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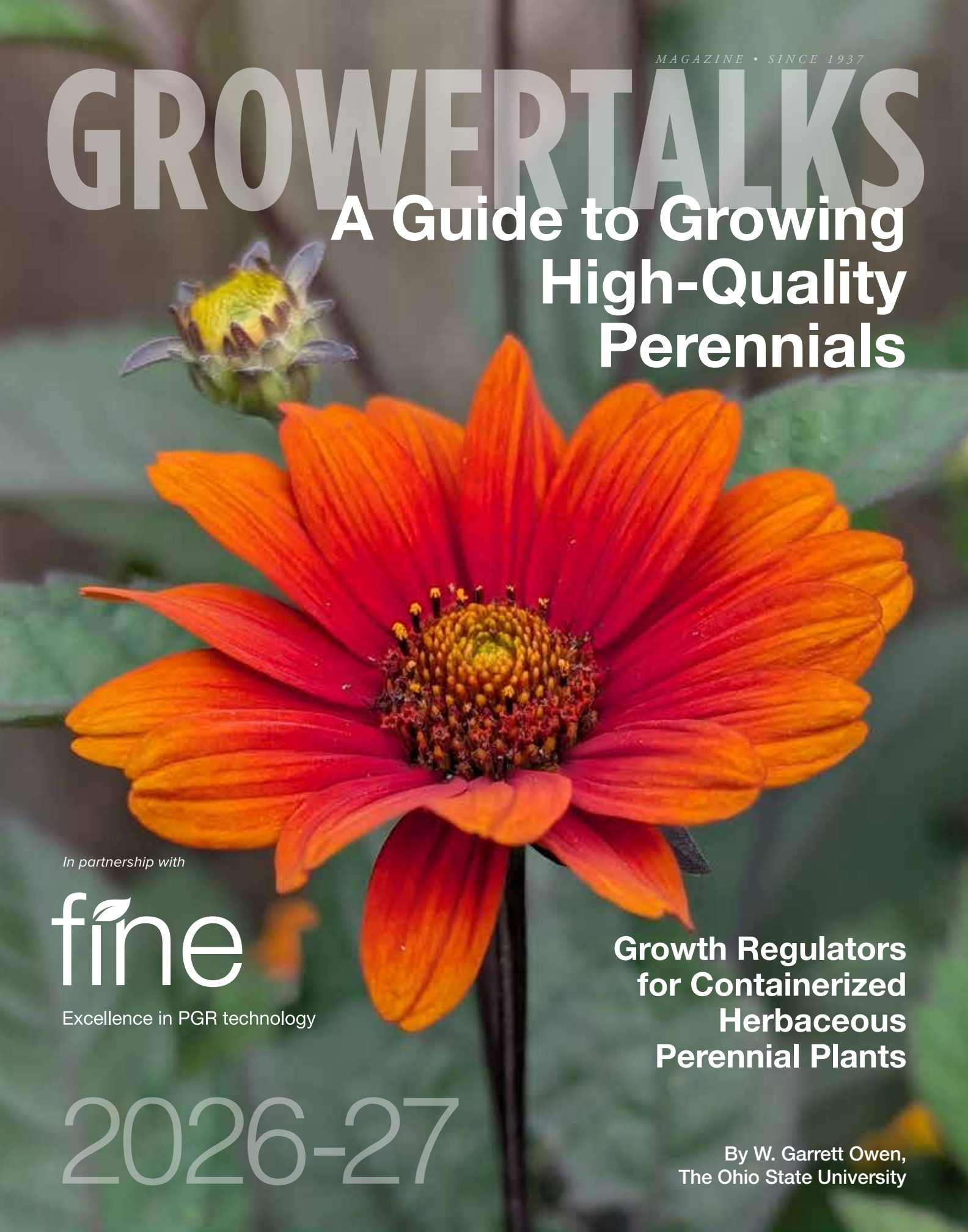
GROWERTALKS

A Guide to Growing High-Quality Perennials



Growth Regulators for Containerized Herbaceous Perennial Plants

2026-27

By W. Garrett Owen,
The Ohio State University

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At Fine Americas, we know that success in perennial production comes down to control, consistency and return on investment. That's why growers continue to rely on Fine PGRs—tools proven to deliver measurable results in quality, efficiency and profitability. From managing height and promoting uniform growth to improving finish times and marketability, our products help every square foot of your greenhouse perform at its best.

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We are deeply grateful to our university research partners. Their expertise and collaboration continue to advance horticultural science and strengthen the insights shared throughout this guide.

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Damian Eldred, President
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BALL PUBLISHING

GrowerTalks (ISSN 0276-9433) is published monthly by Ball Publishing, P.O. Box 1660, West Chicago, Illinois 60186, United States. Subscriptions are free to qualified readers in the U.S. Subscription price for non-qualified readers is $50 per year U.S. and Canada. All other foreign subscriptions must pay $199/year to receive/continue to receive *GrowerTalks* and *Green Profit*. *GrowerTalks* is a U.S. registered trademark of Ball Horticultural Company. Periodicals postage paid at West Chicago, IL and at additional mailing offices. Postmaster: send address changes to *GrowerTalks* Magazine, P.O. Box 1660, West Chicago, Illinois 60186, United States. Posted under Canada publications mail agreement #40732015. Canada returns to be sent to International Delivery Solutions, P.O. Box 456, Niagara Falls, ON L2E 6V2, Canada. Printed in the USA.

GreenProfit Supplement Enclosed

Boost Your Roots with Advocate Foliar Sprays for Woody Ornamental Propagation

By Olivia J. Liebing & W. Garrett Owen, The Ohio State University

Many ornamental woody plant species have complex germination requirements that make starting seed impractical. To hasten production cycles and maintain elite stock, growers commonly propagate by stem cuttings. A central challenge with cutting propagation is the initial absence of roots. Unrooted cuttings are highly prone to water stress, which requires specialized care and environmental conditions. Rapid development of new roots from non-root tissues, called adventitious rooting, is therefore essential.

In addition to careful management of the propagation environment, growers often apply rooting compounds that contain synthetic auxins, such as indole-3-butyric acid (IBA) and naphthaleneacetic acid (NAA) to improve rooting. When properly applied, auxin treatments can accelerate root initiation, increase root number, and enhance root elongation and mass. Treated cuttings also tend to root more uniformly than untreated cuttings (Figure 1).

Auxin can be applied using the traditional method of quick dips, which refers to quickly dipping the excised basal end of the cutting into a talcum or talc powder prior to cutting stick, or weighing and dissolving a powder to form a solution. These rooting compounds commonly utilize IBA and/or IBA+NAA as rooting hormones.

Now, liquid-based products are available such as Advocate, a liquid 20% IBA compound, from Fine Americas, Inc. This product allows growers to easily dose the desired concentrate for mixing and can be applied as an immersion, basal dip or foliar spray (Figure 2). Careful selection of the application method influences rooting response, liner morphology, labor inputs and overall production efficiency.

Advocate application methods & typical ranges

Immersion

The immersion method can efficiently and uniformly treat a large number of cuttings in a short time. To perform this method, cuttings are totally immersed in the hormone solution for approximately five seconds and then stuck immediately after removal. Solutions for immersions are typically in the range of 300 to 1,500 ppm Advocate. Lower Advocate concentrations may be used for immersions compared to quick-dips and foliar spray applications because of the higher application volume and larger treated area.

Quick-dips

As the name implies, a quick-dip consists of inserting the basal end of the cutting into a solution containing Advocate for three to five seconds. It's common for solutions to deliver 500 to 10,000 ppm Advocate, depending on the plant species, developmental stage of plant material and time of year. Quick-dip solutions are often more concentrated than immersion or spray solutions because of the shorter exposure time. Creating quick-dips solutions from Advocate is advantageous over previous, alcohol-based solutions since it eliminates the risk overexposure to alcohol dehydrating and damaging plant tissue. After dipping, growers should insert the cuttings into the propagation substrate and place containers into the propagation environment. ▶

Foliar sprays

Interest in foliar sprays has increased in recent years with the goal of improving production efficiency. Foliar sprays can reduce labor and employee exposure to IBA when handling cuttings, streamline propagation and lower overall costs. Sprays are often applied 24 hours after cutting stick and can be re-applied to hasten root development and uniformity. Once mixed, the Advocate solution should be used within 24 hours. The best time to spray is when light levels are low, mist is off or paused, and cuttings aren't stressed. These conditions allow the Advocate solution to slowly dry on the leaf surface. Spray concentrations often range between 300 to 1,500 ppm Advocate, yet exact rates are still undefined for many ornamental woody species, making this a top research interest at The Ohio State University. The following paragraphs summarize how we conducted our foliar Advocate research trials and highlight key findings.

The Ohio State University woody ornamental propagation research

In trials at The Ohio State University, more than 20 woody ornamental plant species were evaluated. Plant material in each trial was collected from commercial nurseries (Decker's Nursery and Willoway Nurseries, Inc.). Cuttings were prepared following industry specifications and were individually inserted into 2.5-in. deep square pots (237 mL individual container volume) and filled with a pre-moistened commercial peat-based substrate (SunGro Sunshine Mix No. 1) amended with 50% coarse perlite. Unrooted cuttings were placed in a glass-glazed greenhouse in a propagation environment under 33% shade cloth where ambient daylight was supplemented with 1,000-W light-emitting diode lamps to create a 16-hour photoperiod and benches providing 75F (24C) root-zone heating.

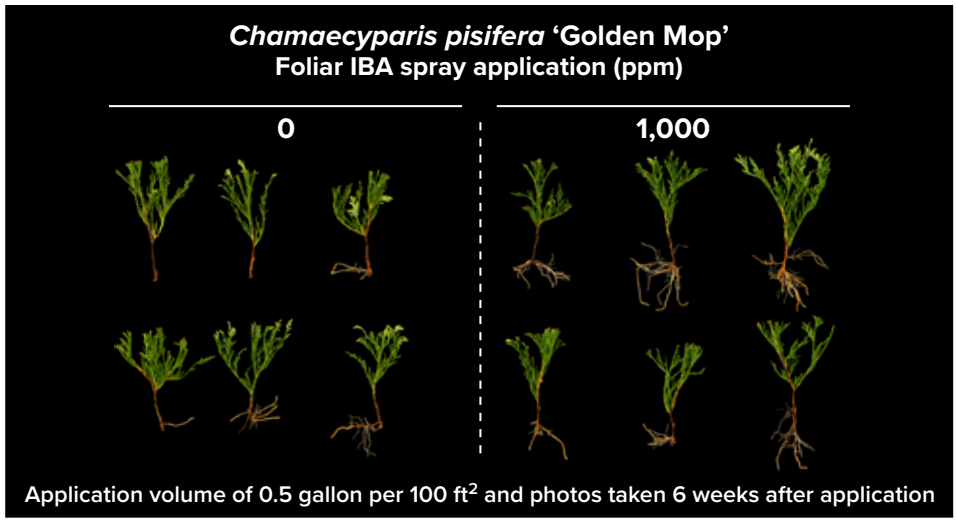

Figure 1. Japanese false cypress (*Chamaecyparis pisifera* Golden Mop) cuttings at 42 days of propagation that received foliar applications of 0 or 1,000 ppm Advocate at a volume of 0.5 gal. per 100 sq. ft. Figure by: Olivia J. Liebing and Dr. W. Garrett Owen, The Ohio State University.

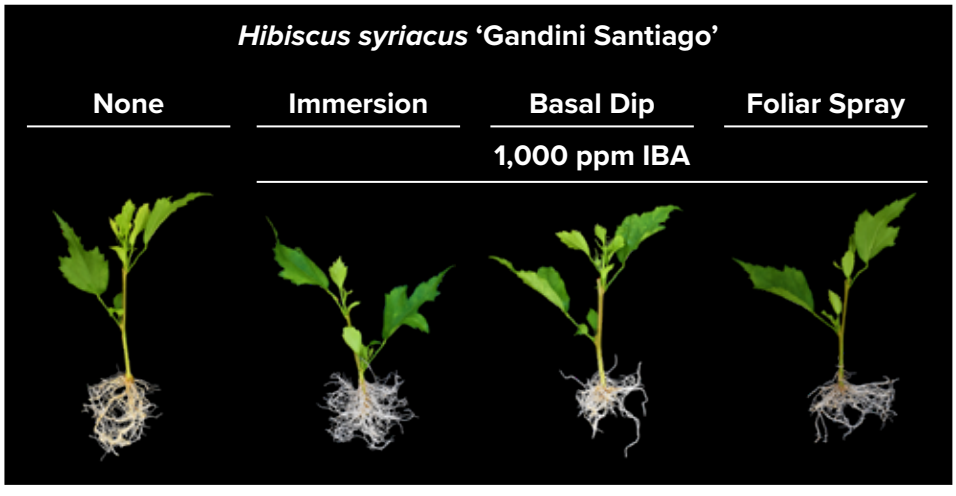

Figure 2. Rose of Sharon (*Hibiscus syriacus* Gandini Santiago) cuttings at 35 days of propagation that received 0 ppm (control) or 1,000 ppm Advocate by immersion, basal dip or foliar spray at a volume of 0.5 gal. per 100 sq. ft. Figure by: Olivia J. Liebing and Dr. W. Garrett Owen, The Ohio State University.

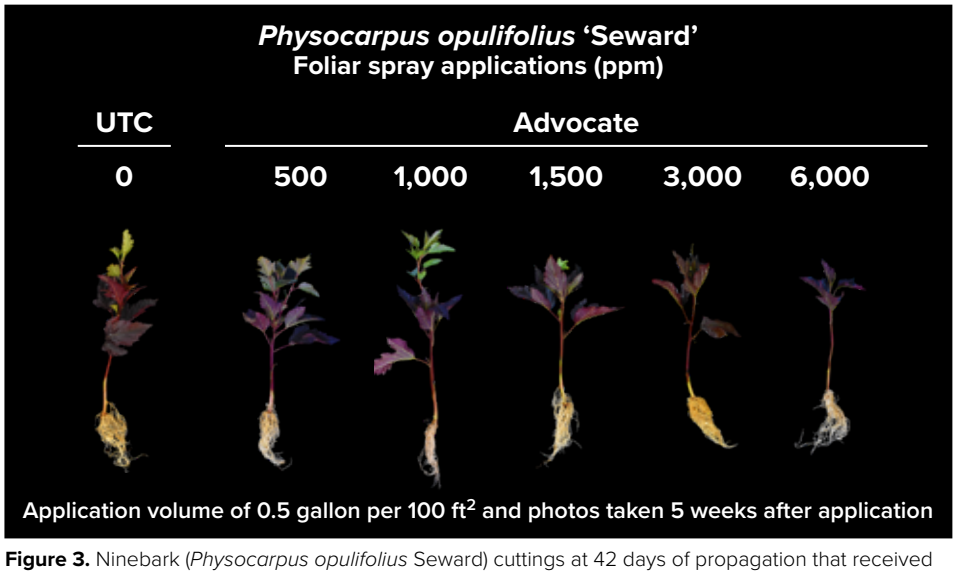

Figure 3. Ninebark (*Physocarpus opulifolius* Seward) cuttings at 42 days of propagation that received foliar applications of 0, 500, 1,000, 1,500, 3,000 or 6,000 ppm Advocate at a volume of 0.5 gal. per 100 sq. ft. Figure by: Olivia J. Liebing and Dr. W. Garrett Owen, The Ohio State University.

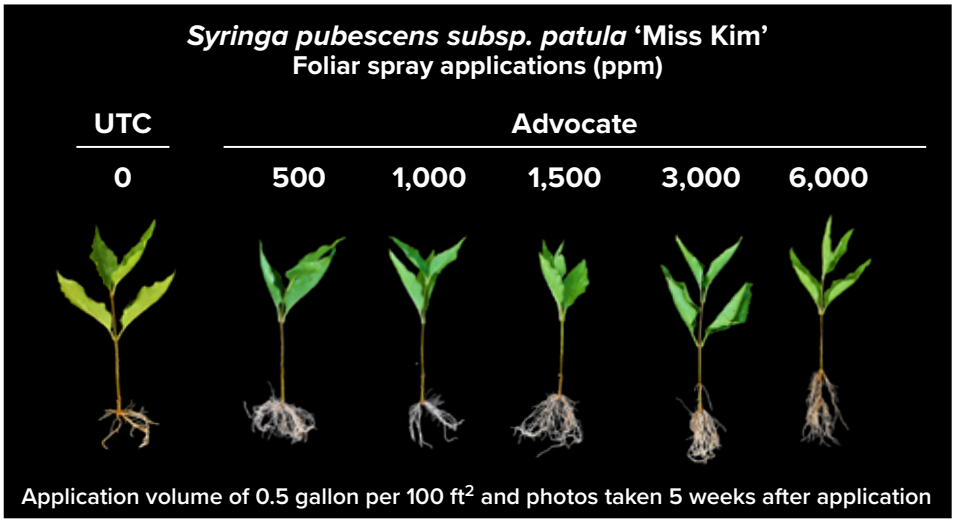

Figure 4. Manchurian lilac (*Syringa pubescens* subsp. *patula* Miss Kim) cuttings at 42 days of propagation that received foliar applications of 0, 500, 1,000, 1,500, 3,000 or 6,000 ppm Advocate at a volume of 0.5 gal. per 100 sq. ft. Figure by: Olivia J. Liebing and Dr. W. Garrett Owen, The Ohio State University.

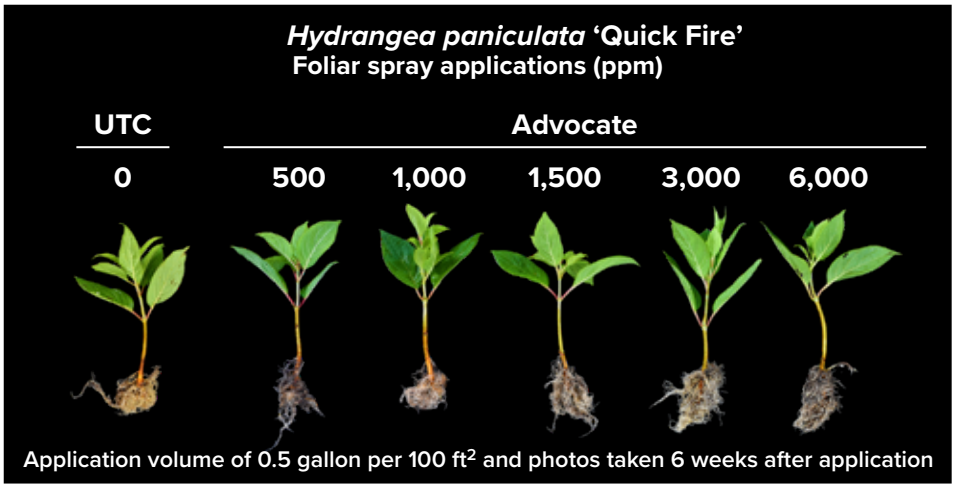

Figure 5. Panicle hydrangea *(Hydrangea paniculata* Quick Fire) cuttings at 42 days of propagation that received foliar applications of 0, 500, 1,000, 1,500, 3,000 or 6,000 ppm Advocate at a volume of 0.5 gal. per 100 sq. ft. Figure by: Olivia J. Liebing and Dr. W. Garrett Owen, The Ohio State University.

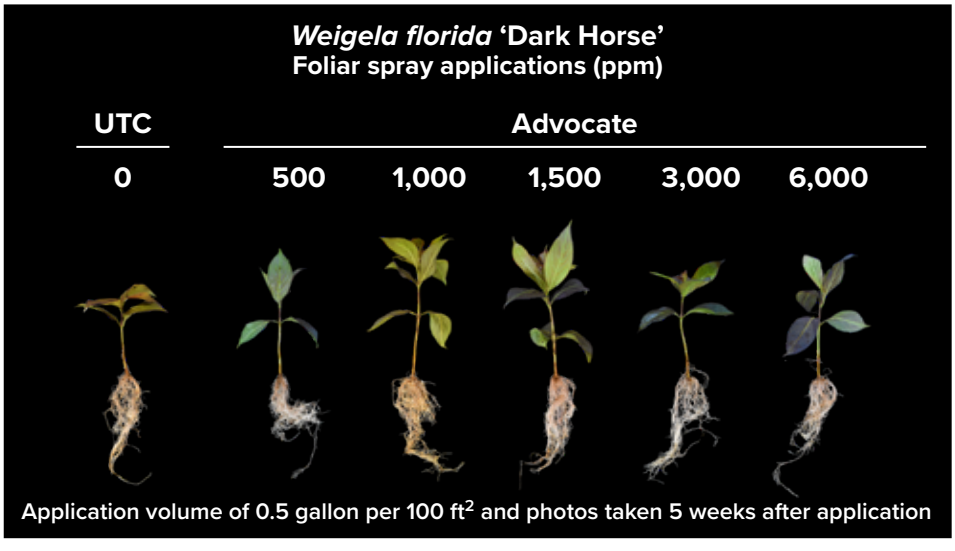

Figure 6. Weigelia (*Weigelia* florida Dark Horse) cuttings at 42 days of propagation that received foliar applications of 0, 500, 1,000, 1,500, 3,000 or 6,000 ppm Advocate at a volume of 0.5 gal. per 100 sq. ft. Figure by: Olivia J. Liebing and Dr. W. Garrett Owen, The Ohio State University.

