16, 1996, and initially spaced pot-to-pot on a greenhouse bench. Fertilization began when plants had roots to the sides and bottom of the pot and was applied at 150 ppm of N using a 20N–4.4P–16.6K (Pro Sol 20–10–20, Frit Industries, Ozark, AL) fertilizer with one water application per week to prevent soluble salts buildup. Plants were watered or fertilized when the medium appeared dry, but before plants wilted. All plants were placed in a walk-in cooler on January 5, 1997, at 4.4C (40F) for vernalization. While in the cooler, water was applied as needed and incandescent light was provided at a minimum of 10 fc for 24 hr per day.

On March 7, 1997, after 8 weeks and 5 days of vernalization, plants were placed in a glass covered greenhouse with a heating set point of 18.3C (65F) and ventilation began at 25.6C (78F). Plants were provided a long-day photoperiod from the time of removal from vernalization until the end of the experiment by lighting from 10:00 pm to 2:00 am using a minimum of 10 fc from incandescent lamps. Plants were spaced on greenhouse benches 22.9 cm (9 in) from the center of one pot to another pot. Plant growth retardant treatments consisted of one spray application of B-Nine at 0, 2550, 5100, or 7650 ppm; Cycocel at 0, 767, 1534, or 2301 ppm; B-Nine/Cycocel at 0, 1275/1534, 2550/1534, or 3825/1534 ppm; Sumagic at 0, 11, 22, 33, 44, or 55 ppm; Bonzi at 0, 32, 64, 96, 128, or 160 ppm; and Cutless at 0, 40, 80, or 120 ppm. Treatments were applied on March 14, 1997, [27.2C (81F) and 70% relative humidity] . Spray treatments were applied uniformly at a rate of 0.2 liter/m^2 (equivalent to 2 qt/100 ft^2) using a pressurized CO_2 sprayer with a flat spray nozzle (XR TeeJet 8003 VK, Bellspray, Inc., Opelousas, LA) calibrated at 138 kPa (20 psi).

Data recorded at the time of the first open inflorescence was the date, shoot height, growth index [GI = (height + widest width + width 90°) / 3], inflorescence width at the widest point, and a market quality rating consisting of 1 = poor, unsalable; 2 = average, salable; 3 = good, salable; or 4 = excellent. Open inflorescence was when three-quarters of the florets in an inflorescence showed yellow color.

The experiment was a randomized complete block design with nine single-pot replications per treatment. Each growth retardant was analyzed separately. Quantitative responses were analyzed using PROC MIXED in PC-SAS (SAS Institute, Cary, NC). Response to growth retardant rate was determined using linear and quadratic orthogonal polynomials (P = 0.05). Quality ratings were analyzed as ordinal responses (17). Mean separation of quality ratings were determined using t-tests, P = 0.05, from PROC GLIMMIX (16).

Results and Discussion

Increasing B-Nine rates resulted in a linear decrease in shoot height (SH) and growth index (GI), a linear increase in the number of days to first open inflorescence (DTI), but had no effect on inflorescence diameter (ID) or quality rating (QR) of 'Coronation Gold' achillea (Table 1). The highest B-Nine rate reduced SH by 36% and GI by 26% but increased DTI by 5 days when compared to the controls. Despite large reductions in plant size, quality ratings were not affected. Vršek et al. (19) treated *Achillea filipendulina* with 3000 or 5000 ppm Alar 85, which contains the same active ingredient as B-Nine, two or four times and found no effect on shoot

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-19 via free access

Table 1. **Response of *Achillea* × 'Coronation Gold' to spray applications of plant growth retardants.**