At 24 hours after cutting stick, unrooted cuttings of each species received a single foliar spray application of 0, 500, 1,000, 1,500, 3,000 or 6,000 ppm Advocate at a volume of 0.5 gal. per 100 sq. ft. Cuttings received a daily mist of supplemental micronutrient package (J.R. Peters, Inc.) until the solution ran off the cutting leaves.

The effects of Advocate on root growth and development varied greatly between species. For example, ninebark (*Physocarpus opulifolius* Seward) developed higher root dry mass with foliar application rates over 500 ppm Advocate, while Manchurian lilac (*Syringa pubescens* subsp. *patula* Miss Kim) and panicle hydrangea (*Hydrangea paniculata* Quick Fire) developed higher root dry mass at foliar spray applications over 1,500 ppm Advocate. In weigelia (*Weigelia florida* Dark Horse), optimal concentrations were within a range of 500 to 3,000 ppm Advocate, with higher application concentrations experiencing reduced root dry mass.

Therefore, based on these trial results, we suggest foliar application rates should begin at 500 ppm Advocate, but not exceed 3,000 ppm Advocate without performing an in-house trial on a small group of cuttings of species and cultivars not listed here. Furthermore, the effects of Advocate on root growth and development will vary among species, developmental stage of cuttings at time of excision from stock plants, and propagation environmental conditions and culture.

Overall, these results demonstrate the effectiveness and ease of using Advocate as a foliar spray to promote rooting in ornamental woody cuttings. Advocate should be considered a tool to enhance, hasten and synchronize rooting during ornamental woody plant propagation. Species and cultivar variation will occur, so as always, growers should consider performing in-house trials and follow the Advocate label. ■

All in the Timing: Using Collate 2L Substrate Drenches to Control Growth of Herbaceous Perennials

By W. Tyler Rich & W. Garrett Owen, The Ohio State University

Collate 2L is an ethylene-releasing plant growth regulator (PGR) containing 21.7% ethephon. In greenhouse production, foliar sprays of Collate 2L are used to suppress unwanted flowering, limit stem elongation and promote lateral branching across many ornamentals and to initiate flowering in bromeliads. Growers often choose Collate 2L as an alternative to anti-gibberellin PGRs such as paclobutrazol when additional branching or flower bud removal is desired.

The Ohio State University Tested Herbaceous Perennials for Collate 2L Drenches

Coreopsis auriculata (Lobed Tickseed)
Delosperma cooperi (Iceplant)
Digiplexis ×hybrida (Tender Foxglove)
Erysimum ×hybrida (Wallflower)
Gaillardia aristate (Blanket Flower)
Gaura lindheimeri (Wand Flower)
Lamium maculatum (Spotted Dead Nettle)
Leucanthemum maximum (Shasta Daisy)
Monarda didyma (Bee Balm)
Nepeta × faassenii (Catmint)
Oenothera speciosa (Evening primrose)
Perovskia atriplicifolia (Russian Sage)
Phlox paniculata (Garden Phlox)
Salvia nemorosa (Perennial Sage)
Scabiosa columbaria (Pincushion Flower)
Sedum lineare (Showy Stonecrop)
Verbena canadensis (Clump Verbena)

Although ethephon foliar sprays have been used for decades, interest in substrate drenches has increased. Building on foundational spray research from the 1990s by Dr. Peter Konjoian, our team at The Ohio State University has tested Collate 2L drenches across 18 annual bedding plants and 17 herbaceous perennial species, evaluated drench timing, assessed how substrate composition influences efficacy, examined residual effects in reused containers, and compared drenches, sprenches and foliar sprays. At this time, Collate 2L is the only ethephon product labeled by the EPA for substrate drench use in floriculture crops. With Collate 2L now labeled for drenches, the practical question is when to apply. To answer it, we conducted controlled trials with coleus and coreopsis as model crops at The Ohio State University that quantify how early versus later drench applications affect growth control and plant quality.

When to drench: Collate 2L timing results from The Ohio State University

For the coreopsis model, unrooted cuttings of Big Bang Mercury Rising Coreopsis (*Coreopsis ×hybrida*) from Dümmen Orange were propagated for 28 days, then transplanted into 5-in. containers (946 mL) filled with a pre-moistened commercial soilless peat-based substrate (SunGro Sunshine Mix #1). At 3, 7, 10, 14, 17 or 21 days after transplant, 3 fl. oz. (90 mL) of drench solution containing 0, 25, 50, 100 or 200 ppm Collate 2L were applied to the substrate surface of each plant. To ensure a true drench, solutions were applied to the substrate surface and did not contact foliage.

Throughout the trial, plants were fertilized with 150 ppm N provided by 15-5-15 Cal-Mag (J.R. Peters, Inc.) and received a monthly Epsom salt drench application at 1 lb. per 100 gal. of water. Plants were grown in a glass-glazed greenhouse under a constant 68F (20C) and 14 $mol \cdot m^{-2} \cdot d^{-1}$ achieved by supplementing ambient sunlight with light emitted from LEDs and deploying a 16-hour photoperiod. At six weeks after initial drench application, data were collected and the trial terminated.

Our research found that Collate 2L provided increased growth control as concentrations increased and the level of control diminished as application time was delayed (Figure 1). For example, when drench concentration increased from 0 to 200 ppm Collate 2L, coreopsis treated at 3, 10 or 21 days after transplant were 18%, 10% and 6% shorter, respectively, than untreated plants. This pattern indicates that, at a given Collate 2L concentration, later drench applications provided less growth control. Therefore, a higher concentration may be needed. Shoot dry weight was also lower as concentrations increased with diminished efficacy as application time was delayed.

For instance, coreopsis drenched with 200 ppm Collate 2L at 3 or 21 days after transplant were 48% (7.4g) and 16% (2.7g) smaller, respectively, compared to untreated plants. At the time of termination, no plants, regardless of Collate 2L concentration or drench application time, had flowered, but all plants displayed visible buds with color.

Taken together, this trial demonstrates that Collate 2L application timing is equally as important as Collate 2L concentration to achieve the desired level of growth control. Our results suggest that Collate 2L substrate drench applications should not be made less than seven days after transplanted, as phytotoxic effects—such as severe stunting and chlorosis (yellowing)—reduced overall aesthetic ornamental quality. We suggest growers apply substrate drenches 10 to 14 days after transplant to provide growth control while avoiding the phytotoxic effects seen at earlier application times.

Furthermore, growers that need to "hold" plants at a desired size, but don't need further growth control should trial substrate drenches made 21 days after treatment. Applying Collate 2L as a substrate drench can alleviate numerous issues commonly associated with ethephon foliar sprays and is a versatile tool in a grower toolbox for herbaceous perennial production.

As with any PGR, growers should always follow the label and trial a small group of plants before treating entire crops. For in-house trials, use the starting drench rates for the 17 herbaceous perennials listed in the "Growth Regulators for Containerized Herbaceous Perennial Plants" table beginning on page 14 of this guide.

Maintain Collate 2L drench solutions near pH 4.5 to 5.0 and note that efficacy declines as water pH increases. For a concise summary of how to use Collate 2L safely and maximize efficacy, check out "Collate Drenches for Herbaceous Perennials" on page 63 of this guide. ■

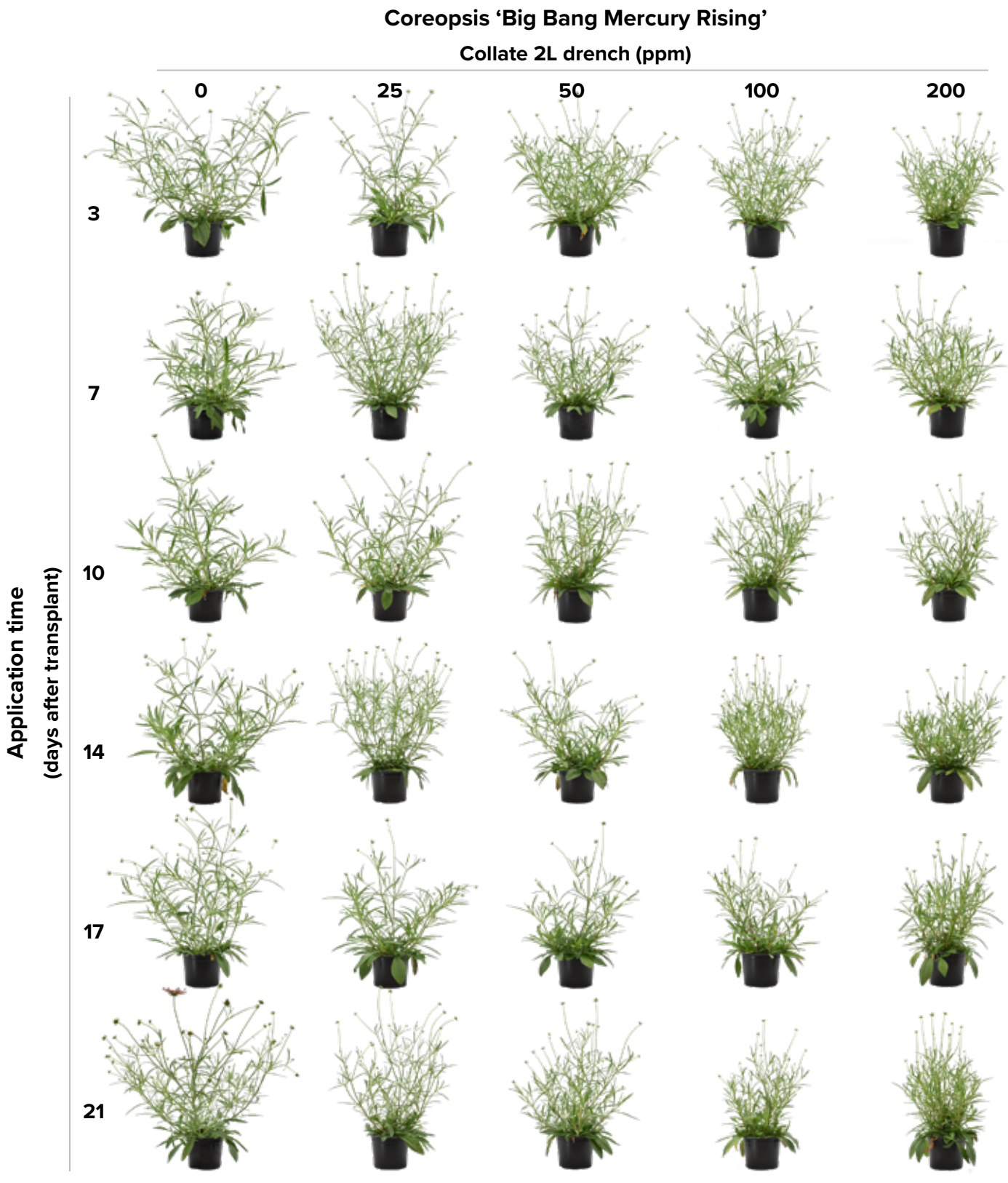

Figure 1. Coreopsis (*Coreopsis ×hybrida* Big Bang Mercury Rising) grown in 5-in. containers (946 mL) filled with a commercial soilless peat-based substrate and drenched at three, seven, 10, 14, 17 or 21 days after transplant with 3 fl. oz. (90 mL) of solution containing 0, 25, 50, 100 or 200 ppm Collate 2L.

Photos by: W. Tyler Rich and Dr. W. Garrett Owen, The Ohio State University.

Controlling Growth of Heliopsis Cultivars With Concise 10X Sprays & Substrate Drenches

By Gaberial Reeves, W. Tyler Rich & W. Garrett Owen, The Ohio State University

False sunflower (*Heliopsis helianthoides*) is a popular midsummer-to-fall herbaceous perennial valued for bright yellow to orange-red, daisy-like blooms. In production, crops are vigorous and can stretch rapidly, which increases the risk of canopy split and creates handling and shipping challenges. Adjusting the greenhouse production environmental set points or cultural practices in greenhouse or outdoor production areas can help reduce stem elongation and mitigate the likelihood of canopy split, but may not provide a complete solution to these challenges.

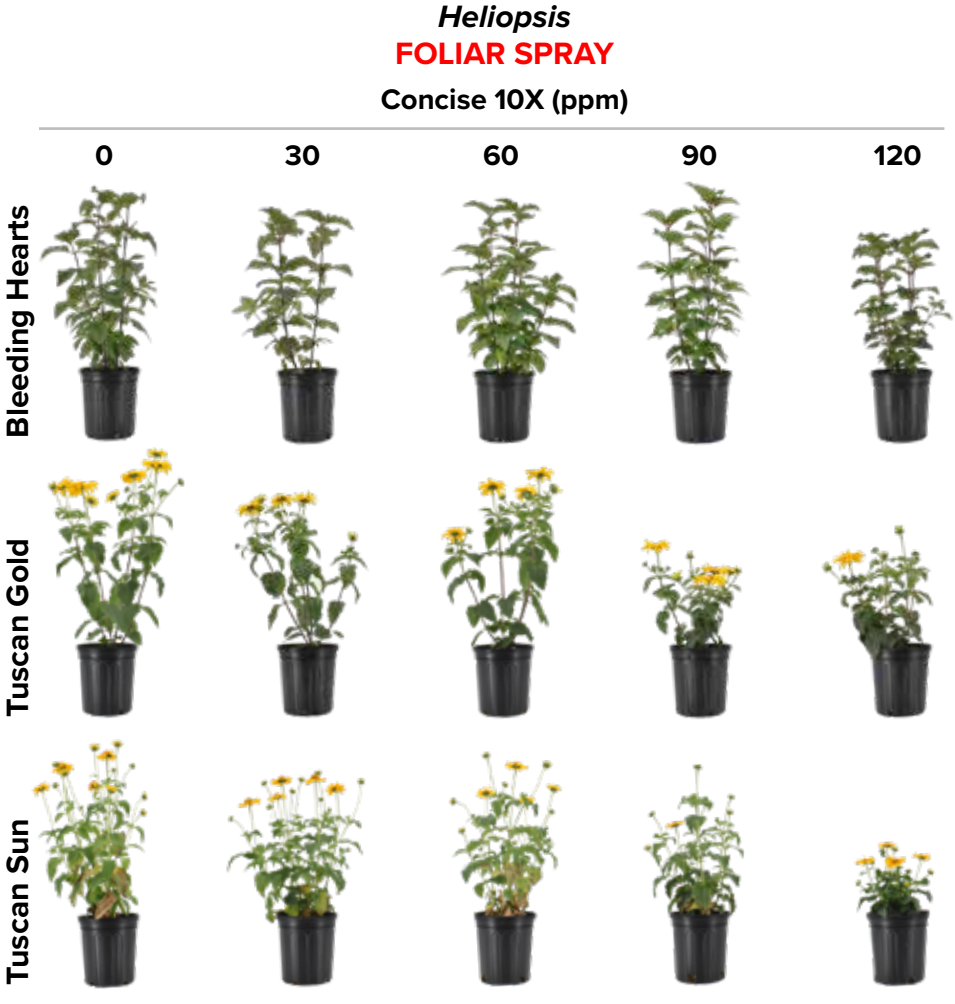

Figure 1. Bleeding Hearts, Tuscan Gold and Tuscan Sun false sunflower (*Heliopsis helianthoides*) sprayed with 0, 30, 60, 90 or 120 ppm Concise 10X at a volume of 0.5 gal. per 100 sq. ft. Photos taken six weeks after spray application. Figure by: Dr. W. Garrett Owen, The Ohio State University.

Plant growth retardants (PGRs) are excellent tools that can be utilized when environmental or cultural adjustments are limited. Therefore, we evaluated foliar sprays and substrate drenches of Concise 10X (0.55% uniconazole) at increasing concentrations to control growth of false sunflower cultivars.

The Ohio State University trial

Bleeding Hearts, Tuscan Gold and Tuscan Sun false sunflower (*Heliopsis helianthoides*) liners (72-cell) were received from a commercial propagator (Walters Gardens) and transplanted into trade gallon containers (2.8 L) filled with a pre-moistened commercial soilless peat-based substrate (SunGro Sunshine Mix No. 1). Plants were grown under a constant 68F (20C) and ambient daylight supplemented with ≈125 $\mu mol \cdot m^{-2} \cdot s^{-1}$ delivered from light-emitting diode arrays to create a 16-hour photoperiod. The average air temperature, daily light integral and relative humidity were 68F (20C), 14 $mol \cdot m^{-2} \cdot d^{-1}$ and 70%, respectively. Throughout the trial, plants were irrigated with acidified tap water supplemented with a water-soluble fertilizer 15-5-15 Cal-Mag (J.R. Peters, Inc.) to deliver 150 ppm N.

At 14 days after transplant, Concise 10X was applied as a foliar spray or substrate drench. Six single-plant replications received a foliar spray of solution containing deionized water (0 ppm; control) or 30, 60, 90 or 120 ppm Concise 10X at a volume of 0.5 gal. per 100 sq. ft.

In a separate trial, six single-plant replications received a substrate drench of 10 fl. oz. (296-mL) of solution containing deionized water (0 ppm; control) or 1, 2, 4 or 8 ppm Concise 10X. Plants were grown six weeks where data was collected including plant height, diameter (taken in two directions and averaged) and plant dry weight. Overall plant size was calculated from plant height and diameter.

Spray results. Foliar sprays of Concise 10X provided cultivar-dependent control of overall plant size. In general, 60 to 120 ppm Concise 10X foliar sprays were determined to be optimal concentrations depending on the level of control desired.

For example, compared to untreated plants, Concise 10X foliar sprays at 60 to 120 ppm decreased overall plant size by 5% to 19% (1.0 to 3.5 in.) in Bleeding Hearts and 10% to 33% (1.3 to 4.6 in.) in

Tuscan Sun false sunflower plants (Figure 1). At termination, Bleeding Hearts false sunflowers at all Concise 10X spray concentrations displayed visible buds with color, but were not flowering. Both Tuscan Sun and Tuscan Gold false sunflowers were flowering at termination regardless of Concise 10X concentration.

Drench results. Increasing Concise 10X substrate drench concentrations effectively controlled plant height and diameter, overall plant size, and shoot dry weight across all false sunflower cultivars trialed. In general, 4 to 8 ppm Concise 10X substrate drenches were determined to be optimal concentrations depending on the level of control desired.

For example, compared to untreated plants, 4 to 8 ppm Concise 10X reduced overall plant size by 26% to 40% (4.1 to 6.2 in.) for Tuscan Sun, 32% to 41% (5.0 to 6.4 in.) for Tuscan Gold, and 9% to 29% (1.5 to 4.8 in.) for Bleeding Hearts, respectively (Figure 2). At termination, Bleeding Hearts false sunflowers had visible flower buds with color, but did not flower at any drench concentration, whereas Tuscan Sun and Tuscan Gold false sunflowers were flowering regardless of drench concentration.

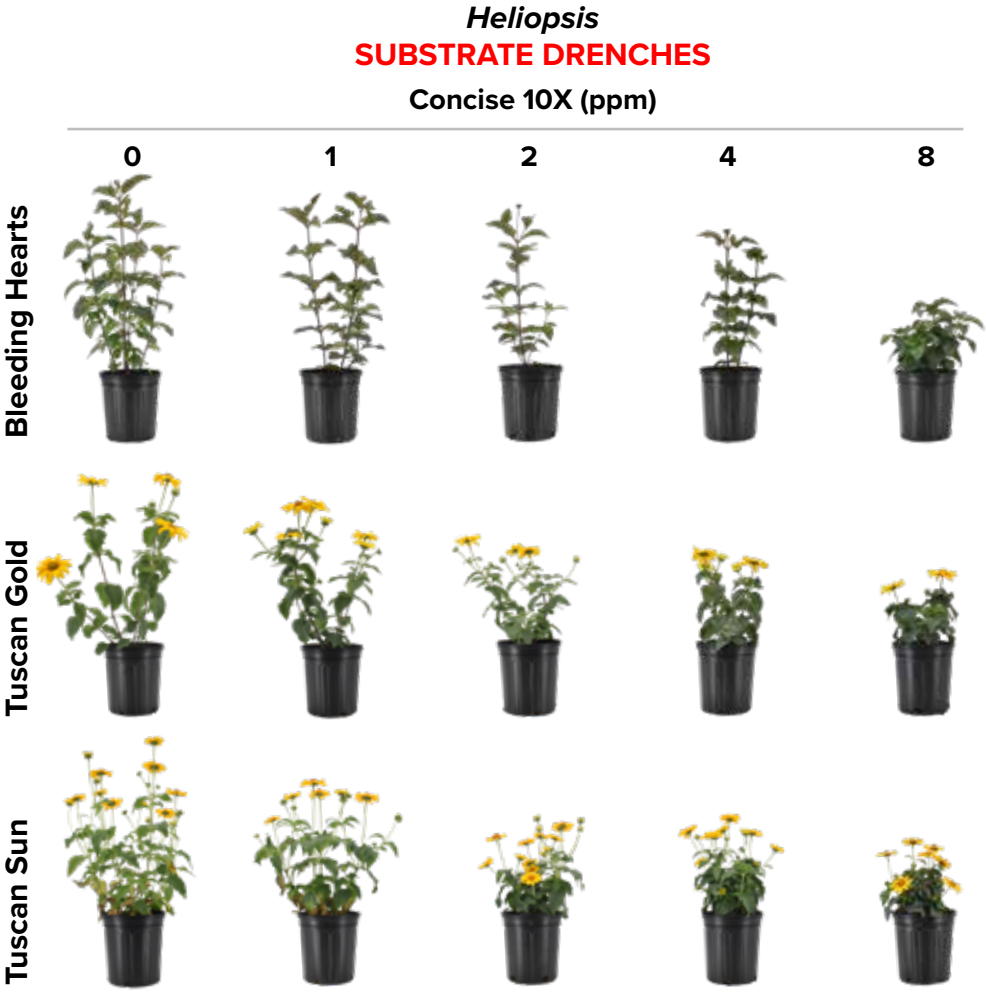

Figure 2. Bleeding Hearts, Tuscan Gold and Tuscan Sun false sunflower (*Heliopsis helianthoides*) drenched with 10 fl. oz. of solution containing 0, 1, 2, 4 or 8 ppm Concise 10X. Photos taken six weeks after drench application. Figure by: Dr. W. Garrett Owen, The Ohio State University.

Conclusion and application

Concise 10X foliar sprays of 60 to 120 ppm and substrate drenches of 4 to 8 ppm effectively controlled growth of Bleeding Heart, Tuscan Gold and Tuscan Sun false sunflowers, with drenches providing the most consistent overall growth control. Growers should be aware that time to flower was not assessed in this trial and should conduct in-house trials if flowering plants are desirable for your market.

When selecting foliar spray and substrate drench concentrations of Concise 10X, growers will need to determine the desired level of control and assess if rate adjustments may be needed based on your geographical location, growing conditions and cultivar.

NOTE: These are research results. Concise 10X is not available at the time of this publication. Concise 10X has been submitted to EPA for registration. Registration of Concise 10X is anticipated in early 2026. ■

Wide Assortment of Available PGRs

Here's an overview of PGRs now available for use on ornamental crops

By Brian E. Whipker, North Carolina State University; Joyce G. Latimer, Virginia Tech; and W. Garrett Owen, The Ohio State University

The number of options available for controlling plant growth has greatly expanded over the past few years (Table 1). There are now options for controlling growth, expanding growth and encouraging branching. Each label has specific recommended dose ranges, recommendations and precautions (Table 2). Here's an overview of the PGRs now available for use on ornamental crops.

Ancymidol

(Commercial names: **Abide** and A-Rest)

Ancymidol readily moves within the plant and is typically used when other chemicals are not effective, most notably in bulb crops or on very high-value crops such as plugs. Growers often prefer the use of ancymidol on plugs because of the lack of phytotoxicity and it's a "safer" PGR to apply. Its limited residual activity allows plugs to grow out of the growth control effects after being transplanted.

Chlormequat chloride

(Commercial names: **Citadel** and Altercel)

Chlormequat chloride is most commonly used on geraniums, hibiscus, poinsettias and osteospermum during production. Foliar chlormequat chloride applications can cause a phytotoxic response (chlorosis), but the symptoms are acceptable because they're usually covered by new leaf growth. In geraniums, poinsettias and herbaceous perennials, a mixture of daminozide and chlormequat chloride may be used, with both used or applied at reduced rates. This usually provides greater height control and reduces the potential for phytotoxicity. Substrate drenches are also effective, but not cost effective.

Daminozide

(Commercial names: **Dazide 85 WSG** and B-Nine)

Daminozide is applied only as a foliar spray because it's rapidly broken down when applied to the substrate. It's highly mobile in the plant and moves quickly from the point of application to all parts of the plant. Daminozide is effective on most crops except lilies. It's highly effective in controlling seedling growth in plug trays or flats and is most effective in cooler climates. Note: The Dazide 85 WSG label now has a 12-hour REI instead of the 24-hour REI previously required.

Dikegulac sodium

(Commercial name: Atrimmec)

Dikegulac sodium temporarily stops shoot elongation, thereby promoting lateral branching. The greenhouse version of dikegulac sodium, Augeo, is no longer on the market, however, Atrimmec is available and registered for greenhouse and nursery use. Dikegulac sodium functions as a growth retardant and a pinching agent for ornamental crops, including azaleas, bougainvillea, clerodendrum, fuchsia, geranium, grape ivy, lantana, lipstick vine, verbena and some of the herbaceous perennials. Be aware that Atrimmec typically causes greater phytotoxicity and distorted growth on herbaceous crops than Augeo did, so use caution—especially at higher rates—and allow sufficient time for new growth to cover any damaged leaves.

Ethephon phosphonic acid

(Commercial names: **Collate 2L** and Florel)

Ethephon phosphonic acid is absorbed by plant tissues, and due to a change in pH once absorbed into the plant cells, releases ethylene. Collate 2L and Florel are used to promote flower bud abortion, improve vegetative branching and provide growth control. Collate 2L and Florel are typically applied as a foliar spray at concentrations of 250 to 500 ppm. Collate 2L is the only ethephon product labeled for use as a drench application and is effective to control plant growth.

Flurprimidol

(Commercial name: Topflor)

Flurprimidol is chemically closely related to ancymidol, yet exhibits a greater degree of activity. Flurprimidol is one of the most cost-effective growth retardants to use as a drench, with recommended rates similar to ▶

Table 1. The wide assortment of plant growth regulators available for ornamental crops.

Chemical	Products
Ancymidol	**Abide**, A-Rest
Chlormequat chloride	**Citadel**, Altercel
Daminozide	**Dazide 85 WSG**, B-Nine
Dikegulac sodium	Atrimmec
Ethephon	**Collate 2L**, Florel
Flurprimidol	Topflor
Paclobutrazol	**Piccolo, Piccolo 10 XC**, Bonzi, Pac O, Downsize (drenches only)
Uniconazole	**Concise**, Sumagic
Benzyladenine (BA)	**Configure, Configure 9.5 SC**
Gibberellin (GA3)	**Florgib 4L**, ProGibb T&O
BA+GA_{4+7} Combinations	**Fresco**, Fascination
Indole-3-butyric Acid (IBA)	**Advocate**, Hortus IBA
Cytokinin+IBA+GA Combination	**Crest 10X**

Table 2. Comparing Attributes of Plant Growth Regulators

Attributes	Plant Growth Regulator							
Chemical	**Ancymidol**	**Chlormequat chloride**	**Daminozide**	**Daminozide + Chlormequat chloride**	**Ethephon**	**Flurprimidol**	**Paclobutrazol**	**Uniconazole**
Trade name(s)	**Abide,** A-Rest	**Citadel,** Altercel	**Dazide 85 WSG,** B-Nine	—	**Collate 2L,** Florel	Topflor	**Piccolo, Piccolo 10 XC,** Bonzi, Pac O, Downsize	**Concise,** Sumagic
Active ingredient (%)	**0.03%**	**11.80%**	**85.00%**	**—**	**21.7% / 3.9%**	**0.38%**	**0.4% / 4% (Piccolo 10 XC)**	**0.06%**
Restricted-entry interval (REI in hours)	12	12	12	12	48	12	12	12
Activity level	++	+	+	++	+	+++	+++	+++
Multiple applications needed	++	+++	+++	++	++	+	+	+
Application type[1]								
Foliar spray	yes	yes	yes	yes	yes	yes	yes[1]	yes
Substrate drench	yes	yes	no	no	no	yes	yes	yes
Dips/Soaks	plugs/liners	plugs/liners	cuttings	–	–	bulbs, plugs/ liners	bulbs, plugs/ liners	bulbs, plugs/ liners
Chemical absorption								
Ease of absorption	+++	+	+	+	++	+++	+++	+++
Time (hours)	0.5-1.0	4	18-24	18-24	12-16	0.5-1.0	0.5-1.0	0.5-1.0
Factors that improve absorption	high humidity, limited air movement, cloudy days, early morning or late afternoon applications							
Translocation within the plant	+++	+++	+++	+++	–	+	+	+
Absorption sites								
Leaves	+++	+++	+++	+++	+++	++	++	++
Stems	+	+	–	+	–	++	++	++
Roots	++	+	–	–	+	+++	+++	+++
Typical concentrations								
Foliar sprays (ppm or mg/L)	15-50	1,000-3,000	1,250-5,000	Daminozide: 750-5,000 + Chlormequat 750-1,500	250-1,000	1-80	1-200	0.5-50
Drench (mg active ingredient per pot)	0.15-4.0 (1.25 to 33.8 ppm)	177-355 (1,500 to 3,000 ppm)	–	–	–	0.01-2.0 (0.08 to 17 ppm)	0.01-8.0 (0.1 to 68 ppm)	0.01-1.0 (0.1 to 11 ppm)
Other factors								
Does pine bark substrates affect drenches?	++	–	–	–	–	++	++	++
Phytotoxicity potential	+	+++	+	+	++ (Do not apply to stressed plants)	+	+	+
Overdose potential	+	+	++	++	++	+++	+++	+++
Optimum water pH	5.5-6.5	3.0-7.0	5.0-9.0	–	below 5.0	–	4.0-9.0	5.5-6.5
Shelf life								
In the bottle (years)	<3	<2	<2	–	indefinite	<4	<4	<2
Mixed solution	within 24 hours	within 24 hours	within 24 hours	within 24 hours	within 4 hours	within 24 hours	Piccolo 10XC - within 24 hours. Other formulations within 4 hours with agitation.	within 24 hours

– = Not applicable.
Degree of activity: (+) least to (+++) greatest
[1] Check label for legal uses

uniconazole on most plants. Flurprimidol is also available in a granular formulation for containerized ornamentals.

Paclobutrazol

(Commercial names: **Piccolo, Piccolo 10 XC**, Bonzi, Pac O and Downsize [labeled for drench applications only])

Paclobutrazol is the most widely used growth retardant for greenhouse-grown floriculture crops. It's commonly applied as a foliar spray or a substrate drench. It can be applied as a single high-dose drench to provide season-long plant growth control or as a low-dose drench of 0.1 to 1 ppm to provide temporary plant growth control.

Uniconazole

(Commercial names: **Concise** and Sumagic)

Uniconazole is applied as a foliar spray, as a substrate drench or as a liner soak. As a drench, uniconazole is applied at rates 50% lower than those recommended for paclobutrazol. This chemical is commonly used on herbaceous perennials because it's highly effective on a very broad range of plant species.

Cautions

Paclobutrazol and uniconazole are both triazole plant growth retardants. Ancymidol and flurprimidol are both pyrimidine plant growth retardants. These chemistries do not readily move within the plant because they're transported in the xylem and not in the phloem. Therefore, all four chemicals are absorbed by the leaves, but aren't readily transported to other parts of the plant. Thus, apply foliar sprays with sufficient volume of water (2 qt. per 100 sq. ft.) to have some stem and substrate activity.

The activity of flurprimidol, paclobutrazol and uniconazole are long lasting even at very low rates, so the potential for error and crop overdose is greater than with other PGRs. Also note, ancymidol, flurprimidol, paclobutrazol and uniconazole persist on plastic surfaces and in substrate. Therefore, do not reuse plug or liner trays or flats, pots or substrate from treated plants, especially for plug production of sensitive crops.

Other Growth Regulators

Not all plant growth regulators are used to control plant height. Others are used to cause flower bud abscission, increase branching, promote flowering, stimulate shoot elongation and aid in rooting. Each label of plant growth regulators used to promote growth, branching and root initiation has specific recommended dose ranges, recommendations and precautions (Table 3).

Benzyladenine

(Commercial name: **Configure and Configure 9.5 SC**)

Benzyladenine (BA) is used to promote branching and increase flower set, but because it doesn't readily move within the plant, complete coverage is required. Configure and Configure 9.5 SC have specific label recommendations for Christmas cactus, echinacea and hosta, as well as use directions for experimental applications on any annual, perennial, foliage or tropical plant grown in a greenhouse. Optimal results occur when the plant is actively growing and is physiologically receptive for growth or flower promotion. Configure and Configure 9.5 SC are very effective in improving branching of many herbaceous perennial crops, as both liners and finished plants.

Gibberellins

(Commercial names: **Florgib 4L** and ProGibb T&O)

Gibberellins can be applied to promote growth and overcome an over-application of gibberellin-inhibiting plant growth retardants. They're also used to promote stem elongation for tree forms of plants such as poinsettias.

Benzyladenine + Gibberellin Combinations

(Commercial names: **Fresco** and Fascination)

These combination products are used on potted lilies as foliar sprays to avoid lower leaf yellowing and leaf drop, plus prolonging flower life. They're also used to overcome the effects of an over-application of gibberellin-inhibiting plant growth retardants.

Indole-3-butyric Acid

(Commercial names: **Advocate** and Hortus IBA)

Indole-3-butyric acid (IBA) is used to promote adventitious root formation in unrooted cuttings. This material can be applied as a total immersion, spray, and basal quick and long dips. It's highly mobile in the plant and effective as a spray. Growers often apply IBA as a foliar spray 24 hours after cutting stick.

Cytokinin + Indole-3-butyric Acid + Gibberellin Combination

(Commercial name: **Crest 10X**)

This material is a plant biostimulant used to reduce apical dominance and promote bud differentiation, cell division, root initiation and early shoot growth in greenhouse crops. Crest 10X can be applied as a foliar spray, sprench, drench, or through irrigation or fertilizer solution. Application can occur during seed or cutting propagation, transplanting and crop production. ■

Table 3. Comparing Attributes of Plant Growth Regulators for Growth Promotion, Branching, and Root Initiation

Attributes	Plant Growth Regulator				
Chemical	**Benzyladenine**	**Gibberellins**	**Benzyladenine + Gibberellins**	**Indole-3-butyric Acid**	**Cytokinin + Indole-3-butyric Acid + Gibberellins**
Trade name(s)	**Configure, Configure 9.5 SC**	**Florgib 4L**, ProGibb T&O	**Fresco**, Fascination	**Advocate**, Hortus IBA	**Crest 10X**
Active ingredient (%)	**2.0% / 9.51%**	**4.00%**	**1.8% + 1.8%**	**20.00%**	**0.10% + 0.05% + 0.05%**
Restricted-entry interval (REI in hours)	12	4	4	12	4
Activity level	++	++	+++	++	+
Multiple applications needed	++	+	+	++	++
Application type[1]					
Foliar spray	yes	yes	yes	Unrooted cuttings	yes
Substrate drench	no	yes	only Fresco	Unrooted cuttings	yes
Dips/Soaks	no	yes	no	Unrooted cuttings	no
Chemical absorption					
Ease of absorption	++	+++	+++	+++	++
Time (hours)	<4	<4	<4	0.5-1.0	<4
Factors that improve absorption	high humidity, limited air movement, cloudy days, early morning or late afternoon applications				
Translocation within the plant	+++	+++	+++	+++	++
Absorption sites					
Leaves	+++	+++	+++	+++	+++
Stems	+	++	+++	+++	++
Roots	++	++	+++	–	+++
Typical concentrations					
Foliar sprays (ppm or mg/L)	50-3,000	0.5-50	1/1-5/5	100-400	refer to label
Drench (mg active ingredient per pot)	–	unknown	<5	–	refer to label
Other factors					
Does pine bark substrates affect drenches?	–	–	–	–	–
Phytotoxicity potential	+	+	+ (>10 ppm)	+	+
Overdose potential	+	+	+	+	+
Optimum water pH	5.5 to 7.0 Keep below 8.0	below 8.5	below 6.0	unknown	below 7.0
Shelf life					
In the bottle (years)	<3	<3	<3	<2	<3
Mixed solution	within 24 hours	within 24 hours	within 24 hours	within 24 hours	within 24 hours

– = Not applicable.
Degree of activity: (+) least to (+++) greatest
[1] Check label for legal uses

Growth Regulators for Containerized Herbaceous Perennial Plants

By W. Garrett Owen, The Ohio State University

This table summarizes labeled rates of plant growth regulators (PGRs) for containerized herbaceous perennial crops and provides recommendations based on research from The Ohio State University, Virginia Tech and other published sources, or grower and supplier experience. Recommendations are color-coded by source.

Spray rates listed within this table are recommended as applications at the label-recommended volume of 1 gal. per 200 sq. ft. unless otherwise stated. Always consult product labels for a complete listing of precautions, recommended use rates and crops. Not all recommended use rates and crops are listed on the label.

When using any PGR for the first time, always trial the rate on a few plants and compare the results to untreated plants before treating an entire crop. Use the rates listed within this table as starting points for your own PGR trials. The level of control can vary depending on several factors, including plant type, cultivar, stage of development, fertilization program, growing temperatures, crop spacing, and PGR application method and volume. Keep in mind that sunbelt growers should consider trialing the upper half of the rate range, while northern growers—especially under lower light conditions—should begin trials at the lower end of the rate range. Also, keep accurate records and adjust rates for your location.

For product mixing instructions, see the PGR Dilution Table on page 75.

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Achillea millefolium (Common Yarrow)	To control plant growth	**Abide**/A-Rest	Greater than 1.5 mg a.i. drench x 1	Summer Pastels – moderate control; Test higher than 1.5 mg a.i. drench rates (3.3 fl. oz./pot); Drench volume and mg a.i. vary with container size	South
			1 to 2 ppm drench x 1	Drench volume and mg a.i. vary with container size	Unspecified
			50 to 100 ppm spray x 1	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
		Collate 2L/Florel	500 or 1,000 ppm spray x 1 to 3	Higher rates or more frequent treatment gave moderate growth control; All treatments increased number of inflorescences with slight delay in flowering	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2	Red Beauty and Paprika – good control with 2 applications 2 weeks apart; Moonshine – less responsive	South
			2,500 to 5,000 ppm spray x 2 to 3	Tutti Frutti – 2,500 ppm daminozide applied at weekly intervals until desired control is established; Apply lower rates early in production and higher rates later under better growing conditions	North
			Tank mix	2,000 ppm daminozide plus 3 ppm uniconazole applied at weekly intervals until desired control is established	
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Paprika	South
			3,000 + 1,500 ppm spray x 4	Summer Pastels – at 2-week intervals	North
		Citadel/Altercel	Not responsive at 5,000 ppm spray x 1	Coronation Gold – not responsive	South
			1,500 ppm spray x 4	Summer Pastels – at 2-week intervals	North

* Mixing Rate Table on page 75

Color Code: Gold = Sunbelt sources; Blue = Northern sources; White = No specification; Pink = Increase branching recommendations

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Achillea millefolium (Common Yarrow) *continued*	To control plant growth *continued*	**Piccolo**/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	96 to 120 ppm spray x 1	Coronation Gold, Summer Pastels	South
			60 ppm spray x 4	Summer Pastels – at 2-week intervals	North
			1.0 mg a.i. drench x 1	Summer Pastels – good control with a 1.0 mg a.i. drench (3.3 fl. oz./ pot); Drench volume and mg a.i. vary with container size	South
			1 to 2 ppm drench x 1	Multiple applications may be necessary; Drench volume and mg a.i. vary with container size	Unspecified
		Concise/Sumagic	10 to 30 ppm spray x 1	Paprika and Coronation Gold – excellent control at lower rates; Red Beauty and Moonshine not responsive at 60 ppm spray x 1	South
			0.25 mg a.i. drench x 1	Summer Pastels; Higher than 0.25 mg a.i. drench rates reduced number of flowers (3.3 fl. oz./pot); Drench volume and mg a.i. vary with container size	
			7 to 15 ppm spray x 1 to 4	Apply lower rates early in production and higher rates later under better growing conditions; Summer Pastels – 15 ppm sprays x4 at 2-week intervals	North
		Topflor	150 ppm spray x 1	Coronation Gold – multiple applications may be required	South
	To increase lateral or basal branching	**Configure**/ **Configure 9.5 SC**	600 ppm spray x 2	Moonshine – 60% increase in branching when applied as liner (21 days after sticking) and again at 5 days after transplanting; No phytotoxicity	Branching
Agastache hybrids (Anise Hyssop)	To root cuttings	**Advocate**/Hortus IBA	200 to 400 ppm x 1 spray	Blue Fortune – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	South
	To control plant growth	**Collate 2L**/Florel	500 ppm spray x 4	Blue Fortune – excessive height control, but no delay in flowering; applied at 2-week intervals	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2 to 3	Blue Fortune	South
			1,200 to 5,000 ppm spray x 1 to 3	All hybrids; Weekly applications as necessary	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Blue Fortune	South
			2,500 + 1,000 ppm spray to 5,000 + 1,500 ppm spray x 2 to 3	Weekly applications as necessary	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	1 to 2 ppm drench x 1	Drench volume and mg a.i. vary with container size	North
			30 to 60 ppm spray x 1	Good control	
			80 to 160 ppm spray x 1	Tutti Frutti – use lower rates; Purple Haze – use higher rates; Multiple applications may be required	South
			Less than 5 ppm drench x 1	Tutti Frutti – stunted at 5 ppm at 2 fl.oz. per quart pot; Purple Haze – excellent control with 8 ppm drench at 10 fl. oz. per trade gallon pot; Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	10 to 30 ppm spray x 1	Cultivar variation, Blue Fortune, Blue Boa – use lower rates; Purple Haze – use higher rates	South
			2 ppm drench x 1	Purple Haze – Drench at 10 fl. oz. per trade gallon pot; Drench volume and mg a.i. vary with container size	
			Less than 1 ppm liner soak x 1 or 1 ppm liner drench x 1	Blue Boa – excessive growth control after liner soak or drench (0.3 fl. oz. per 72-size cell) just prior to transplanting; reduce rate	
			5 to 10 ppm spray x 1	Good control	North
	To enhance lateral branching	**Configure**/ **Configure 9.5 SC**	300 to 500 ppm spray x 1 on liners	Purple Haze – 300 ppm at 4 days after liners were removed from mist increased lateral branching; Multiple applications during liner production or higher rates decreased root growth. Tutti Frutti – 500 ppm spray the day after removal from mist increased branching of liners and finished plants	Branching

(PGRs in **bold typeface** are from Fine Americas, Inc.)