Growth retardant	ppm	Shoot height (cm)	Growth index[z]	Inflorescence diameter (cm)	Quality rating[y]	Days to first open inflorescence
B-Nine	0	48.2	28.0	5.2	2.0[ns x]	39
	2550	41.8	26.1	5.1	2.0	40
	5100	39.8	24.9	5.1	2.0	41
	7650	31.0	20.6	5.0	2.1	44
Significance[w]		L***	L***	NS		L**
Cycocel	0	49.1	28.6	5.2	2.0b	38
	767	40.8	24.6	5.1	2.0b	40
	1534	37.6	24.4	5.0	2.2b	41
	2301	30.0	20.9	4.9	2.7a	41
Significance		L***	L***	NS		L*
B-Nine + Cycocel	0	47.9	27.9	5.3	2.0b	39
	1275/1534	32.3	22.0	5.2	2.1b	40
	2550/1534	27.0	19.8	5.1	2.4ab	43
	3825/1534	18.7	16.4	4.9	2.8a	44
Significance		L***	L***	NS		L***
Sumagic	0	47.6	27.8	5.4	2.0b	39
	11	30.1	21.1	5.3	2.6ab	39
	22	20.5	17.5	4.7	3.0a	42
	33	17.7	16.1	4.7	2.9a	42
	44	12.3	13.6	4.6	2.3b	42
	55	11.9	13.4	4.6	2.3b	43
Significance		Q***	Q***	L***		L***
Bonzi	0	48.4	28.6	5.6	2.0c	40
	32	29.5	20.5	4.9	2.6ab	41
	64	26.0	19.0	4.7	2.9a	41
	96	26.3	18.5	4.7	2.4abc	40
	128	25.6	18.8	4.6	2.3bc	41
	160	23.1	18.2	4.6	2.2bc	42
Significance		Q***	Q***	L***		NS
Cutless	0	45.2	28.0	5.0	2.0b	40
	40	16.1	15.2	4.5	2.6a	41
	80	13.4	14.3	4.5	2.4a	42
	120	11.3	13.8	4.3	2.0b	43
Significance		Q***	Q***	L*		NS

[z]Growth index = (height + widest width + width 90°) / 3; in cm.
[y]Quality rating: 1 = poor, unsalable; 2 = average, salable; 3 = good, salable; or 4 = excellent.
[x]Mean separation for quality ratings in columns using main effect t-tests, $P = 0.05$, from PROC GLIMMIX ns = non-significant.
[w]Non-significant (NS) or significant linear (L) or quadratic (Q) trend at $P = 0.05$ (*), 0.01 (**), or 0.001 (***).

height. However, plants in their study plants were potted in April and data were not collected until September, possibly allowing treated plants to out-grown the Alar effects. Burnett et al. (1) likewise did not find a difference in shoot height of 'Coronation Gold' achillea in 1998 using B-Nine rates comparable to those used in this study, but shoot height reductions were found in 1999. Unlike in this study, Burnett et al. (1) found no difference in DTI in either years but like this study, B-Nine did not impact QR. Differences between the two studies may be attributed to different growing environments (nursery versus greenhouse), different container sizes, and possibly differences in the stage of plant development when the treatments were applied.

Similar to B-Nine, increasing rates of Cycocel resulted in a linear decrease in SH and GI, a linear increase in DTI, but no effect on ID of 'Coronation Gold' achillea (Table 1). Unlike B-Nine however, Cycocel did impact QR. The highest Cycocel rate reduced SH by 39% and GI by 27% but increased DTI by 3 days when compared to the controls. Cycocel was only slightly more effective in reducing plant size of 'Coronation Gold' achillea when compared to B-Nine but 2301 ppm Cycocel resulted in a higher QR than other rates. Nausieda et al. (13) reported that Cycocel was ineffective on *Achillea millefolium* 'Summer Pastels' though the rates tested were not reported. However, Latimer (9) reported that *Achillea millefolium* 'Summer Pastels' responded to one application of

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-19 via free access

Cycocel at 4000 ppm but details on treatments and methods were not reported. In this study, 'Coronation Gold' achillea responded to about half the rate used by Latimer (9) with a linear reduction in SH and GI and an improvement in QR at the highest rate.

The combinations of B-Nine and Cycocel resulted in a linear decrease in SH and GI, a linear increase in DTI, but had no effect on ID with increasing rates in 'Coronation Gold' achillea (Table 1). Like Cycocel alone but unlike B-Nine alone, B-Nine/Cycocel did impact QR. The highest B-Nine/Cycocel rate reduced SH by 61% and GI by 41% when compared to the controls, a 25 and 22% larger reduction in SH and a 15 and 14% larger reduction in GI than the highest rates of B-Nine and Cycocel alone, respectively. However, the highest B-Nine/Cycocel rate increased DTI by 5 days when compared to the controls, the same as B-Nine alone but 2 days less than for Cycocel alone. Quality rating was highest at the highest rates of B-Nine/Cycocel but similar to plants treated with 2550/1534 ppm of B-Nine/Cycocel and approximately equal to the rating observed at the highest rate of Cycocel alone. Latimer (10) reported that *Achillea millefolium* 'Paprika' responded to one application of B-Nine/Cycocel at 5000/1500 ppm but details on treatments and methods were not reported. This rate was higher than the highest rate used here and may indicate that further investigation into B-Nine/Cycocel application to 'Coronation Gold' achillea in needed.