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Ajuga reptans (Bugleweed)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2500 ppm spray x 1	Multiple applications may be required	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	1 to 2 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	2.5 ppm spray x 1	Use caution in applying uniconazole as plants can be very sensitive	North
		Collate 2L/Florel	300 to 500 ppm spray x 1 on liners	For branching	Branching
Alcea hybrids (Hollyhock)	To control plant growth	**Abide**/A-Rest	100 ppm spray x 6	Chaters Doubles – weekly sprays	North
		Citadel/Altercel	500 ppm spray x 3+	Alcea Spring Celebrities Series – weekly after true leaf appears with no more than 3 applications on plugs. For finishing, as needed until buds appear. Stop PGR applications when bud emergence is detected to prevent deformation of flowers	Unspecified
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 6	Chaters Doubles – weekly sprays	North
			2,500 ppm spray x 3+	For Alcea Spring Celebrities Series – apply weekly after true leaf appears with no more than 3 applications on plugs. For finishing, as needed until buds appear. Stop PGR applications when bud emergence is detected to prevent deformation of flowers	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	15 ppm spray x 1	Effective early in crop cycle	North
			3 to 6 ppm drench x 1	Drench late in crop to counter rapid elongation that occurs as the plants approach flowering; Drench volume and mg a.i. vary with container size	
			0.5 ppm drench x 1	Alcea Spring Celebrities Series – light drench when initial flower spike has extended to 6-8 inches will keep plant more compact for shipping; Drench volume and mg a.i. vary with container size	Unspecified
		Concise/Sumagic	2.5 ppm spray x 1	Early treatment most effective	North
Alchemilla mollis (Lady's Mantle)	To control plant growth	**Dazide 85 WSG**/ B-Nine	Not responsive at 5,000 ppm spray x 2	Not responsive	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Multiple applications at 10- to 14-day intervals may be necessary	South
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Not responsive at 200 ppm spray x 1	Not responsive	South
			30 ppm spray x 1 to 3	Multiple applications may be necessary	Unspecified
			6 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	Not responsive at 90 ppm spray x 1	Not responsive	South
Amsonia (Blue Star)	To control plant growth	**Piccolo**/**Piccolo 10 XC**/Bonzi/Pac O	30 ppm spray x 1	Storm Cloud – apply when plant is 4 to 6 inches tall	North
		Concise/Sumagic	5 ppm spray x 1	Multiple applications may be necessary	North
			1 ppm drench x 1	Drench volume and mg a.i. vary with container size	
Aeonium hybrid (Succulent)	Increase offsets	**Configure**/ **Configure 9.5 SC**	Not responsive at 50 to 400 ppm spray x 1	Single foliar spray applied 2 weeks after potting	Branching
Agave hybrid (*A. guiengola A. gemniflora*)	Increase offsets	**Configure**/ **Configure 9.5 SC**	Not responsive at 100 to 800 ppm spray x 2	Two foliar sprays applied 1 month apart, starting 6 weeks after potting	Branching
Alpinia purpurata (Red Ginger)	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	Not responsive at 100 ppm soak x 1	Foliar soak of rooted plants	Branching

* Mixing Rate Table on page 75

Color Code: Gold = Sunbelt sources; Blue = Northern sources; White = No specification; Pink = Increase branching recommendations

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Aquilegia* × *hybrida (Hybrid Columbine)	To control plant growth, apply as flower stalks get above foliage	**Abide**/A-Rest	25 ppm spray x 2 to 3	Apply weekly sprays	North
			25 to 50 ppm spray x 1	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	
			65 to 132 ppm spray x 1	Apply when plants are well-rooted with 5 to 8 leaves	Unspecified
			2 to 4 ppm drench x 1	Apply when plants are well-rooted with 5 to 8 leaves	
		Collate 2L/Florel	Not responsive at 750 ppm sprays x 5	Pink & White – height and flowering not responsive to weekly sprays	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2	McKana Giants	South
			5,000 ppm spray x 4 to 5	Music Pink & White – excellent control with 4 applications at 2-week intervals; Origami Blue & White and Pink & White – excellent control with 5 weekly applications	North
			Tank Mix	Songbird F1, Swan F1 Series, Star Series – tank mix spray of 1,875 to 2,000 ppm daminozide + 10 ppm ancymidol as needed	
			Tank Mix	Tank mix spray of 2,000 ppm daminozide + 3 ppm uniconazole x 2 to 3 weekly	
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	2,500 ppm + 1,000 ppm spray x 2 to 3	Apply as flower stalks get above foliage; weekly applications	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Not responsive at 240 ppm spray x 1	McKana Giants was not responsive	South
			30 ppm spray x 2 to 3	Apply weekly Origami Blue & White and Pink & White – not responsive at 90 ppm sprays x 5 weekly applications	North
			30 ppm spray x 1 to 3	Multiple applications may be necessary	Unspecified
			6 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	Not responsive at 120 ppm spray x 1	McKana Giants – not responsive	South
			5 to 15 ppm spray x 2 to 4	Apply 5 ppm sprays 2 to 3 weekly; Music Pink & White and Origami Blue & White – good control with 15 ppm sprays x 4 to 5	North
Aquilegia flabellate (Columbine)	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	Not responsive at 50 to 1,600 ppm spray x 1	No effect of single foliar spray applied 2 weeks after potting	Branching
Aquilegia vulgaris (Columbine)	To control plant growth	**Dazide 85 WSG**/ B-Nine	1,500 to 2,500 ppm spray x 1	Clementine, Winky Double and Winkly Single Series – multiple applications may be necessary	Unspecified
	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	Not responsive at 600 ppm spray x 1	Winky Purple White – no effect with our screening rate; Test multiple applications or higher rates	Branching
Arenaria montana (Sandwort)	To control plant growth	**Piccolo**/**Piccolo 10 XC**/Bonzi/Pac O	5 ppm spray x 1 on liners	Avalanche – liners were responsive	South
Artemisia arborescens (Powis Castle)	To control plant growth	**Collate 2L**/Florel	300 to 500 ppm spray x 1 on liners	Liners	Unspecified
		Dazide 85 WSG/ B-Nine	2,500 ppm spray x 2 to 3	Multiple applications as needed	
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	5 to 40 ppm spray x 1	Responsive to 5 to 40 ppm paclobutrazol sprays	
		Concise/Sumagic	5 to 8 ppm spray x 1	Multiple applications may be required	

(PGRs in **bold typeface** are from Fine Americas, Inc.)

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Artemisia schmidtiana (Wormwood, White Sage)	To control plant growth	**Collate 2L**/Florel	300 to 500 ppm spray x 1 on liners	Liners	Unspecified
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2	Silver Mound – moderate control with multiple applications	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Silver Mound – multiple applications may be required	South
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	50 to 200 ppm spray x 1	Silver Mound – may require multiple applications	South
			40 to 50 ppm spray x 1	Responsive; may require multiple applications	Unspecified
			6+ ppm drench x 1	Drench volume and mg a.i. vary with container size	North
		Concise/Sumagic	30 to 60 ppm spray x 1	Cultivars vary in response; Oriental Limelight – sensitive; Silver Mound – moderate; Powis Castle – less responsive; Multiple applications may be necessary	South
Aruncus hybrid (Goat's Beard)	To control plant growth	**Concise**/Sumagic	5 ppm spray x 1	Apply 3 to 4 weeks after transplanting. Multiple applications may be needed at 7 to 10 day intervals	North
Asclepias tuberosa (Butterfly Weed)	To control plant growth	**Abide**/A-Rest	25 to 50 ppm spray x 1 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
			26 ppm spray x 1	Multiple applications may be required	Unspecified
			2 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Dazide 85 WSG/ B-Nine	Not responsive at 5,000 ppm spray x 3	Not responsive	South
			3,750 to 5,000 ppm spray	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 1	Not responsive	South
			2,500 + 1,500 ppm spray x 1	Label rate for Royal Red (Altercel)	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Not responsive at 50 ppm spray x 1	Hello Yellow – no effect on plant height, but reduced width	South
			Not responsive at 2 ppm drench x 1	Drenches applied at 2 fl. oz. per quart pot; Drench volume and mg a.i. vary with container size	
			10 to 20 ppm spray x 1 to 2	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
			30 to 60 ppm spray x 1	Label rate	Unspecified
		Concise/Sumagic	45 ppm spray x 1	Good control	South
			5 to 10 ppm spray x 1	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
	To induce lateral branching	**Configure**/ **Configure 9.5 SC**	Not responsive at 600 ppm spray x 1	Higher rates or multiple applications may be effective	Branching

* Mixing Rate Table on page 75

Color Code:
- Gold = Sunbelt sources
- Blue = Northern sources
- White = No specification
- Pink = Increase branching recommendations

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Aster dumosus [*Symphyotrichum dumosum*] (Bushy Aster) ***Aster x frikartii*** (Frikart's Aster) ***Aster novae-angliae*** (New England Aster)	To control plant growth	**Dazide 85 WSG**/ B-Nine	5,000 ppm spray x 2	Apply first application after pinching when new shoots are approximately 1-in. long	South
			2,500 to 4,000 ppm spray x 1 to 3	Apply first application after pinching when new shoots are approximately 1-in. long; Rates vary depending on variety vigor, temperature and growth stage of the crop; Do not apply daminozide after buds reach pea size to avoid flower discoloration and delay	Unspecified
			2,500 ppm spray x 2	Good control	North
			Tank mix	Tank mix of 2,000 ppm daminozide + 3 ppm uniconazole sprays x 1 to 2	
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 1	*A. dumosus* Sapphire – not responsive to this rate	South
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	80 ppm spray x 1	*A. dumosus* Sapphire; *A. x frikartii* Monarch and Monch – not responsive to 240 ppm spray x 1	South
			2 to 16 ppm drench x 1	*A. x frikartii* Monarch and Monch – responsive; Drench applied at 2 fl. oz. per quart pot; Volume and mg a.i. vary with container size	
			30 ppm spray x 1 to 2	Apply 7 to 10 days apart	North
			6+ ppm drench x 1	Drench volume and mg a.i. vary with container size	
			30 to 50 ppm sprays x 1	Multiple applications may be required	Unspecified
			2 ppm drench x 1	Some growers use a paclobutrazol drench to hold their crop at a given height; Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	30 ppm spray x 1	*A. dumosus* Sapphire; *A. x frikartii* Alpine Mix, Monarch and Monch – not responsive to 60 ppm spray x 1	South
			2.5 to 10 ppm spray x 1	Very effective, but results have been quite variable; Multiple applications may be required	Unspecified
			0.1 to 1.0 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Topflor	Not responsive at 60 ppm spray x 1	*A. dumosus* Sapphire – not responsive in fall trial	South
	To induce lateral branching	**Collate 2L**/Florel	300 to 500 spray x 1 on liners	Liners responsive	Branching
		Configure/ **Configure 9.5 SC**	Phytotoxic at 600 ppm spray x 1	Significant phytotoxic response with a single spray applied to liners or transplanted plants	Branching
Astilbe × arendsii (False Spirea) ***Astilbe chinensis*** (Chinese Astilbe) ***Astilbe thunbergii*** (False Spirea)	To control plant growth	**Abide**/A-Rest	100 ppm spray x 6	*A. thunbergii* Ostrich Plume – weekly applications; A. arendsii Granat – no control with 4 sprays at 2-week intervals	North
		Collate 2L/Florel	500 ppm spray x 4	*A. arendsii* Granat – stunting with 4 sprays at 2-week intervals; Did not delay flowering	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2	Timing is critical; Apply 2 sprays 1 week apart beginning soon after inflorescences begin to elongate; Growth regulators were ineffective when they were applied prior to inflorescence elongation	North
			Less than 5,000 ppm spray x 2	*A. chinensis* Purpurkerze – stunted, use lower rate and/or fewer applications; *A. x arendsii* Elizabeth Bloom – not responsive to 5,000 ppm x 2	South
			5,000 ppm spray x 6	*A. thunbergii* Ostrich Plume – weekly applications; A. arendsii Granat – no control with 4 sprays at 2-week intervals	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Less than 5,000 + 1,500 ppm spray x 1	*A. chinensis* Purpurkerze stunted; Reduce both daminozide and chlormequat rates	South

(PGRs in **bold typeface** are from Fine Americas, Inc.)

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Astilbe* × *arendsii (False Spirea) ***Astilbe chinensis*** (Chinese Astilbe) ***Astilbe thunbergii*** (False Spirea) ***continued***	To control plant growth ***continued***	**Citadel**/Altercel	1,500 ppm spray x 1	*A. chinensis* Purpurkerze – moderate control	South
			750 to 1,500 ppm spray x 1 to 3	Apply lower rates early in production and higher rates later under better growing conditions *A. thunbergii* Ostrich Plume – weekly applications of 1,500 ppm x 6; *A. arendsii* Granat – no control with 1,500 x 4 at 2-week intervals	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	40 to 80 ppm spray x 1 to 2	*A. chinensis* Purpurkerze – good control with 40 ppm x 1 A. x arendsii Elizabeth Bloom – use multiple applications of 80 ppm	South
			30 ppm spray x 2	Apply weekly after inflorescences begin to elongate	North
			6+ ppm drench x 1	Treat after inflorescences begin to elongate: Drench volume and mg a.i. vary with container size	
			90 ppm spray x 6	*A. thunbergii* Ostrich Plume – weekly applications; *A. arendsii* Granat – no control with 4 sprays at 2-week intervals	
		Concise/Sumagic	25 to 35 ppm spray x 1 to 2	*A. chinensis* Purpurkerze – good control with 1 spray A. x arendsii Elizabeth Bloom – use multiple applications	South
			15 ppm spray x 6	*A. thunbergii* Ostrich Plume – 15 ppm spray x 6 weekly resulted in excellent control; *A. arendsii* Granat – 15 ppm spray x 4 at 2-week intervals resulted in stunting	North
			5 ppm spray x 2 to 3	Apply to *A. arendsii* 2 to 3 weeks after transplant; Multiple applications at 7- to 10-day intervals as necessary; Apply when flower stems begin to appear above foliage	
Baptisia australis (Blue Wild Indigo) ***Baptisia hybrids*** (False Indigo)	To control plant growth	**Piccolo**/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	45 to 60 ppm spray x 2 to 3	Decadence, Baptisia hybrids – apply when plants are 6-inches tall; Multiple applications required	North
			6 to 18 ppm drench x 1	Decadence, Baptisia hybrids – apply when plants are 6-inches tall; Drench is more effective than sprays; Drench volume and mg a.i. will vary with container size	
		Concise/Sumagic	1 ppm drench x 1 at 6 inches in height	American Goldfinch or Pink Lemonade – follow drench with 5 ppm sprays for additional control as needed; Drench volume and mg a.i. will vary with container size	North
			Not responsive to 60 ppm spray x 1	Test higher rates or multiple spray applications	South
			1.5 ppm drench x 1	Drench volume and mg a.i. will vary with container size	
Bellis perennis (Common Daisy)	To control plant growth	**Dazide 85 WSG**/ B-Nine	1,000 to 2,000 ppm spray x 1 to 2	Multiple applications may be required	North
Boronia heterophylla (Red Boronia)	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	100 ppm foliar spray x 6 on mature plants	Mature plants in mid-fall – spray every 3 days for 18 days increased branching over pinching; Transient phytotoxicity noted.	Branching
			50 ppm foliar spray x 4 on rooted cuttings	Rooted cuttings in mid-fall – spray every 2 days for 4 to 8 days. Higher rates and more applications caused phytotoxicity and reduced flowering	
Boronia metastigma (Brown Boronia)	Induce lateral branching and additional cuttings	**Configure**/ **Configure 9.5 SC**	100 ppm foliar spray x 3	Weekly sprays starting 2 months prior to taking cuttings increased branching but subsequent cuttings rooted very poorly compared to control	Branching
Brunnera macrophylla (Heartleaf Brunnera)	To control plant growth	**Concise**/Sumagic	5 to 10 ppm spray x 1	Jack Frost – apply 2 weeks after transplant.	North
			0.875 to 5 ppm drench x 1	Jack Frost – apply 2 weeks after transplant; Good growth control with drench; Drench volume and mg a.i. will vary with container size	

* Mixing Rate Table on page 75

Color Code: Gold = Sunbelt sources; Blue = Northern sources; White = No specification; Pink = Increase branching recommendations

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Buddleia davidii (Butterfly Bush)	To control plant growth	**Collate 2L**/Florel	300 to 500 ppm spray x 1 on liners	Liners responsive	Unspecified
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2	Royal Red good but no control of Pink Delight; Apply at 10- to 14-day intervals	South
			2,500 ppm spray x 2+	Multiple applications as needed	Unspecified
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 1	Royal Red, Pink Delight – not responsive	South
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Not responsive at 160 ppm spray x 1	Royal Red not responsive	South
			Not responsive at 10 ppm drench x 1	Royal Red not responsive; Drench applied at 10 fl. oz. per trade gal. pot (~3 mg a.i.); Volume and mg a.i. vary with container size	
			10 mg a.i drench x 1	Dubonnet – good control with drench (3.3 fl .oz./2.8-L pot); Drench volume and mg a.i. vary with container size	
			5 to 40 ppm spray x 2	Multiple applications as needed	Unspecified
			6 ppm drench x 1	Drench volume and mg a.i. vary with container size	North
		Concise/Sumagic	60 ppm spray x 1	Moderate control of Royal Red; Multiple applications may be required;	South
			0.025 ppm drench x 1	Drench applied at 10 fl. oz. per trade gal. pot; Volume and mg a.i. vary with container size	
			20 ppm spray x 2	Moderate height control of Pink Delight with 2 applications 7 days apart; Additional applications may be necessary	
			5 ppm spray x 1 to 2	Begin PGR applications about 2 weeks following the pinch and reapply at 7 to 10 day intervals if additional control is necessary	North
		Topflor	125 ppm spray x 1	Good control of growth of Royal Red with no delay in flowering	South
Buddleia fallowiana Lochinch (Butterfly Bush)	To control plant growth	**Concise**/Sumagic	60 ppm spray x 2 to 3	Multiple applications required	South
			1.5 ppm drench x 1	Drench applied at 10 fl. oz. per trade gal. pot; Drench volume and mg a.i. vary with container size	
Buddleia weyeriana Honeycomb (Butterfly Bush)	To control plant growth	**Piccolo**/**Piccolo 10 XC**/Bonzi/Pac O	4 ppm liner soak x 1	Good control	South
		Concise/Sumagic	2 ppm liner soak x 1	Moderate control	South
Caladium bicolor (Caladium)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 ppm spray x 6 to 8	As needed at 5- to 7-day intervals	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	30 ppm spray x 1	Apply near end of crop cycle to improve shelf life	North
			8 ppm drench x 1	Drench when shoots have emerged but before leaves unfold (approximately 2 to 3 weeks after potting); Drench volume and mg a.i. vary with container size	
Calamagrostis × acutifolia Karl Foerster (Feather Reed Grass)	To control plant growth	**Dazide 85 WSG**/ B-Nine	Not responsive at 5,000 ppm spray x 2	Not responsive	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000+1,500 ppm spray x 2	Good height control with Karl Foerster	South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	Not responsive to 160 ppm spray x 1	Not responsive	South

(PGRs in **bold typeface** are from Fine Americas, Inc.)

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Calamagrostis × acutifolia Karl Foerster (Feather Reed Grass) *continued*	To control plant growth *continued*	**Concise**/Sumagic	Not responsive to 60 ppm spray x 1	Not responsive	South
			1 ppm liner soak x 1	Good height control with a 2-minute liner soak	
		Topflor	Not responsive to 120 ppm spray x 1	Not responsive	South
Campanula carpatica (Carpathian Bellflower) ***Campanula glomerata*** (Clustered Bellflower) ***Campanula persicifolia*** (Peach-Leaved Bellflower)	To control plant growth *C. carpatica* cultivars usually do not require PGRs, but are responsive to most of them. Under low-light conditions or for toning and shaping, one application is usually sufficient. If necessary, make a second application 7 to 10 days after the first	**Abide**/A-Rest	25 to 50 ppm spray x 1	*C. carpatica* or *C. persicifolia* may require 50 ppm sprays, especially later in the spring; Multiple applications may be required	North
			100 ppm spray x 6	*C. glomerata* – Very good control on Kent Belle and Birch Hybrid with weekly applications; Superba not responsive; Cherry Bells stunted	
		Collate 2L/Florel	500 ppm spray x 4	*C. glomerata* – Superba good control with 4 sprays at 2-week intervals; No delay in flowering. Phytotoxic to Campanula Kent Belle; Did not reduce flower buds; Reduced growth	North
		Dazide 85 WSG/ B-Nine	2,500 to 3,750 ppm spray x 1 to 2	*C. carpatica* or *C. persicifolia* may require the higher rates, especially later in the spring; Apply just as the flower stems are beginning to elongate; Multiple applications 7 days apart may be required	North
		Citadel/Altercel	750 ppm spray x 1	*C. carpatica* – Multiple applications may be required	North
			Less than 1,500 ppm spray x 3	Label rate C. carpatica; Excessive height reduction; Reduce rate or frequency (Altercel)	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	10 to 20 ppm spray x 1	*C. carpatica* cultivars are very sensitive to paclobutrazol; Multiple applications may be required, especially later in the spring	North
			15 ppm spray x 1 to 3	*C. carpatica* – Multiple spray applications may be necessary	Unspecified
			3 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	2 to 4 ppm spray x 1	*C. carpatica* cultivars are very sensitive to uniconazole; Multiple applications may be required, especially later in the spring	North
		Topflor	10 to 30 ppm spray x 1	Rate range determined largely under mid-Atlantic conditions using medium-vigor cultivars; Adjust for your area (Label)	Unspecified
Canna × generalis (Canna Lily) ***Canna × orchiodes*** (Hybrid Canna)	To control plant growth	**Dazide 85 WSG**/ B-Nine	Not responsive at 7,500 ppm spray x 1	No growth reduction, but delayed flowering	South
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	66 to 99 ppm spray x 1	*C. x orchiodes* requires higher rates	South
			1 to 4 ppm drench x 1	For height control of Cannova Series; apply 2 weeks after transplant at volume appropriate for the growing container; Drench volume and mg a.i. vary with container size	Unspecified
		Topflor	Less than 50 ppm spray x 1	*C. x orchiodes* growth reduced about 40% up to 8 weeks after treatment; No delay in flowering	South
			50 to 80 ppm spray x 1	Rate range determined largely under mid-Atlantic conditions using medium-vigor cultivars; Adjust for your area (Label)	Unspecified
Carex buchananii (Leatherleaf Sedge) ***Carex comans*** (Hair Sedge) ***Carex flagellifera*** (Weeping Brown Sedge)	To control plant growth	**Concise**/Sumagic	20 ppm spray x 1	Moderate height control of *C. flagellifera* Toffee Twist with an increase in early tillers. Use lower rate on *C. buchananii* and *C. comans* Frosted Curls; this rate stunted both cultivars and reduced number of tillers on Frosted Curls	South
	To increase tillering	**Configure**/ **Configure 9.5 SC**	Not responsive at 500 or 1,000 ppm spray x 1	No increase in number of tillers on *C. buchananii, C. comans* Frosted Curls, *C. flagellifera* Toffee Twist up to 8 weeks after treatment; No effect on plant height	Branching

* Mixing Rate Table on page 75

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Caryopteris × clandonensis (Bluebeard)	To control plant growth	**Dazide 85 WSG**/ B-Nine	Not responsive at 5,000 ppm spray x 2	Dark Knight – not responsive	South
			2,500 ppm spray x 1 to 2	Multiple spray applications may be necessary	Unspecified
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000/1,500 ppm spray x 1	Dark Knight – not responsive	South
		Piccolo/**Piccolo 10 XC**/Bonzi/Paczo	Not responsive at 160 ppm spray x 1	Dark Knight – not responsive	South
			5 to 40 ppm spray x 1 to 2	Multiple spray applications may be necessary	Unspecified
		Concise/Sumagic	30 ppm spray x 1	Good control of Dark Knight	South
			5 to 8 ppm spray x 1 to 2	Multiple spray applications may be necessary	Unspecified
Centaurea montana (Bachelor's Button)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 to 5,000 ppm spray x 1 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
		Concise/Sumagic	7 to 15 ppm spray	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
Clematis ×hybrida (Clematis)	Induce lateral branching	**Collate 2L**/Florel	500 to 1000 ppm spray	H.F. Young – Apply during bulking to increase lateral branching	Branching
Coreopsis auriculata (Lobed Tickseed)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Leading Lady Iron and Limoncello Golden – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Collate 2L**	125 to 750 ppm drench x 1	Leading Lady Iron – apply 10 days after transplant; Controlled plant height and diameter; No delay in flowering observed; Lower leaf chlorosis at >750 ppm; Drench volume varies with container size	North
Coreopsis grandiflora (Tickseed)	To control plant growth	**Abide**/A-Rest	0.375 mg a.i. drench x 1	Moderate growth control of Early Sunrise and enhanced flowering with 3.3 fl. oz./pot; Drench volume and mg a.i. vary with container size	South
			25 to 50 ppm spray x 2 to 3	Apply at weekly intervals	North
		Dazide 85 WSG/ B-Nine	2,500 to 5,000 ppm spray x 2	Lower rates on liners; Good control of Sunray with multiple applications to 10- to 14-day intervals under nursery conditions	South
			2,500 to 5,000 ppm spray x 2 to 3	Apply one week after pinching to control growth of SunKiss or Utopia Series cultivars; Apply lower rates early in production and 5,000 ppm later under better growing conditions; Multiple applications may be required	North
			Tank Mix	Tank mix spray of 2,000 ppm daminozide + 15 ppm paclobutrazol x 2 to 3	
				Tank mix spray of 2,000 ppm daminozide + 3 ppm uniconazole	
			5,000 ppm spray x 2	Foliar sprays at 5,000 ppm applied twice after transplant work well; First application can be done 2 weeks after transplant followed by a second application 2 weeks later; Early Sunrise requires more PGRs than Rising Sun or Sunfire	Unspecified
		Citadel/Altercel	1,250 to 1,500 ppm spray x 2 to 3	Apply at weekly intervals; 3 applications of 1,500 ppm at 10-day intervals resulted in moderate growth reduction of Sunray	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Moderate control of Sunray; Multiple applications may be required; much lower rates on liners	South
			2,500 + 1,000 ppm spray x 2 to 3	Apply at weekly intervals	North
			Greater than 2,500 + 1,500 ppm spray x 1	Label rate: Increase daminozide rate for better control of Baby Sun and Sunray (Altercel)	Unspecified

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Coreopsis grandiflora (Tickseed) *continued*	To control plant growth *continued*	**Piccolo/Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Less than 5 ppm spray x 1 for liners	Excessive control with Baby Sun plugs in California	South
			80 to 100 ppm spray x 1	Sunray and Baby Sun responsive	
			5 to 10 ppm drench x 1	Sunray and Baby Sun; Drenches applied at 2 fl. oz. per qt. pot; Volume and mg a.i. vary with container size	
			2.5 mg a.i. drench x 1	Applied as 3.3 fl. oz./pot; Moderate growth control of Early Sunrise and enhanced flowering; Drench volume and mg a.i. vary with container size	
			30 to 45 ppm spray x 2 to 3	Treat as leaves reach edge of pot; Spray applications at weekly intervals; 3 applications of 30 ppm at 10-day intervals resulted in good control of Sunray	North
			2 to 6 ppm drench x 1	Heliot and Santa Fe – Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	15 to 40 ppm spray x 1 to 2	Multiple applications of lower rates; May delay flowering of Sunray	South
			0.25 mg a.i. drench x 1	Moderate growth control of Early Sunrise and enhanced flowering with 3.3 fl. oz./pot; Drench volume and mg a.i. vary with container size	
			5 to 10 ppm spray x 1 to 3	Excellent control of Early Sunrise; Apply one week after pinching to control growth of SunKiss or Utopia Series cultivars; Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
			2 to 4 ppm spray x 1	Control of Heliot and Santa Fe	Unspecified
		Topflor	150 ppm spray x 1	Reduced height and days to flower of Early Sunrise	South
Coreopsis rosea (Pink Coreopsis)	To control plant growth	**Dazide 85 WSG**/ B-Nine	1,500 to 2,500 ppm spray x 1	Effective on American Dream	Unspecified
			5,000 to 7,500 ppm spray x 1	Good growth control of American Dream with little effect on flowering	South
		Citadel/Altercel	1,500 ppm spray x 6	Good control of growth of Sweet Dreams and the hybrid Limerock Ruby with 6 weekly applications	North
		Piccolo/Piccolo 10 XC/Bonzi/ Pac O/Downsize (drenches only)	4 to 8 ppm liner soak x 1	Moderate response to lower rate with Sweet Dreams; Rates up to 8 ppm resulted in good control	South
			40 ppm spray x 1	Finished plants in California	
			2 ppm drench x 1	Drench volume and mg a.i. vary with container size	
			6 ppm drench x 1	Drench volume and mg a.i. vary with container size	North
			90 ppm spray x 6	Good control of growth of Sweet Dreams and the hybrid Limerock Ruby with 6 weekly applications	
		Concise/Sumagic	40 ppm spray x 1	Moderate control of American Dream; Multiple applications may be required	South
			0.5 ppm liner soak x 1	Sweet Dreams – good growth control	
			2 to 4 ppm spray x 1	Effective on American Dream	Unspecified
		Topflor	75 to 100 ppm spray x 1	American Dream – moderate control; Multiple applications may be required	South

* Mixing Rate Table on page 75

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Coreopsis verticillata (Thread Leaf Coreopsis)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Moonbeam – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	South
	To root cuttings and induce lateral branching	**Advocate**/Hortus IBA + **Configure**/**Configure 9.5 SC**	200 + 50 to 400 ppm x 1 spray	Moonbeam – Apply 200 ppm **Advocate** 24-hours after cutting stick, and again at 10 days after cutting stick but as a tank-mix with **Configure**/**Configure 9.5 SC**; Rates of **Configure**/**Configure 9.5 SC** up to 400 ppm did not control growth control or stimulate lateral branching; Trial rates	South
	To control plant growth	**Abide**/A-Rest	6 ppm drench x 1	Drench applied at 2 fl. oz. per 4-in. pot; Volume and mg a.i. vary with container size	South
		Collate 2L/Florel	500 to 1,000 ppm spray x 1 to 3	Moonbeam – no response in plant growth or days to flower, but 40% increase in number of flower inflorescences. With Moonbeam stock plants – good growth control with 600 ppm sprays x 4 biweekly; Increased branching; Removed flower buds	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 1 to 3	Moonbeam and overwintered Golden Gain – good control, but slight flower delay; Apply at 10- to 14-day intervals	South
			2,500 to 5,000 ppm spray 1 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required; Cruizin' Main Street – good control	North
			1,500 to 2,500 ppm spray x 1 to 3	Moonbean and Zagreb	Unspecified
			Tank mix	Tank mix spray of 2,000 ppm daminozide + 3 ppm uniconazole x 1 to 2 weekly; good control for Cruizin' Main Street	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Effective on overwintered Golden Gain	South
			Greater than 2,500 + 1,500 ppm spray x 1	Zagreb and Golden Gain – label rate; Increase daminozide rate for better control (Altercel)	Unspecified
		Citadel/Altercel	Not responsive at 1,500 ppm spray x 1	Overwintered Golden Gain – not responsive	South
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Not responsive at 160 ppm spray x 1	Moonbeam or overwintered Golden Gain – spray application not effective	South
			Less than 6 ppm drench x 1	Moonbeam – 6 ppm drench applied at 2 fl. oz. per 4-in. pot; Some distortion of laterals with this drench rate; volume and mg a.i. vary with container size	
			30 to 60 ppm spray x 1	Cruizin' Main Street – good control	North
			1 to 2 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	15 to 20 ppm spray x 1	Moonbeam – good control with spray application; overwintered Golden Gain – growth was moderately responsive at 45 ppm spray x 1; Multiple applications necessary	South
			Less than 1 ppm drench x 1	Moonbeam – stunted at 1 ppm drench; Test rates approximately 0.5 ppm; Drench applied as 2 fl. oz. per qt. pot; Volume and mg a.i. vary with container size;	
			2 to 4 ppm spray x 1	Moonbeam and Zagreb	Unspecified
			5 to 10 ppm spray x 1 to 2	Cruizin' Main Street – one 5 to 7 ppm spray of uniconazole gives good control; Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
		Topflor	75 to 100 ppm spray x 1	Moonbeam – good growth control with no delay in flowering; Higher rates resulted in high-quality ratings	South

(PGRs in **bold typeface** are from Fine Americas, Inc.)

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Coreopsis sp.	Induce lateral or basal branching on liners or finished plants	**Configure**/ **Configure 9.5 SC**	300 to 600 ppm spray x 1 on liners	Various cultivars including American Dreams, Sweet Dreams, Moonbeam, Rum Punch and Zagreb are responsive to a single foliar application to increase lateral and basal branching in liners and finished plants; Multiple applications may improve response	Branching
Cortaderia selloana (Pampas Grass)	To control plant growth	**Abide**/A-Rest	4 mg a.i. drench x 1	Moderate growth control; Drench volume and mg a.i. vary with container size	South
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	1 to 2 mg a.i. drench x 1	Good control of plant growth, shorter, but less diameter as well; Volume and mg a.i. vary with container size	South
		Concise/Sumagic	Less than 1 mg a.i. drench x 1	This rate resulted in continued growth regulation under landscape conditions; Test lower rates; Volume and mg a.i. vary with container size	South
			40 ppm spray x 1	Rosea – good height control with no effect on tiller number	
	To increase tillering	**Configure**/ **Configure 9.5 SC**	Not responsive to 500 or 1,000 ppm spray x 1	Rosea – not responsive in increasing number of tillers	Branching
Delosperma cooperi (Iceplant)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Jewel of Desert Ruby – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Dazide 85 WSG**/ B-Nine	1,500 to 2,500 ppm spray x 1 to 2	Multiple applications may be necessary	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	80 ppm spray x 1	Table Mountain – short term control with spray application; Multiple applications required	South
			Less than 10 ppm drench x 1	Excessive reduction in growth with 10 ppm drench at 2 fl. oz. per quart pot; test lower rates; Volume and mg a.i. vary with container size	
		Concise/Sumagic	3 to 4 ppm spray x 1 to 3	Multiple applications may be necessary	Unspecified
		Collate 2L	125 to 1000 ppm drench x 1	Jewel of Desert Ruby – not responsive; Higher rates may be effective; Drench volume varies with container size	North
	To induce lateral branching	**Configure**/ **Configure 9.5 SC**	Not responsive at 600 ppm spray x 2	Not responsive; Higher rates or multiple applications may be effective	Branching
Delphinium × elatum (Larkspur, Hybrid Bee Delphinium)	To control plant growth	**Abide**/A-Rest	4 ppm drench x 1	Apply as flower stalks start to elongate; Blue Bird – good control; Drench applied at 10 fl. oz. per trade gal. pot; Volume and mg a.i. vary with container size	South
			100 ppm spray x 3 to 6	Volkerfreiden – applications 7 to 14 days apart resulted in stunting; Magic Fountain and Pacific Giants – good control	North
			5 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Collate 2L/Florel	750 ppm spray x 4	Guardian – good growth control with weekly sprays; Some flower delay. Pacific Giants not responsive to 500 ppm sprays x 4 at 2-week intervals; Delayed flowering	North
		Dazide 85 WSG/ B-Nine	Not responsive at 5,000 ppm spray x 2	Astolat – not responsive	South
			5,000 ppm spray x 3 to 6	Volkerfreiden – applications 7 to 14 days apart gave moderate control; Guardian and Magic Fountain – good control; Pacific Giants – no growth control	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 1	Astolat – not responsive	South

* Mixing Rate Table on page 75

Color Code: Gold = Sunbelt sources; Blue = Northern sources; White = No specification; Pink = Increase branching recommendations

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Delphinium × elatum (Larkspur, Hybrid Bee Delphinium) *continued*	To control plant growth *continued*	**Citadel**/Altercel	1,500 ppm sprays x 4 to 6	Volkerfreiden and Guardian – weekly applications gave moderate control; Magic Fountain and Pacific Giants – not responsive to weekly sprays	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	40 to 100 ppm spray x 1	Astolat – moderate control at lower rates; Black Knight moderate control at higher rates; Multiple applications may be necessary; Blue Bird – height not responsive to 60 ppm spray x 1; Slight reduction in width	South
			Less than 2 ppm drench x 1	Blue Bird – very sensitive to drenches; Drench applied at 10 fl. oz. per qt. pot; Volume and mg a.i. vary with container size	
			20 to 30 ppm spray x 1 to 2	Guardian Series or Million Dollar Sky – make first application just as the flower stem is just beginning to rise above the basal foliage and second application 7 to 10 days later if necessary; Rates greater than 30 ppm sprays or more frequent applications resulted in stunting of other cultivars	North
			15 to 20 ppm spray x 1 or 2	Apply first spray at 12-in. tall; Apply second spray 2 weeks later if needed; Guardian F1 Series – apply 20 ppm spray as needed; Excalibur Series – apply 15 ppm 10 to 14 days apart	Unspecified
			2 to 4 ppm drench x 1	Apply drench 1 week after transplant; Volume and mg a.i. vary with container size	
		Concise/Sumagic	30 to 45 ppm spray x 1	Astolat – multiple applications may be required	South
			1 ppm drench x 1	Blue Bird – very short-term response; Multiple applications or higher rate required; Drench applied at 10 fl. oz. per trade gal. pot; Volume and mg a.i. vary with container size	
			5 ppm spray x 1 to 2	Guardian Series or Million Dollar Sky – make first application just as the flower stem is just beginning to rise above the basal foliage and second application 7 to 10 days later if necessary	North
			1 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Topflor	15 ppm spray x 1	Blue Bird – good control	South
			6 ppm drench x 1	Drench volume and mg a.i. vary with container size	North
	To increase branching	**Configure**/ **Configure 9.5 SC**	Not responsive at 600 ppm spray x 1	Galahad – not responsive; Higher rates may be effective	Branching
Delphinium grandiflorum (Siberian Larkspur)	To control plant growth; make first application just as the flower stem is beginning to rise above the basal foliage and second application 7 days later if necessary	**Abide**/A-Rest	25 to 50 ppm spray x 2		North
			100 ppm spray x 4 to 5	Summer Blues – applications 7 to 14 days apart gave excellent control; Sky Blue and Summer Nights – stunted by applications 7 to 14 days apart; reduce frequency of application	
		Collate 2L/Florel	500 ppm spray x 4	Sky Blue – good growth control with 4 sprays at 2-week intervals; Little flower delay	North
		Dazide 85 WSG/ B-Nine	2,500 ppm spray x 2		North
			Tank mix	Tank mix sprays of 2,000 ppm daminozide + 15 ppm paclobutrazol x 2	
			Tank mix	Tank mix sprays of 2,000 ppm daminozide + 3 ppm uniconazole x 1 to 2	
			Not responsive at 5,000 ppm spray x 4 to 5	Summer Blues, Sky Blue or Summer Nights – Applications 7 to 14 days apart gave no control	

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Delphinium grandiflorum (Siberian Larkspur) *continued*	To control plant growth; make first application just as the flower stem is beginning to rise above the basal foliage and second application 7 days later if necessary *continued*	**Dazide 85 WSG**/ B-Nine + **Citadel**/ Altercel Tank Mix	2,500 + 1,000 ppm spray x 2		North
		Citadel/Altercel	1,500 ppm spray x 4 to 5	Summer Blues – applications 7 to 14 days apart gave good control; Sky Blue or Summer Nights – no control	North
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	30 ppm spray x 2	Rates greater than 30 ppm sprays or more frequent applications resulted in stunting of some cultivars	North
			15 to 20 ppm spray x 1 to 2	For Delfix Series – apply 1 or 2 applications of 15 ppm 10 to 14 days apart. For Diamonds Blue F1 – apply 20 ppm spray as needed	Unspecified
		Concise/Sumagic	5 ppm spray x 2	Summer Blues – a single application of 5 ppm spray at 10 days after potting gave excellent control; Sky Blue and Summer Nights – 15 ppm spray rate with more frequent applications resulted in stunting; Pacific Giants – 10 ppm spray x 2 stunted growth	North
Dianthus gratiano-politanus (Cheddar Pinks)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 ppm spray x 1	Growth regulators typically not required, but daminozide can be applied if growing conditions cause stretch	Unspecified
			Tank mix	Tank mix spray of 2,000 ppm daminozide + 3 ppm uniconazole x 1	North
Dianthus barbatus (Sweet William) ***Dianthus hybrida*** (Dianthus)	To control plant growth	**Abide**/A-Rest	100 ppm spray x 4	Four spray applications at 2-week intervals gave moderate control	North
		Collate 2L/Florel	Not responsive at 500 ppm spray x 4	No response to 4 spray applications at 2-week intervals	North
		Dazide 85 WSG/ B-Nine	2,500 to 3,000 ppm spray x 1 to 2	Barbarini hybrids	Unspecified
			2,500 to 3,750 ppm spray x 2 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required; Significant cultivar variation in response	North
			Tank Mix	Tank mix spray of 2,000 ppm daminozide + 3 ppm uniconazole x 1 to 2, as needed for compact growth	
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	2,000 + 1000 ppm spray x 1	Coconut Punch	Unspecified
		Citadel/Altercel	Not responsive at 1,500 ppm spray x 4	No response to 4 spray applications at 2-week intervals	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	5 to 8 ppm spray x 1 to 2	Barbarini, Charms, Diabunda, Dulce, Elation, Fandango, Super Farfait and Venti Parfait hybrids	Unspecified
			60 ppm spray x 4	4 spray applications at 2-week intervals gave excellent control	North
			6 ppm drench x 1	Drench volume and mg a.i. vary with container size	
			15 to 20 ppm spray x 3 to 4	Bouquet F1 Series, Rockin' Red F1 – as needed	Unspecified
			5 ppm spray x 1 on liners	Stagirond (Rondo mix) – good control of liners	South
		Concise/Sumagic	3 to 5 ppm spray x 1 to 2	Barbarini hybrids	Unspecified
			15 ppm spray x 1	Single application early in production	South
			15 ppm spray x 4	4 spray applications at 2-week intervals gave excellent control	North
			1 ppm drench x 1	Drench volume and mg a.i. vary with container size	

* Mixing Rate Table on page 75

Color Code: Gold = Sunbelt sources; Blue = Northern sources; White = No specification; Pink = Increase branching recommendations