Increasing Sumagic rates resulted in a quadratic decrease in SH and GI, a linear decrease in ID, a linear increase in DTI, and impacted QR in 'Coronation Gold' achillea (Table 1). The highest Sumagic rate reduced SH by 75% and GI by 52% but increased DTI by 4 days when compared to the controls. Sumagic at the highest rate resulted in an 14 and 11% larger reduction in SH and GI than the highest rates of B-Nine/Cycocel, a 39 and 26% larger reduction in SH and GI than B-Nine alone, and a 39 and 27% larger reduction in SH and GI than Cycocel alone, respectively. The highest QR occurred at 22 and 33 ppm Sumagic. Though similar to plants treated with 11 ppm Sumagic, it was a 1 unit increase when compared to the control and the only treatments averaging good and salable. Shoot height was 17.7 and 20.5 cm when treated with 22 or 33 ppm Sumagic, respectively, which is 2.1 and 2.5 times the height of the pots. However, the highest rate of Sumagic resulted in a 15% reduction in ID when compared to the controls unlike B-Nine, Cycocel, or B-Nine/Cycocel. Latimer (8) reported that when four species and cultivars of *Achillea* were examined, *Achillea* × 'Coronation Gold' and *Achillea millefolium* 'Paprika' responded to 15 ppm Sumagic or less while *Achillea* × 'Moonshine' and *Achillea millefolium* 'Summer Pastels' showed no growth reductions when treated with 60 ppm Sumagic. In this study, 'Coronation Gold' achillea had the highest QR at 22 and 33 ppm Sumagic which may indicate that further investigation into Sumagic application to 'Coronation Gold' achillea is needed.

Increasing Bonzi rates resulted in a quadratic decrease in SH and GI, a linear decrease in ID, and impacted QR but not DTI in 'Coronation Gold' achillea (Table 1). The highest Bonzi rate reduced SH by 52% and GI by 36% but decreased ID by 18% when compared to the controls. Across all plant growth retardant rates, Bonzi at 2.9 times the rates of Sumagic resulted in a 23 and 16% smaller reduction in SH and GI, respectively, and a 3% larger reduction in ID than Sumagic. Across all rates, Bonzi also resulted in a 16 and 10% larger reduction in SH and GI, respectively, than B-Nine alone and a 13 and 9% larger reduction in SH and GI, respectively, than Cycocel alone while B-Nine/Cycocel resulted in a 9 and 5% larger reduction in SH and GI, respectively, than Bonzi. The highest QR occurred at 64 ppm Bonzi. Though similar to plants treated with 32 or 96 ppm Bonzi, it was a 0.9 unit increase when compared to the control and comparable to the best QR for Sumagic. Burnett et al. (1) found a decrease in shoot height of 'Coronation Gold' achillea in 1998 and 1999 using 33, 66, or 99 ppm Bonzi and a small change in DTI in 1998 but not in 1999. Again, differences in experimental conditions may account for the small differences with this study.

Increasing Cutless rates resulted in a sharp quadratic decrease in SH and GI, a linear decrease in ID, and impacted QR without affecting DTI (Table 1). The highest Cutless rate reduced SH by 75% and GI by 51% but decreased ID by 14% when compared to the controls. Across all plant growth retardant rates, Cutless resulted in a 23 and 15% smaller reduction in SH and GI, respectively, than Bonzi, a 14 and 10% smaller reduction in SH and GI, respectively, than B-Nine/Cycocel, a 39 and 25% smaller reduction in SH and GI, respectively, than B-Nine, and a 36 and 24% smaller reduction in SH and GI, respectively, than Cycocel but was comparable to Sumagic. The highest QR occurred at 40 and 80 ppm Cutless, a 0.6 and 0.4 unit increase when compared to the control, respectively. These QR are lower than the highest QR for Bonzi or Sumagic and reflect the larger reduction in plant size observed at even the lowest rate of Cutless. This implies that future work with Cutless on 'Coronation Gold' achillea should examine a lower, broader range of rates to elucidate an optimum rate range for the best quality product. Burnett et al. (1) found a decrease in shoot height of 'Coronation Gold' achillea in 1998 and 1999 using 50, 100, or 150 ppm Cutless and a small change in DTI in 1998 but not in 1999. However, the difference in the amount of shoot suppression in the two studies is striking. In this study, the highest Cutless rate (120 ppm) reduced SH by 75% when compared to the controls while Burnett et al. (1) found a reduction of 23% at DTI in 1998 and a reduction of 47 and 54% at 28 days and 42 days, respectively, after treatment between 150 ppm Cutless and the control.