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Dicentra spectabilis (Common Bleeding Heart)	To control plant growth, make first spray application as soon as shoot growth is visible; Second application 5 days later	**Abide**/A-Rest	Less than 50 ppm spray x 2	This rate was phytotoxic causing leaf tip chlorosis; Higher rates reduced number of flowers	South
			50 to 100 ppm spray x 1 to 2	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
			26 ppm spray x 1	Spray rates above 132 ppm cause curling and burn of foliage	Unspecified
			2 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Dazide 85 WSG/ B-Nine	3,000 ppm spray x 2	Slight (approximately 4 days) delay in flowering	South
			2,000 to 2,500 ppm spray x 2	Begin applications when Valentine plants reach 3-in. tall and reapply as needed at 7- to 10-day intervals	North
		Citadel/Altercel	Not responsive at 2,000 ppm spray x 2		South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	50 ppm spray x 2	No effect on plant flowering	South
		Concise/Sumagic	1 to 5 ppm spray x 2	Excellent growth control with no delay in flowering	South
Digiplexis (Tender Foxglove)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Berry Canary – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Concise**/Sumagic	10 ppm spray x 1	Illumination Flame – Spray just as the flower spikes are beginning to elongate	North
			1 ppm drench x 1	Illumination Flame – Drench just as the flower spikes are beginning to elongate; Drench volume and mg a.i. vary with container size	
		Collate 2L	125 to 750 ppm drench x 1	Berry Canary – apply 10 days after transplant. Controlled plant height and plant diameter; Delay in flowering with ≥500 ppm; Drench volume varies with container size	North
	To enhance lateral branching	**Configure**/ **Configure 9.5 SC**	600 ppm spray x 1	Illumination Flame – Enhanced lateral branching; Lower rates may be effective	Branching
Digitalis purpurea (Foxglove)	To control plant growth	**Abide**/A-Rest	25 ppm spray x 2 to 3	To control plant growth, apply just as inflorescence begins to elongate above foliage; 2 to 3 spray applications 7 days apart	North
			5 ppm drench x 1	To control plant growth, apply just as inflorescence begins to elongate above foliage; Drench volume and mg a.i. vary with container size	
			Rates not tested	Camelot Series – Syngenta only recommends application before elongation of flower spike; Will respond to ancymidol	Unspecified
			15 ppm spray x 1	Foxy	South
			4 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Collate 2L/Florel	500 ppm spray x 4	Foxy – good growth control with 4 sprays at 2-week intervals; Delayed flowering	North
		Dazide 85 WSG/ B-Nine	Not responsive at 5,000 ppm spray x 4	Foxy not responsive to multiple applications	South
			2,500 to 5,000 ppm spray x 2 to 4	Foxy – good growth control with 4 applications at 2-week intervals; weekly applications necessary	North
			2,500 to 3,000 ppm spray x 1 to 2	Virtuoso hybrids, Camelot Series, Dalmatian Series – apply in the plug stage to produce more compact plants that are easier to ship; For finished plants, apply just as the flower spike begins to elongate	Unspecified
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 1	Foxy – not responsive	South

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Digitalis purpurea (Foxglove) *continued*	To control plant growth *continued*	**Citadel**/Altercel	1,500 ppm spray x 4	Foxy – good growth control with 4 applications at 2-week intervals	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	30 to 45 ppm spray x 2 to 3	Multiple spray applications may be necessary	North
			6 to 10 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	30 ppm spray x 1	Foxy – excellent height control; Moderate width reductions	South
			5 ppm spray x 2 to 3	Multiple applications at weekly intervals may be required	North
			1 ppm drench x 1	Drench volume and mg a.i. vary with container size	
			5 ppm spray x 2	Virtuoso hybrids and Camelot – apply just as the flower spike begins to elongate; Two applications 7 days apart should provide good control; Dalmatian F1 Series – spray as needed	Unspecified
			3 ppm spray x 1 on plugs	PGRs applied in the plug stage will produce more compact plants that are easier to ship; Camelot will respond to uniconazole	
			0.5 ppm drench x 1	Dalmatian F1 Series – apply 2 weeks after transplant. Drench volume and mg a.i. vary with container size	South
		Topflor	6+ ppm drench x 1	Drench volume and mg a.i. vary with container size	North
Echinacea purpurea (Purple Coneflower) ***Echinacea hybrids*** (Purple Coneflower)	To control plant growth	**Abide**/A-Rest	25 ppm spray x 2 to 3	Apply sprays weekly beginning when flower stalks are near leaf canopy and beginning to elongate	North
			50 to 100 ppm spray x 2	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required; Magnus – 6 weekly applications at 100 ppm stunted growth	
		Collate 2L/Florel	500 ppm spray x 1	White Swan – moderate growth control; No flower data	South
			500 ppm spray x 3	Bravado – biweekly sprays gave moderate growth regulation with no effect on flower date or number of inflorescences or branches;	North
				1,000 ppm x 3 reduced growth and delayed flowering slightly	
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2	Bravado and Magnus – apply at 10- to 14-day intervals for control	South
			5,000 ppm spray x 6	Magnus – weekly applications gave good control	North
			2,500 ppm spray x 2 to 3	Apply sprays weekly beginning when flower stalks are near leaf canopy and beginning to elongate	
			Tank Mix	Tank mix spray 2,500 ppm daminozide + 5 ppm uniconazole x 2 to 3 at weekly intervals	
		Citadel/Altercel	1,250 to 1,500 ppm spray x 2 to 6	Apply 1,250 ppm sprays weekly 2 to 3 times beginning when flower stalks are near leaf canopy and beginning to elongate; Magnus – 6 weekly applications at 1,500 ppm gave excellent control	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1 to 2	Magnus – good control; May require multiple applications at 10- to 14-day intervals	South
			2,500 + 1,250 ppm spray x 2 to 3	Apply weekly sprays beginning when flower stalks are near leaf canopy and beginning to elongate	North
			2,500 + 750 ppm spray x 1	Recommend after using **Configure**/**Configure 9.5 SC** (see below), if additional height control is necessary on tissue culture Echinacea	Unspecified

* Mixing Rate Table on page 75

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Echinacea purpurea (Purple Coneflower) ***Echinacea hybrids*** (Purple Coneflower) ***continued***	To control plant growth ***continued***	**Piccolo**/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	120 ppm spray x 1	Doubledecker – moderate control	South
			15 ppm spray x 3 to 4	First spray before budding; Evaluate weekly to determine need for additional control	
			30 to 90 ppm spray x 2 to 6	Apply 30 ppm sprays 2 to 3 times weekly beginning when flower stalks are near leaf canopy and beginning to elongate; Magnus – 90 ppm sprays x 6 weekly gave good control	North
			6 ppm drench x 1	Drench volume and mg a.i. vary with container size	
			15 to 30 ppm spray x 2	Prairie Splendor – Use multiple spray applications	Unspecified
			2 to 6 ppm drench x 1	Prairie Splendor – 3 ppm; Drench volume and mg a.i. vary with container size	
			2 to 4 ppm liner soak x 1	Soak liners for 30 sec	
		Concise/Sumagic	30 ppm spray x 1 to 2	Ruby Star – multiple applications may be required; Bravado – sensitive, test rates less than 30 ppm	South
			5 to 10 ppm spray x 2 to 3	Apply 5 ppm sprays weekly beginning when flower stalks are near leaf canopy and beginning to elongate; Three 10 ppm sprays applied at 2-week intervals beginning at bolting provided good control of Magnus with no effect on flowering	North
			1 ppm drench x 1	Drench volume and mg a.i. vary with container size	
			30 to 40 ppm spray x 1	Multiple applications of lower rate may be applied as necessary	Unspecified
		Topflor	22 to 45 ppm spray x 1 to 2	Ruby Star – short-term control; Multiple applications may be required	South
			22 ppm spray x 2 to 3	Apply weekly sprays beginning when flower stalks are near leaf canopy and beginning to elongate	North
	To increase basal branching	**Configure**/ **Configure 9.5 SC**	300 to 600 ppm spray x 1 to 2 on liners or finished plants	Increases basal branching; Multiple applications may be required; Little effect on plant height; Do NOT use on cultivars in the Sombrero or Pow Wow Series	Branching
Erysimum linifolium (Wallflower)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	WallArt Citric – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Dazide 85 WSG**/ B-Nine	5,000 ppm spray x 2	Multiple applications at 10 to 14 day intervals	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	May require multiple applications	South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	80 to 120 ppm spray x 1	Moderate control	South
		Concise/Sumagic	15 ppm spray x 1	Good control	South
		Topflor	30 ppm spray x 1	Good control	South
		Collate 2L	125 to 250 ppm drench x 1	WallArt Citric – apply 10 days after transplant; Controlled plant height and plant diameter; Leaf reddening observed with >250 ppm; Plant death occurred at ≥500 ppm; Drench volume varies with container size	North
Eupatorium coelestinum (Hardy Ageratum)	To control plant growth	**Dazide 85 WSG**/ B-Nine	Not responsive at 5,000 ppm spray x 2	Not responsive	South
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Not responsive at 240 ppm spray x 1		South
			8 to 10 ppm drench x 1	Moderate control with drenches applied at 2 fl. oz. per quart pot	
		Concise/Sumagic	60 ppm spray x 1		South
			Not responsive at 1 ppm drench x 1	Drench applied at 4 fl. oz. per quart pot	

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Eupatorium rugosum [*Ageratina altissima*] (Chocolate Bonset, White Snake Root)	To control plant growth	**Concise**/Sumagic	60 to 90 ppm spray x 1 to 3	Moderate, short-term growth control; Multiple applications recommended	South
			4 ppm drench x 1	Moderate, short-term growth control; Drench applied at 2 fl. oz. per quart pot	
			2 to 6 ppm liner soak x 1	Moderate, short-term growth control; Liners soaked for 30 seconds	
Euphorbia dulcis (Purple Spurge)	To increase branching	**Configure**/ **Configure 9.5 SC**	600 ppm spray x 1	Chameleon – this rate was our screening rate; Lower rates may be effective	Branching
Euphorbia hybrid (Wood Spurge)	To control plant growth	**Dazide 85 WSG**/ B-Nine	Not responsive at 5,000 ppm spray x 3	Efanthia and Despina – Not responsive	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 2	Efanthia and Despina – Not responsive	South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	40 to 80 ppm spray x 1	Efanthia and Despina – Good control	South
			30 ppm spray x 2 to 3	Multiple applications at weekly intervals may be required	North
		Concise/Sumagic	30 ppm spray x 1	Efanthia and Despina – Good control	South
			5 ppm spray x 1 to 2	Multiple applications at weekly intervals may be required	North
		Topflor	30 ppm spray x 1	Efanthia and Despina – Good control	South
			45 ppm spray x 1	Good control	North
Gaillardia × grandiflora (Blanket Flower)	To root cuttings	**Advocate**/Hortus IBA	200 to 400 ppm x 1 spray	Spintop Red and Spintop Red Starburst – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Abide**/A-Rest	50 ppm spray x 3	Begin weekly applications when stems are rapidly elongating and before flower buds appear	North
			Tank mix	Tank mix spray of 15 ppm ancymidol + 2.5 ppm uniconazole as needed	Unspecified
		Collate 2L/Florel	500 ppm spray x 4	Burgundy – growth control and delayed flowering with 4 sprays at 2-week intervals	North
		Collate 2L	250 to 500 drench x 1	Spintop Red Starburst – apply 10 days after transplant; Controlled plant height and plant diameter; Lower leaf chlorosis observed with ≥1000 ppm; No delay in flowering observed; Drench volume varies with container size	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 3	Burgundy – responsive; Apply at 10- to 14-day intervals; Goblin (Gold Kobold) – not responsive at 5,000 ppm spray x 2	South
			2,500 to 5,000 ppm spray x 2 to 4	Begin weekly applications when stems are rapidly elongating and before flower buds appear; Burgundy- excellent control with 5,000 ppm spray x 4 at 2-week intervals	North
			Tank Mix	A tank mix spray of 2,500 to 3,750 ppm daminozide + 15 to 30 ppm paclobutrazol x 1 to 3; Make first application after bud set, but before stem elongation and a second application before the first bud opens	
			Tank Mix	Tank mix spray of 2,500 ppm daminozide + 5 ppm uniconazole x 3	
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Burgundy – responsive to a single application; Goblin (Gold Kobold) – not responsive	South
			3,000 + 1,250 ppm spray x 3	Begin weekly applications when stems are rapidly elongating and before flower buds appear	North

* Mixing Rate Table on page 75

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Gaillardia × grandiflora (Blanket Flower) *continued*	To control plant growth *continued*	**Piccolo**/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Not responsive at 160 ppm spray x 1	Goblin (Gold Kobold) – not responsive at 160 ppm spray x 1	South
			Not responsive at 5 ppm drench x 1	Goblin (Gold Kobold) – not responsive; drench applied at 4 fl. oz. per qt. pot; Drench volume and mg a.i. vary with container size	
			30 to 60 ppm spray x 3	Begin weekly applications when stems are rapidly elongating and before flower buds appear; Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required; Four applications of 60 ppm sprays at 2-week intervals gave excellent control of Burgundy	North
		Concise/Sumagic	60 ppm spray x 1	Burgundy – moderate control; May require multiple applications; Goblin (Gold Kobold) – not responsive to uniconazole applied as a 60 ppm spray, a 5 ppm liner soak or a 2 ppm drench applied at 4 fl. oz. per qt. pot)	South
			7 to 15 ppm spray x 2 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required; Begin weekly applications of 10 ppm sprays when stems are rapidly elongating and before flower buds appear	North
	To induce lateral branching	**Collate 2L**/Florel	500 ppm spray x 1	One application after roots have established in final container to enhance branching	Branching
		Configure/ **Configure 9.5 SC**	600 ppm spray x 1 or 2 on liners or finished plants	Gallo Yellow, Dazzler and Gallo Red – had increased branching, but EXCESSIVE DELAYS in flowering	Branching
Gaura lindheimeri (White Gaura, Wand Flower, Butterflies)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Siskiyou Pink – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	South
	To root cuttings and induce lateral branching	**Advocate**/Hortus IBA + **Configure**/ **Configure 9.5 SC**	200 + 50 to 600 ppm x 1 spray	Siskiyou Pink – apply 200 ppm **Advocate** 24-hours after cutting stick, and again at 10 days after cutting stick but as a tank-mix with **Configure**/**Configure 9.5 SC**; Rates up to 600 ppm can be used after conducting your own trial; Controlled liner growth and stimulated lateral branching	South
	To control plant growth	**Abide**/A-Rest	100 ppm spray x 4 to 5	Sprays at 7- to 14-day intervals gave excellent control of Rose, no control of Whirling Butterflies and stunted Blush; Reduce number of applications	North
			1 to 2 ppm drench x 1	Drench volume and mg a.i. vary with container size	Unspecified
		Collate 2L/Florel	500 ppm spray x 4	No growth control of Whirling Butterflies with 4 sprays at 2-week intervals, but appeared to increase branching; Slight delay in flowering	North
			500 ppm spray x 2	Corrie's Gold – moderate growth control with 2 sprays at 2-week interval	South
		Collate 2L	125 to 500 ppm drench x 1	Siskiyou Pink – apply 10 days after transplant; Controlled plant height and plant diameter; A delay in flowering observed at all concentrations trialed; Drench volume varies with container size	North
		Dazide 85 WSG/ B-Nine	3,000 to 5,000 ppm spray x 2	Siskiyou Pink, Whirling Butterflies and Corrie's Gold; Apply at 10- to 14-day intervals	South
			3,000 to 5,000 ppm spray x 2 to 5	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required; Blush and Rose – multiple applications at 7- to 14-day intervals gave good control; Whirling Butterflies – not responsive	North
			Tank Mix	More upright cultivars will require multiple applications; Tank mix spray 2,000 ppm daminozide + 30 ppm paclobutrazol x 1 to 3	
				Tank mix spray 2,000 ppm daminozide + 5 ppm uniconazole x 1 to 2	
			2,500 to 4,000 ppm spray x 1 to 3	The first application should be 7 to 10 days after the first pinch	Unspecified

(PGRs in **bold typeface** are from Fine Americas, Inc.)

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Gaura lindheimeri (White Gaura, Wand Flower, Butterflies) *continued*	To control plant growth *continued*	**Dazide 85 WSG**/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Corrie's Gold – good control; Whirling Butterflies – moderate control; Multiple applications may be required	South
			2,500 + 750 to 1,000 ppm spray x 1	Sparkle White – multiple applications may be required	Unspecified
			2,000 + 1,000 ppm spray x 1 to 3	More upright cultivars will require multiple applications	North
		Citadel/Altercel	1,250 to 1,500 ppm spray x 1 to 5	More upright cultivars will require multiple applications; Blush and Rose – good control with 1,500 ppm spray x 5 weekly; Whirling Butterflies – not responsive at 1,500 ppm spray x 4 at 2-week intervals	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	80 to 100 ppm spray x 1	Corrie's Gold – 80 ppm resulted in good growth control; Siskiyou Pink – 100 ppm x 1 gave only moderate growth control; Test multiple applications or higher rate.	South
			15 ppm drench x 1	Drench applied at 2 fl. oz. per qt. pot; Volume and mg a.i. vary with container size.	
			2 to 4 ppm liner soak x 1	Pink Fountain – good growth control with liner soak	
			30 to 90 ppm spray x 4 to 5	More upright cultivars will require multiple applications of 30 ppm sprays; Blush and Rose – good control with 90 ppm spray weekly; Whirling Butterflies – good control with 60 ppm sprays at 2-week intervals	North
			6+ ppm drench x 1	Drench volume and mg a.i. vary with container size	
			30 to 50 ppm spray x 1	Will control unwanted growth	Unspecified
		Concise/Sumagic	15 to 60 ppm spray x 1	Significant cultivar differences in response: Whirling Butterflies – growth excessively reduced by 15 ppm x 1; Corrie's Gold – 30 ppm x 1 gave short-term growth regulation; Dauphin – only moderately controlled by 60 ppm x 1; Siskiyou Pink – not responsive to a 60 ppm spray x 1	South
			3 to 15 ppm spray x 1 to 5	One 5 ppm spray controls compact cultivars; More upright cultivars will require multiple applications; Blush and Rose – stunted with 15 ppm spray x 5 weekly; Whirling Butterflies – good control without affecting flowering with 10 ppm sprays x 2 at 2-week intervals; Apply lower rates early in production and higher rates later under better growing conditions	North
		Topflor	100 ppm spray x 1	Corrie's Gold – moderate height control; Test multiple applications or higher rates	South
	To increase branching	**Configure**/ **Configure 9.5 SC**	500 to 600 ppm spray x 1 to 2 on finish plants 300 ppm spray x 1 to 2 on liners	Siskiyou Pink, Whirling Butterflies – increased branches, shoots and flower stalks; For liners, single or multiple foliar sprays applied when removed from mist. Snow Fountain liners – not responsive to 600 ppm spray x 1	Branching
Geranium Rozanne (Cranesbill Geranium)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 ppm spray x 1 to 3	Brookside – multiple applications as needed	Unspecified
			Tank mix	Tank mix spray of 2,000 ppm daminozide + 3 ppm uniconazole as needed to control overall plant size	North
		Concise/Sumagic	3 to 5 ppm spray x 1 to 3	Brookside – multiple applications as needed	Unspecified
	To induce lateral branching	**Configure**/ **Configure 9.5 SC**	Not responsive at 600 ppm spray x 1	This rate was our screening rate. Higher rates or multiple applications may be effective	Branching
Geum sp. (Avens)	To control plant growth	**Piccolo**/**Piccolo 10 XC**/Bonzi/Pac O	30 ppm spray x 1 to 3	For control of flower height, apply at 7 to 10 day intervals as stems begin to emerge from the foliage	North
		Concise/Sumagic	5 ppm spray x 1 to 3	For control of flower height, apply at 7 to 10 day intervals as stems begin to emerge from the foliage	North

* Mixing Rate Table on page 75

Color Code:
- Gold = Sunbelt sources
- Blue = Northern sources
- White = No specification
- Pink = Increase branching recommendations

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Gladiolus × hybridus (Gladiolus)	To control plant growth	**Abide**/A-Rest	100 ppm soak x 1	Amsterdam and Bananarama – Soak corms for 24 hours prior to potting.	North
Hedera canariensis (Algerian Ivy)	To control plant growth	**Piccolo**/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	1 to 2 ppm drench x 1	Apply after plant fills container to keep runners under control	Unspecified
		Concise/Sumagic	6 to 8 ppm spray x 1 to 2	Apply after plant fills container to keep runners under control	Unspecified
	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	50 to 200 ppm spray x 3	Foliar spray every 2 weeks starting 2 weeks after potting increased branching	Branching
Helenium autumnale (Sneezeweed)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 ppm spray x 1	Mariachi Salsa – may require higher rates in the South	North
			2,500 ppm spray x 2 to 4	Mardi Gras – apply weekly prior to bud set	Unspecified
			2,500 ppm spray x 2	Coppelia – moderate height control	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 1	Coppelia – reduced width but no height control	South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	Not responsive to 160 ppm spray x 1	Coppelia – not responsive	South
		Concise/Sumagic	Not responsive to 60 ppm spray x 1	Coppelia – not responsive	South
	To induce lateral branching	**Configure**/ **Configure 9.5 SC**	Not responsive to 600 ppm spray x 1	Coppelia – not responsive; This was our test rate; Higher rates or multiple applications may be more effective	Branching
			20 to 40 ppm spray x 3	Foliar sprays weekly in summer increased lateral branching and delayed flowering but increased flower number	
Helianthus simulans (Swamp Sunflower)	To control plant growth	**Piccolo**/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	4 mg a.i. drench x 1	4 fl.oz. applied per trade gallon pot; Drench volume and mg a.i. vary with container size	South
		Topflor	4 mg a.i. drench x 1	4 fl.oz. applied per trade gallon pot; Drench volume and mg a.i. vary with container size	South
Heliopsis helianthoides (False Sunflower, Sunflower Heliopsis)	To control plant growth	**Dazide 85 WSG**/ B-Nine	Less than 5,000 ppm spray x 2	Summer Sun – very sensitive to daminozide under nursery conditions; Test at lower rates	South
			2,500 ppm spray x 1 shortly after pinching	Tuscan Gold – apply shortly after pinching if needed	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Summer Sun – persistent control under nursery conditions; Test lower rates	South
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Not responsive at 160 ppm spray x 1	Summer Sun – not responsive under nursery conditions	South
			Not responsive at 10 ppm drench x 1 to liners	Summer Green – not responsive to liner drench just prior to transplanting; Drench applied to liners at 0.3 fl. oz. per 72-size cell; Volume and mg a.i. will vary with container size	
			6 ppm drench x 1	Drench volume and mg a.i. vary with container size	North
		Concise/Sumagic	Not responsive at 60 ppm spray x 1	Summer Sun – not responsive under nursery conditions	South
	To increase lateral branching	**Configure**/ **Configure 9.5 SC**	600 ppm spray x 2	Summer Green – applied at transplant and again 2 weeks after transplant doubled number of lateral branches and enhanced growth	Branching

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Helleborus* × *hybridus (Lenten Rose, Hellebore)	To tone the foliage	**Piccolo**/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	1 to 2 ppm drench x 1	Toning foliage; Volume and mg a.i. will vary with container size	Unspecified
		Concise/Sumagic	3 to 4 ppm spray x 1	Toning foliage	Unspecified
	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	50 to 800 ppm spray x 1	Foliar spray applied every 2 weeks for 12 weeks during the summer; Some increase in branching; No phytotoxicity, but leaves were feathered	Branching
Hemerocallis sp. (Daylily)	To control plant growth	**Abide**/A-Rest	2 ppm drench x 1	Happy Returns – moderate control of height, but significant reduction of flower stalk height; Applied at 10 fl. oz. per trade gal. pots; Volume and mg a.i. will vary with container size	South
			50 to 100 ppm spray x 2	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
			5+ ppm drench x 1	Applied to overwintered plants at shoot emergence; Drench volume and mg a.i. will vary with container size	
		Dazide 85 WSG/ B-Nine	3,750 ppm spray x 2 to 3	2 to 3 weekly spray applications	North
			Tank Mix	Tank mix spray of 3,750 daminozide + 5 ppm uniconazole x 1	
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	2,500 + 1,250 ppm spray x 2 to 3	Weekly spray applications	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	160 to 180 ppm spray x 1	Mary Todd and Hyperion – moderate height control; Black Eyed Stella or Prairie Blue Eyes – not responsive;	South
				Irish Elf responsive to single 50 ppm spray application	
			2 ppm drench x 1	Happy Returns, Hyperion and Prairie Blue Eyes – drench application gave moderate control of height, but significantly reduced flower stalk height; Applied at 10 fl. oz. per trade gal. pots; Volume and mg a.i. will vary with container size	
			45 ppm spray x 2 to 3	Spray applications at weekly intervals	North
			5 to 6+ ppm drench x 1	Rhythm Rainbow – apply 5 ppm drench when plants are 6 to 8 inches tall; Drench volume and mg a.i. will vary with container size	
		Concise/Sumagic	0.5 to 1.0 ppm drench x 1	Butter Pat, Sammy Russell, Happy Returns and Frankly Scarlet – moderate control of height with 10 fl. oz. per trade gal. pots, but significant reduction of flower stalk height; Use care with higher rate; Bare root liners of Pink Song not responsive to 1 ppm drench applied at 2 fl. oz. per quart pot; Volume and mg a.i. will vary with container size	South
			5 to 10 ppm spray x 2 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
			1.0 ppm drench x 1	Drench when grown under greenhouse conditions; Drench volume and mg a.i. will vary with container size	
			Not responsive at 60 ppm spray x 1	Bare root liners of Pink Song not responsive to uniconazole	South
			Not responsive at 2 ppm liner soak x 1	Bare root liners of Pink Song not responsive	
	To increase basal branching	**Configure**/ **Configure 9.5 SC**	Not responsive at 600 ppm spray x 1	Strutters Ball – not responsive to our screening rate of 600 ppm; Higher rates or multiple applications may be effective	Branching
			2,500 ppm spray x 1 to 3	Weekly applications increased the number of ramets (basal plantlets)	
			2,500 or 5,000 ppm spray x 1 to 5	Foliar spray for 1, 2, 3, 4, or 5 consecutive weeks increased offset formation; higher rates and more applications were generally optimal	

* Mixing Rate Table on page 75

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Heuchera sp. (Coral Bells)	To control plant growth	**Abide**/A-Rest	100 ppm spray x 6	Bloody Mary – good control with weekly applications	North
		Dazide 85 WSG/ B-Nine	3,750 to 5,000 ppm spray x 2	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required; Bloody Mary – good control with 5,000 ppm spray x 6 weekly	North
		Citadel/Altercel	1,500 ppm spray x 6	Bloody Mary – good control with weekly applications	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Not responsive at 120 ppm spray x 1	Silver Lode – not responsive	South
			30 ppm spray x 2	Spray at weekly intervals; Height of flower stems can also be reduced by applying when flower buds approach the top of the canopy, may require two weekly applications	North
			6 ppm drench x 1	Drench volume and mg a.i. vary with container size	
			10 to 25 ppm spray x 1	Generally, not needed	Unspecified
		Concise/Sumagic	5 to 15 ppm spray x 2 to 6	Spray 5 ppm at weekly intervals; Height of flower stems can also be reduced by applying when flower buds approach the top of the canopy, may require two weekly applications; Apply 5 ppm sprays early in production and 10 ppm sprays later under better growing conditions; Multiple applications may be required; Bloody Mary – excellent control with 15 ppm spray x 6 weekly	North
			2 to 4 ppm spray x 1	Generally, not needed	Unspecified
	To increase basal branching	**Configure**/ **Configure 9.5 SC**	600 ppm spray x 1	Raspberry Ice and Silver Lode – increased basal branching at our screening rate; Lower rates may be effective	Branching
Hibiscus moscheutos (Hardy Hibiscus, Rose Mallow)	To control plant growth	**Abide**/A-Rest	100 ppm spray x 5 or 6	Disco Belle Mix – excellent control; Luna Blush or Luna Red – not responsive	North
		Collate 2L/Florel	Less than 500 ppm spray x 4	Pink Champagne – biweekly sprays excessively reduced growth without increasing branching; Reduce number of applications	North
		Dazide 85 WSG/ B-Nine	3,750 to 5,000 ppm spray x 5 to 8	Disco Belle Mix – moderate control; Luna Blush or Luna Red – not responsive; Treat about 1 week after pinch with weekly sprays as necessary	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	3,750 + 1,000 ppm spray x 2 or 2,500 + 1,250 ppm spray x 2 to 3	For best results, begin PGR applications about 3 to 7 days following a pinch – apply weekly if additional control is needed	North
			2,500 + 750 to 1,000 ppm spray x 1	Luna – apply spray about 2 weeks after transplant and again 2 weeks later, if necessary	Unspecified
			Unspecified	**Dazide 85 WSG**/B-Nine can delay flowering; Only use when **Citadel**/Altercel rate must exceed 750 ppm for adequate control	
		Citadel/Altercel	500 ppm spray x 2	Lord Baltimore – good control with spray applications	South
			Less than 2,000 ppm drench x 1	Lord Baltimore – stunting with 2,000 ppm drench applied at 4 fl. oz. per 6-in. pot; Reduce drench rate; Volume and mg a.i. vary with container size	
			750 to 1,000 ppm spray x 3	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required; Disco Belle Mix, Luna Blush and Luna Red – multiple sprays with 1,500 ppm caused excessive stunting	North
			Up to 750 ppm spray x 1	Do not apply until length of new shoots (after pinch) is 0.5 to 1.0 inch; Do not apply after visible bud	Unspecified

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CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Hibiscus moscheutos (Hardy Hibiscus, Rose Mallow) *continued*	To control plant growth *continued*	**Piccolo**/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	10 to 45 ppm spray x 6 to 8	For best results, begin PGR applications about 1 week after pinch; Apply weekly if additional control is needed	North
			5 to 10 ppm drench x 1	Apply about 1 week after pinch, when new growth reaches 4 to 6 inches after soft pinch; Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	10 to 20 ppm spray x 1 to 2	Grenache – good control with 20 ppm spray x 1; Luna Blush – height control with 10 ppm spray x 2; Make second application 2 to 3 weeks after first, if necessary	South
			0.5 ppm drench x 1	Very sensitive to uniconazole drenches; Drench applied at 10 fl. oz. per trade gal. pot; Volume and mg a.i. vary with container size	
			5 to 10 ppm spray x 6 to 8	Apply lower rates early in production and higher rates later under better growing conditions; Treat about 1 week after pinch, apply weekly sprays as necessary	North
			1 ppm drench x 1	One application 1 week after pinch is usually sufficient; Drench volume and mg a.i. will vary with container size	
	To increase branching	**Configure**/ **Configure 9.5 SC**	500 ppm spray x 4	Pink Champagne – biweekly sprays increased branching with reduction in plant height	Branching
Hosta sp. (Hosta, Plantain Lily)	To control plant growth, spray when leaves begin to unfold	**Abide**/A-Rest	25 to 50 ppm spray x 2 to 3	Spray when leaves begin to unfold; Gold Standard and H. hyacinthia – 100 ppm sprays x 4 to 6 stunted growth, but gave excellent control of Royal Standard	North
			5 ppm drench x 1	Drench after first few leaves have expanded; Volume and mg a.i. will vary with container size	
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 4 to 6	Royal Standard – good control; Gold Standard – not responsive	North
			Tank Mix	Tank mix spray 2,500 ppm daminozide + 5 ppm uniconazole effective; Multiple applications may be needed at 7-day intervals on larger varieties or under warm greenhouse conditions; H. undulata is more sensitive, reduce rates to 2,000 ppm daminozide + 3 ppm uniconazole	
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	3,000 + 1,500 ppm spray x 4 to 6	Royal Standard – good control	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	6 to 10 ppm drench x 1	Effective growth control; Drench volume and mg a.i. will vary with container size	North
			90 ppm spray x 4 to 6	*H. hyacinthia* – sprays stunted growth; Gold Standard, Royal Standard – not responsive	
			30 ppm spray x 1 to 3	Multiple spray applications may be necessary	Unspecified
		Concise/Sumagic	5 to 15 ppm spray x 2 to 3	Apply when leaves begin to unfurl; 5 ppm spray weekly;	North
				H. hyacinthia, Gold Standard and Royal Standard – 15 ppm spray x 4 to 6 gave good control	
				H. undulata is more sensitive, reduce spray rates to 5 ppm uniconazole	
			1 ppm drench x 1	Drench volume and mg a.i. will vary with container size	
			20 ppm spray x 1	Single application early in production	South
	To increase basal branching	**Collate 2L**/Florel	500 ppm spray x 4	Royal Standard – biweekly sprays increased branching with slight reduction in plant height	Branching
		Configure/ **Configure 9.5 SC**	500 to 3,000 ppm spray x 1 to 2	See Fine **Configure**/**Configure 9.5 SC** Product Information guide for detailed application instructions and cultivar responses	Branching
			500 ppm spray x 4	Biweekly sprays increased branching of Royal Standard with little reduction in plant height	

* Mixing Rate Table on page 75

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Hypericum calycinum (Aaron's Beard, St. John's Wort)	To control plant growth	**Dazide 85 WSG**/ B-Nine	Not responsive at 5,000 ppm spray x 2	Not responsive in nursery trials	South
			1,500 to 2,500 ppm spray x 2 to 3	As needed	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 1	Not responsive in nursery trials	South
			2,500 + 1,000 ppm spray x 2 to 3	Weekly applications	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	120 to 160 ppm spray x 1	Moderate control with a single spray application under greenhouse conditions; Not responsive in nursery trials	South
			4 ppm drench x 1	Excellent control with 4 ppm drench at 10 fl. oz. per trade gallon pot under greenhouse conditions; Drench volume and mg a.i. vary with container size	
			30 ppm spray x 2 to 3	Weekly applications	North
		Concise/Sumagic	30 ppm spray x 1	Good growth regulation	South
			1 ppm drench x 1	Drench applied at 10 fl. oz. per trade gallon pot; Drench volume and mg a.i. vary with container size	
			4 to 6 ppm spray x 2 to 3	Weekly applications as needed	North
Iris germanica Iris hybrids (Tall Bearded Iris)	To control plant growth	**Abide**/A-Rest	Not responsive at 100 ppm spray x 6	Immortality – not responsive to weekly sprays	North
		Dazide 85 WSG/ B-Nine	Not responsive at 5,000 ppm spray x 6	Immortality – not responsive to weekly sprays	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 6	Immortality – not responsive to weekly sprays	North
		Citadel/Altercel	Not responsive at 1,500 ppm spray x 6	Immortality – not responsive to weekly sprays	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	90 ppm spray x 6	Immortality – weekly sprays gave good control	North
			6 to 10 ppm drench x 1	More responsive to drenches than to spray applications; Drench volume and mg a.i. will vary with container size	
		Concise/Sumagic	Not responsive at 15 ppm spray x 6	Immortality – not responsive to weekly sprays	North
	To increase basal branching	**Configure**/ **Configure 9.5 SC**	100 ppm spray x 1	Slight increase in basal branching	Branching
Iris siberica (Siberian Iris)	To control plant growth	**Dazide 85 WSG**/ B-Nine	Tank mix	Tank mix spray of 2,500 ppm daminozide + 5 ppm uniconazole x 2 to 3 weekly applications	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	90 ppm spray x 1	Caesar's Brother – a single spray controlled growth; Chilled Wine – not responsive to 180 ppm spray x 1	South
			Less than 2 to 4 ppm drench x 1	Caesar's Brother – use lower drench rates; Chilled Wine – use higher rates; Drench applied at 10 fl. oz. per trade gal. pot; Drench volume and mg a.i. vary with container size	
			6 to 10 ppm spray x 1 to 2	Multiple applications as needed	North
Jovibarba hirta (Hens and Chicks)	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	1,600 ppm spray x 1	Increased number of offsets	Branching

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Knautia macedonica (Crimson Scabiosa, Knautia)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 ppm spray x 1 to 2	Multiple applications at 7 to 10 day intervals	North
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	30 ppm spray x 1 to 2	Multiple applications at 7 to 10 day intervals	North
		Concise/Sumagic	5 ppm spray x 1 to 2	Multiple applications at 7 to 10 day intervals	North
Kniphofia uvaria (Torch Lily, Red Hot Poker)	To control plant growth	**Dazide 85 WSG**/ B-Nine	Not responsive at 5,000 ppm spray x 2	Bressingham Comet – not responsive	South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	Not responsive at 160 ppm spray x 1	Bressingham Comet – not responsive	South
			30 to 45 ppm spray x 1	Echo Series – multiple applications required to obtain adequate height control	North
		Concise/Sumagic	45 ppm spray x 1	Bressingham Comet – good control	South
			5 to 7.5 ppm spray x 1	Echo Series – multiple applications required to obtain adequate height control	North
Lamiastrum galeobdolon (Yellow Archangel, Golden Dead Nettle)	To control plant growth	**Dazide 85 WSG**/ B-Nine	3,750 to 5,000 ppm spray x 2	Hermann's Pride – excellent control of runners with 5000 ppm x 2; Apply at 10-14 day intervals	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	2,500 + 1,500 ppm spray x 1	Hermann's Pride – excellent control of runners	South
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	80 ppm spray x 1	Hermann's Pride – moderate width control	South
			3 to 5 ppm drench x 1	Drench volume and mg a.i. vary with container size	Unspecified
		Concise/Sumagic	15 ppm spray x 1	Hermann's Pride – moderate width control	South
		Topflor	45 ppm spray x 1	Hermann's Pride – moderate width control; May need multiple applications	South
Lamium maculatum (Spotted Dead Nettle)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Purple Dragon and Nancy Red – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To root cuttings and induce lateral branching	**Advocate**/Hortus IBA + **Configure**/ **Configure 9.5 SC**	200 + 50 to 400 ppm x 1 spray	Nancy Red – apply 200 ppm **Advocate** 24-hours after cutting stick, and again at 10 days after cutting stick but as a tank-mix with **Configure**/**Configure 9.5 SC**; Rates of **Configure**/**Configure 9.5 SC** up to 400 ppm controlled liner growth; No branching stimulated; Trial rates	South
	To control plant growth	**Abide**/A-Rest	50 ppm spray x 2 to 3	Multiple applications may be required; Orchid Frost – excessive width reduction with 100 ppm spray x 4 at 2-week intervals	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2	Pink Pewter – moderate control; Beacon Silver – not responsive under nursery conditions	South
			2,500 to 3,750 ppm spray x 2 to 3	Begin applications when canopy starts to close; Multiple applications as necessary; Orchid Frost – good width reduction with 5,000 ppm x 4 sprays at 2-week intervals	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Pink Pewter – moderate control; Multiple applications may be required; Beacon Silver – not responsive under nursery conditions	South
			Not responsive at 3,000 + 1,500 ppm spray x 4	Orchid Frost – not responsive with 4 sprays at 2-week intervals	North
		Citadel/Altercel	750 to 1,500 ppm spray x 2 to 3	Multiple applications may be required; Orchid Frost – good width reduction with 1,500 ppm sprays x 4 at 2-week intervals	North

* Mixing Rate Table on page 75

Color Code: Gold = Sunbelt sources; Blue = Northern sources; White = No specification; Pink = Increase branching recommendations

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Lamium maculatum (Spotted Dead Nettle) *continued*	To control plant growth *continued*	**Piccolo/Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	40 ppm spray x 1	Pink Pewter – good control, but multiple applications may be necessary; Beacon Silver – not responsive with 160 ppm spray x 1 under nursery conditions	South
			30 to 60 ppm spray x 2 to 3	Lower rate recommended at weekly intervals; Orchid Frost – good width reduction with 60 ppm sprays x 4 at 2-week intervals	North
			3 to 5 ppm drench x 1	Drench volume and mg a.i. vary with container size	Unspecified
		Concise/Sumagic	30 ppm spray x 1	Pink Pewter – moderate control; Multiple applications may b required; Beacon Silver – not responsive with 60 ppm x 1 under nursery conditions	South
			5 to 15 ppm spray x 2 to 3	Lower rate recommended; Orchid Frost – excellent width reduction with 15 ppm sprays x 4 at 2-week intervals	North
		Collate 2L	125 to 250 ppm drench x 1	Purple Dragon – apply 10 days after transplant; Controlled plant height and plant diameter; Leaf purpling, leaf deaf, and death of lateral shoot tips observed at ≥250 ppm; No delay in flowering; Drench volume varies with container size	North
Lantana camara (Lantana)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 ppm spray x 1 on liners	Dallas Red or New Gold – No effect on growth or branching of liners or finished plants	South
		Piccolo/Piccolo 10 XC/Bonzi/Pac O	40 to 50 ppm spray x 1	Moderate growth control	Unspecified
			4 to 8 ppm liner soak x 1	Soak for 30 seconds; moderate growth control	
		Concise/Sumagic	20 to 30 ppm spray x 1	Moderate growth control	Unspecified
		Collate 2L/Florel	Not responsive at 500 ppm spray x 1 on liners	Dallas Red or New Gold – No effect on growth or branching of liners or finished plants	Branching
Lavandula angustifolia (Lavender)	To root cuttings	**Advocate**/Hortus IBA	300 ppm x 1 spray	LaDiva Spirit Purple Blue – similar rooting to basal dip and cutting immersion	North
	To control plant growth	**Abide**/A-Rest	25 ppm spray x 2 to 3	Weekly applications as necessary	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 1	Provence – moderate control applied once in liner stage	South
			1,500 to 3,000 ppm spray x 1	Ellegance or Mini Blue – multiple applications as needed	Unspecified
			2,500 to 5,000 ppm spray x 2 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications at weekly intervals may be required	North
		Piccolo/Piccolo 10 XC/Bonzi/ Pac O/Downsize (drenches only)	30 ppm spray x 2	Weekly applications as necessary	North
			6 ppm drench x 1	Drench volume and mg a.i. vary with container size	
			15 ppm spray x 1	Blue Scent	Unspecified
		Concise/Sumagic	5 to 10 ppm spray x 1 to 3	Hidcote Blue or Munstead – as needed	Unspecified
			15 to 30 ppm spray x 1	Phenomenal – for control of flower stalk height, apply when flower stalk reaches the top of the foliage. Higher rate delayed flower opening by 5 days	South
			5 to 10 ppm spray x 2	Weekly applications at 5 ppm as necessary; Sweet Romance – may need 5 ppm spray x 1 for compact growth; Apply lower rates early in production and higher rates later under better growing conditions	North

(PGRs in **bold typeface** are from Fine Americas, Inc.)