Increasing application rates of the five plant growth retardants used in this study resulted in decreases in SH and GI and improvements in QR by all except B-Nine alone. B-Nine, Cycocel, B-Nine/Cycocel, and Sumagic increased DTI and Sumagic, Bonzi, and Cutless decreased ID. Quality ratings ranging from 2.8 to 3.0 were found for B-Nine/Cycocel at 3825/1534 ppm, Sumagic at 22 and 33 ppm, and Bonzi at 64 ppm. Differences between the results in this study and earlier studies implicate the possible impact of differences in experimental environments, container size, or stage of development when plant growth retardant treatments were applied.

Literature Cited

1. Burnett, S.E., G.J. Keever, C.H. Gilliam, J.R. Kessler, and C. Hesselein. 2000. Plant growth regardant application to *Achillea* × 'Coronation Gold' and *Gaura lindheimeri* 'Corrie's Gold'. J. Environ. Hort. 18:149–153.

2. Cameron, A., R. Heins, and W. Carlson. 1996. Forcing perennials 101: We have the technology. Greenhouse Grower 14(3):19–20.

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-19 via free access

3. Cameron, A., R. Heins, and W. Carlson. 1996. Forcing perennials 102: Here's a look at cold requirements of certain herbaceous perennials. Greenhouse Grower 14(4):19–20.

4. Cameron, A., E. Runkle, R. Heins, B. Fausy, and C. Whitman. 2003. Herbaceous perennials: Summary tables. Greenhouse Grower 21(12):44, 46, 48, 50, 52, 56, 59.

5. Holcomb, E.J. and D.J. Beattie. 1988. Effect of growth retardants on perennials. Bedding Plants Foundation, Inc. Research Report 032:1–4.

6. Joeright, D., C. Whitman, R. Heins, A. Cameron, and W. Carlson. 2001. Herbaceous perennials: Plant growth regulators. Greenhouse Grower 21(7):84, 88–91, 94, 96.

7. Keever, G.J., J.R. Kessler, and J.C. Stephenson. 2003. Accelerated flowering of herbaceous perennials under nursery conditions in the southern United States. J. Environ. Hort. 19:140–144.

8. Latimer, J. 2004. Trends and uses of plant growth regulators on herbaceous perennials. Proc. Ann. Conf. Plant Growth Regulator Society Amer. 31:1–4.

9. Latimer, J. 2001. PGR chart. *In*: Buyer's Guide 2001. Greenhouse Product News 11:40,42–57.

10. Latimer, J. 2003. PGR chart. *In*: Buyer's Guide 2003/2004. Greenhouse Product News 13:24–25.

11. Latimer, J. 2006. Herbaceous perennials, use PGRs, too. Greenhouse Grower 24(7):52, 54, 56, 58, 60.

12. Latimer, J., H. Scoggins, and V. Groover. 2006. PGRs on perennial plants: Examples from the Asteraceae family. Ohio Florists Assoc. Bulletin 895:9–12.

13. Nausieda, E., L. Smith, T. Hayahsi, B. Fausey, A. Camerson, R. Heins, and W. Carlson. 2000. Forcing perennials crop-by-crop. Species: *Achillea* spp. Common name: Common Yarrow. *In*: Firing Up Perennials the 2000 Edition. Greenhouse Grower, Willoughby, OH.

14. Olrich, M., D. Joeright, R. Heins, E. Runkle, and A. Cameron. 2003. Herbaceous perennials: Plant growth retardants. Greenhouse Grower 21(8):94,96,98,105–106.

15. Pyle, A. 1997. Finishing perennials from plugs. Greenhouse Management and Production 17(12):16–17, 21.

16. SAS Institute. 2006. The GLIMMIX procedure, June 2006. SAS Institute, Cary, NC.

17. Schabenberger, O. and F.J. Pierce. 2002. Contemporary Statistical Models for the Plant and Soil Sciences. CRC Press, Boca Raton, FL.

18. Thomas, P.A. and J.G. Latimer. 1997. Chemical regulation of growth of perennial bedding plants. HortScience 23:509.

19. Vršek, I., K. Karloviæ, and V. Židovec-Kalember. 2001. *Achillea filipendulina* Lam. as a pot plant. P. Salaš eds. Proceedings of the 9th Inter. Conf. Hort. September 3–6, 2001, Lednice, Czech Republic. 2:416–422.

20. Walters Garden, Inc. Plant Database. Last accessed March 21, 2007. http://www.waltersgardens.com/index.cfm?fuseaction=plants.plantDetail&plant_id=3.

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-19 via free access