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Lavandula x intermedia (Lavander)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Provence – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	South
	To root cuttings and induce lateral branching	**Advocate**/Hortus IBA + **Configure**/**Configure 9.5 SC**	200 + 50 to 400 ppm x 1 spray	Provence – apply 200 ppm **Advocate** 24-hours after cutting stick, and again at 10 days after cutting stick but as a tank-mix with **Configure**/**Configure 9.5 SC**; Rates of **Configure**/**Configure 9.5 SC** up to 400 ppm controlled liner growth; No branching stimulated; Trial rates.	South
	To control plant growth	**Dazide 85 WSG**/ B-Nine	5,000 ppm spray x 2	Silver Edge (Walvera) – good growth control; Apply at 10- to 14-day intervals	South
			1,500 to 2,500 ppm spray x 2 to 3	Weekly sprays as needed	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Silver Edge (Walvera) – good growth control	South
			2,500 + 1,000 ppm spray x 2 to 3	Weekly sprays as needed	North
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	Not responsive at 160 ppm spray x 1	Silver Edge (Walvera) – not responsive	South
			30 ppm spray x 2 to 3	Weekly sprays	North
		Concise/Sumagic	Not responsive at 60 ppm spray x 1	Silver Edge (Walvera) – not responsive to 60 ppm spray x 1	South
			4 to 6 ppm spray x 2 to 3	Weekly sprays as needed	North
	To increase lateral branching of liners	**Configure**/ **Configure 9.5 SC**	300 ppm spray x 2 on liners	Provence – 2 sprays, first after rooting and again 2 weeks later, increased lateral and basal branching with slight reduction in root growth; Apply after liners are well rooted	Branching
Leucanthemum × superbum (Shasta Daisy)	To root cuttings	**Advocate**/Hortus IBA	200 to 400 ppm x 1 spray	Snow Cap and Sweet Daisy Christine – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	South
	To control plant growth	**Abide**/A-Rest	25 ppm spray x 2 to 3	Weekly sprays as necessary; Becky – stunting with 100 ppm spray x 6	North
			5 ppm drench x 1	Drench volume and mg a.i. will vary with container size	
		Collate 2L/Florel	750 ppm spray x 4	Ice Star – weekly sprays reduced growth while increasing the number of inflorescences; Thomas Killen – 500 ppm spray x 3 at 2-week intervals gave moderate growth control, but reduced number of inflorescences per shoot and number of shoots per pot	North
		Collate 2L	125 to 500 ppm drench x 1	Snow Cap – apply 10 days after transplant; Controlled plant height and plant diameter; Lower leaf chlorosis observed with 1000 ppm; Drench volume varies with container size	North
		Dazide 85 WSG/ B-Nine	Not responsive at 5,000 ppm spray x 2	Alaska and Becky – not responsive	South
			2,500 to 5,000 ppm spray x 4 to 6	Amazing Daisies – 2,500 ppm spray as needed; Becky and Ice Star – 5,000 ppm sprays weekly	North
			Tank mix	Tank mix spray 2,500 ppm daminozide + 15 ppm paclobutrazol x 1 to 2	
			Tank mix	Tank mix spray 2,000 ppm daminozide + 3 to 5 ppm uniconazole x 1 to 2	
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 1	Becky – not responsive; Test higher daminozide rate	South
		Citadel/Altercel	Not responsive at 4,000 ppm spray x 1	Becky – not responsive	South
			1,500 ppm spray x 4 to 6	Becky and Ice Star – good control with weekly sprays	North

* Mixing Rate Table on page 75

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Leucanthemum × superbum (Shasta Daisy) *continued*	To control plant growth *continued*	**Piccolo**/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Less than 40 ppm spray x 1	Alaska – sensitive to paclobutrazol; Test rates below 40 ppm; Becky – moderate, short-term response to 120 ppm spray x 1; Multiple applications or higher rates required	South
			10 to 30 ppm spray x 2 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Weekly sprays as necessary; Becky and Ice Star – stunting with 90 ppm spray x 6	North
			6 ppm drench x 1	Drench volume and mg a.i. will vary with container size	
		Concise/Sumagic	Less than 15 ppm spray x 1	Alaska – sensitive to uniconazole; Test rates below 15 ppm; Becky – not responsive to 60 ppm spray x 1; Multiple applications or higher rates required	South
			5 to 10 ppm spray x 1 to 2	Amazing Daisies – weekly sprays as necessary; Becky and Ice Star – stunting with 15 ppm spray x 6	North
		Topflor	6 ppm drench x 1	Drench volume and mg a.i. will vary with container size	North
	To increase basal branching	**Configure**/ **Configure 9.5 SC**	300 ppm spray x 1 to 2 for liners	Snowcap – single or multiple foliar sprays applied after rooting increased basal branching, but slightly reduced root growth; Apply after liners are well rooted	Branching
			600 ppm spray x 1 to 2 on finished plants	Becky and Alaska – applied to finish plants once increased branching short term, but doubled the number of flowers of Alaska; 600 ppm was our screening rate; Higher rates or multiple applications may be more effective	
Liatris spicata (Spike Gayfeather)	To control plant growth	**Abide**/A-Rest	50 ppm spray x 2 to 3	Weekly applications; Kobold Blue – stunting with 100 ppm spray x 6	North
		Collate 2L/Florel	Not responsive at 500 to 1,000 ppm spray x 1 to 3	Kobold – not responsive to biweekly sprays	North
		Dazide 85 WSG/ B-Nine	3,750 ppm spray x 2 to 3	Weekly applications; Kobold Blue – not responsive to 5,000 ppm sprays x 6 weekly	North
			Tank mix	Tank mix spray of 2,500 ppm daminozide + 5 ppm uniconazole x 2 to 3	
		Citadel/Altercel	Not responsive at 1,500 ppm spray x 6	Kobold Blue – not responsive to weekly applications	North
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	Not responsive at 160 ppm spray x 1	Floristan Violet – not responsive	South
			90 ppm spray x 6	Kobold Blue – weekly applications gave good control	North
		Concise/Sumagic	Not responsive at 60 ppm spray x 1	Floristan Violet – not responsive	South
			15 ppm spray x 6	Kobold Blue – weekly applications gave good control	North
Lobelia cardinalis (Cardinal Flower)	To control plant growth	**Abide**/A-Rest	25 ppm spray x 2 to 3	Weekly sprays	North
			5 ppm drench x 1	Drench volume and mg a.i. will vary with container size	
		Dazide 85 WSG/ B-Nine	Not responsive at 5,000 ppm spray x 2	Not responsive	South
			2,500 to 5,000 ppm spray x 2 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Weekly applications may be required	North
			Tank mix	Good height control with Tank mix spray 2,000 ppm daminozide + 3 ppm uniconazole x 2 to 3 weekly applications	
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000 + 4,000 ppm spray x 1	Not responsive	South
			2,500 + 1,000 ppm spray x 2 to 3	Weekly sprays	North
		Citadel/Altercel	1,250 ppm spray x 2 to 3	Weekly sprays	North

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Lobelia cardinalis (Cardinal Flower) *continued*	To control plant growth *continued*	**Piccolo**/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Not responsive at 60 ppm spray x 1	Not responsive	South
			30 ppm spray x 2 to 3	Weekly sprays	North
			6 ppm drench x 1	Drench volume and mg a.i. will vary with container size	
		Concise/Sumagic	30 ppm spray x 1	Good control	South
			5 ppm spray x 2 to 3	Weekly sprays	North
			1 ppm drench x 1	Drench volume and mg a.i. will vary with container size	
		Topflor	6 ppm drench x 1	Drench volume and mg a.i. will vary with container size	North
	To increase lateral branching	**Configure**/ **Configure 9.5 SC**	600 ppm spray x 1	This rate was our screening rate; Lower rates may be effective	Branching
Lobelia × speciosa (Hybrid Lobelia)	To control plant growth	**Abide**/A-Rest	25 to 50 ppm spray x 2 to 3	Weekly spray applications at 7-day intervals	North
		Dazide 85 WSG/ B-Nine	2,500 to 5,000 ppm spray x 2 to 3	Weekly sprays	North
		Citadel/Altercel	1,250 ppm spray x 2 to 3	Weekly sprays	North
			1,500 ppm spray x 3	Label rate: Compliment Scarlet and Queen Victoria (Altercel)	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	120 ppm spray x 2 to 3	Fan Deep Rose – moderate response to a single application; Multiple applications required	South
			30 ppm spray x 1	Starship Series and Vulcan Red – multiple sprays may be required	Unspecified
		Concise/Sumagic	5 to 10 ppm spray x 2 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Weekly sprays at 5 ppm; Starship Series and Vulcan Red – 5 ppm sprays as needed	North
	To increase lateral branching	**Configure**/ **Configure 9.5 SC**	600 ppm spray x 1	Fan Deep Rose – increased number of shoots, not branches; This rate was our screening rate; Higher rates or multiple applications may be more effective	Branching
Lupinus sp. (Lupine)	To tone or control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 ppm spray x 2 to 3	Weekly as needed	North
			Tank Mix	Tank mix spray 2,000 to 2,500 ppm daminozide + 3 ppm uniconazole x 2 to 3; Staircase Series to tone or harden foliage. To reduce the height of the flower, apply weekly just as the flower stem is beginning to elongate above the foliage	
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	20 ppm spray x 2 to 3	Weekly as needed	North
	To increase lateral branching	**Configure**/ **Configure 9.5 SC**	175 ppm spray x 1	Staircase Series – apply about 5 weeks after transplanting, when plant is well rooted	Branching
Lysimachia sp. (Loosestrife)	To control plant growth	**Dazide 85 WSG**/ B-Nine	5,000 ppm spray x 2	Snow Candles – moderate control; Apply at 10- to 14-day intervals	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	2,500 + 1,500 ppm spray x 1	Snow Candles – moderate control of height and width	South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	120 ppm spray x 1	Snow Candles – moderate control of height and width	South
		Topflor	30 ppm spray x 1	Snow Candles – moderate control of height and width	South
	To increase lateral branching	**Configure**/ **Configure 9.5 SC**	100 to 150 ppm spray x 1 on liners	Increased branching	Branching

* Mixing Rate Table on page 75

Color Code:
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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Malva alcea (Hollyhock Malva)	To control plant growth	**Dazide 85 WSG**/ B-Nine	Not responsive to 5,000 ppm spray x 2	Not responsive	South
		Citadel/Altercel	750 to 1,500 ppm spray x 1	Not responsive	South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	Much less than 40 ppm spray x 1	Very sensitive; Test rates around 10 to 20 ppm	South
			15 ppm spray x 1	Effective at controlling plant height when applied early in the crop	North
		Concise/Sumagic	Much less than 15 ppm spray x 1	Very sensitive; Test rates around 2 to 5 ppm	South
			2.5 ppm spray x 1	Effective at controlling plant height when applied early in the crop	North
Miscanthus sinensis (Maiden Grass)	To control plant growth	**Citadel**/Altercel	1,500 ppm spray x 4	Weekly sprays reduced plant height moderately	North
		Dazide 85 WSG/ B-Nine	Not responsive at 5,000 ppm spray x 2	Gracillimus – not responsive	South
			5,000 ppm spray x 4	Weekly sprays reduced plant height moderately	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 2	Gracillimus – not responsive	South
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Not responsive at 160 ppm spray x 1	Gracillimus – not responsive	South
			10 ppm drench x 1	Apply when plants are 10 to 12 inches tall; drench volume and mg a.i. will vary with container size	North
		Concise/Sumagic	40 to 60 ppm spray x 2 to 3	Gracillimus – moderate height control only at 2 weeks after single treatment; Multiple applications may provide control	South
			2 ppm liner soak x 1	Gracillimus – very responsive to liner soaks	
			15 ppm spray x 4	Excessive growth regulation with weekly sprays; Reduce spray frequency	North
			2 ppm drench x 1	Apply when plants are 10 to 12 inches tall; Drench volume and mg a.i. will vary with container size	
		Topflor	Not responsive at 120 ppm spray x 1	Gracillimus – not responsive	South
			10 ppm drench x 1	Apply when plants are 10- to 12-in. tall; Drench volume and mg a.i. will vary with container size	North
	To increase tillering	**Collate 2L**/Florel	750 ppm spray x 4	Weekly sprays reduced plant height and increased number of tillers	Branching
		Configure/ **Configure 9.5 SC**	Not responsive 500 or 1,000 ppm spray x 1	Gracillimus – not responsive	Branching
Monarda didyma (Bee Balm)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Pocahontas Red – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Abide**/A-Rest	25 ppm spray x 2 to 3	Weekly sprays	North
			1 to 2 ppm drench x 1	Drench volume and mg a.i. vary with container size	Unspecified
		Collate 2L /Florel	500 ppm spray x 2	Gardenview Scarlet – good growth control; No flower data	South
			500 ppm spray x 3	Blue Stocking – biweekly sprays gave moderate growth control with slight delay in flowering and moderate reduction in the number of inflorescences; No effect on branching.	North
				Marshall's Delight – stunting and delayed flowering with 500 ppm sprays x 4; Reduce frequency of application	
		Collate 2L	125 to 250 ppm drench x 1	Pocahontas Red – apply 10 days after transplant; Controlled plant height and plant diameter; Leaf epinasty observed at all trialed concentrations and leaf chlorosis and leaf observed at ≥500 ppm; A delay in flowering observed in all plants trialed; Drench volume varies with container size	North

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Monarda didyma (Bee Balm) *continued*	To control plant growth *continued*	**Dazide 85 WSG**/ B-Nine	5,000 ppm spray x 2 to 3	Mahogany, Marshall's Delight and Raspberry Wine – good control; Blue Stocking – not responsive	South
			2,500 to 3,750 ppm spray x 2 to 3	Weekly sprays at lower rates; Marshall's Delight – not responsive at 5,000 ppm spray x 4 at 2 week intervals	North
			Tank mix	Tank mix spray of 2,000 ppm daminozide + 3 ppm uniconazole x 2 to 3	
		Citadel/Altercel	Not responsive at 4,000 ppm spray x 1	Blue Stocking – not responsive	South
			1,500 ppm spray x 4	Marshall's Delight – excellent control with sprays at 2-week intervals	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Mahogany and Marshall's Delight – good control; Multiple applications may be required	South
			2,500 + 1,000 ppm spray x 2 to 3	Weekly applications	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	100 ppm spray x 1	Raspberry Wine – good control; Blue Stocking, Jacob Kline or Mahogany – not responsive with 160 ppm spray x 1	South
			6 to 8 ppm drench x 1	Raspberry Wine – good control with 6 ppm drench x 1 applied as 2 fl. oz. per qt. pot; Jacob Kline – moderate control with 8 ppm drench x 1 applied as 10 fl. oz. per trade gal. pot but reduced the number of flowers. Drench volume and mg a.i. vary with container size	
			16 ppm liner soak x 1	Raspberry Wine – good but short-term control with liner soak	
			30 to 60 ppm spray x 2 to 4	Weekly 30 ppm sprays; Marshall's Delight – excellent control with 60 ppm sprays x 4 at 2-week intervals	North
			45 ppm spray x 1 to 3	Multiple spray applications may be necessary	Unspecified
			3 to 6 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	15 to 30 ppm spray x 1	Mahogany, Marshall's Delight, Blue Stocking and Jacob Cline – good control	South
			1 ppm drench x 1	Jacob Cline – drench applied at 4 fl. oz. per qt. pot; Drench volume and mg a.i. vary with container size	
			5 to 15 ppm sprays x 2 to 4	Weekly sprays at 5 ppm; Marshall's Delight – stunting with 15 ppm sprays x 4 at 2-week intervals; reduce rate or frequency	North
			15 to 30 ppm spray x 1	Multiple applications of lower rate may be applied as necessary	Unspecified
		Topflor	Less than 37 ppm spray x 1	Excessive control of Jacob Cline	South
Muhlenbergia capillaris (Pink Muhlygrass)	To control plant growth	**Concise**/Sumagic	40 ppm spray x 1	Early control of growth; Multiple applications may be required	South
	To increase tillering	**Configure**/ **Configure 9.5 SC**	Not responsive at 500 or 1,000 ppm spray x 1	Small early increase in number of tillers that did not persist after 2 weeks after treatment; Test multiple applications	Branching
Myosotis sylvatica (Forget Me Nots)	To control plant growth	**Dazide 85 WSG**/ B-Nine + **Citadel**/ Altercel Tank Mix	3,500 + 750 ppm spray x 1 to 3	May require multiple applications	North

* Mixing Rate Table on page 75

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Nepeta × faassenii (Catmint)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Walker's Low – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Abide**/A-Rest	25 ppm spray x 2 to 3	Weekly applications	North
		Dazide 85 WSG/ B-Nine	2,500 to 5,000 ppm spray x 5	Blue Moon, Pink Cat – weekly applications at 2,500 ppm; Walker's Low – good control with 5,000 ppm spray x 5 weekly	North
			Tank Mix	Tank mix spray 2,000 ppm daminozide + 3 ppm uniconazole x 2 to 3	
			Tank Mix	Tank mix spray 3,750 ppm daminozide + 6 to 8 ppm uniconazole x 2 to 3	Unspecified
		Citadel/Altercel	1,500 ppm spray x 5	Walker's Low – weekly applications gave good control	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Six Hills Giant – good control; Multiple applications may be required	South
			2,500 + 1,000 ppm spray x 3	Six Hills Giant – excellent control	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	15 ppm spray x 1	Walker's Low – single application at 3 weeks after planting gave good control	South
			30 ppm spray x 2 to 3	Walker's Low, Kitten Around – repeat at 7- to 10-day intervals beginning when plants are 4- to 6- in. high; Multiple spray applications may be necessary	North
			5 ppm drench x 1	Good control with drench of 4 fl. oz. per 5.5-in. pot at 1 week after planting; Drench volume and mg a.i. affected by pot size; Higher drench rates resulted in leaf necrosis	
			Greater than 20 ppm liner soak x 1	Liner soak gave only 3 weeks control; Test higher rate	
		Concise/Sumagic	5 to 15 ppm spray x 1 to 3	Walker's Low – repeat 5 ppm sprays x 3 at 7- to 10-day intervals beginning when plants are 4- to 6-in. high; Or, apply a single spray of 15 ppm at 8 days after planting or 2 sprays of 10 ppm (at 1 and 3 weeks after planting)	North
		Collate 2L	125 to 500 ppm drench x 1	Walker's Low – apply 10 days after transplant; Controlled plant height and plant diameter; Phytotoxic effects including leaf epinasty, leaf chlorosis, and shoot-tip death at ≥500 ppm; Drench volume varies with container size	North
	To increase lateral branching	**Configure**/ **Configure 9.5 SC**	600 ppm spray x 1 to 2 on liners	Applied once at 5 days after transplant or twice [at liner stage (7 days after sticking) and at 5 days after transplant] increased number of lateral branches; Slight reduction in plant growth	Branching
Oenothera fruticosa youngii (Sundrops)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 ppm spray x 1 to 3	Multiple applications may be necessary	Unspecified
		Concise/Sumagic	5 to 10 ppm spray x 1	If necessary, uniconazole is effective	North
	To increase lateral branching	**Configure**/ **Configure 9.5 SC**	Not responsive to 50 to 1,600 ppm spray x 1	Not responsive to single spray applied 2 weeks after potting	Branching
Oenothera specisoa (Evening Primrose)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Twilight – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Collate 2L**	250 to 750 ppm drench x 1	Twilight – apply 10 days after transplant; Controlled plant height and plant diameter; No delay in flowering; Drench volume varies with container size	North
Opuntia microdasys (Pricklypear Cactus)	Induce lateral branching	**Configure**/ **Configure 9.5 SC**	Not responsive to 100 to 200 ppm spray x 1	Not responsive	Branching

(PGRs in **bold typeface** are from Fine Americas, Inc.)

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Paeonia lactiflora (Peony)	To control plant growth	**Piccolo**/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drench only)	30 to 90 ppm drench x 1	Fall drench application has little effect on growth or flowering of Sarah Bernhardt or Inspecteur Lavergne; higher rates may reduce the number of shoots per plant.	South
		Concise/Sumagic	10 to 20 ppm drench x 1	Drench applied in spring prior to shoot emergence resulted in moderate height control but may reduce flowering; Drench volume and mg a.i. affected by container size	South
			30 to 45 ppm drench x 1	Apply prior to spring emergence for moderate growth regulation of Sarah Bernhardt or Inspecteur Lavergne	
			Not responsive at 10 to 20 ppm sprench x 1 (4x volume)	Spring growth was not responsive to sprenches applied the previous fall or after Spring emergence	
			30 to 45 ppm sprench x 1	Fall drench has little effect on plant growth of Sarah Bernhardt or Inspecteur Lavergne but increased the number of flowering shoots per plant.	
	Induce basal branching	**Configure**/ **Configure 9.5 SC**	100 to 1,600 ppm crown soak x 1	BA applied as a 5-minute pre-plant soak of peony crown divisions in the fall caused buds to sprout about 20 days earlier and over a shorter time period; 400 ppm optimal	Branching
			Not responsive at 250 or 500 ppm crown soak x 1	Not responsive to 2-min pre-plant soaks of divisions in the fall	
Panicum virgatum (Switchgrass)	To control plant growth	**Abide**/A-Rest	Not responsive at 100 ppm spray x 4	Heavy Metal – little effect of biweekly sprays	North
		Collate 2L/Florel	Not responsive at 500 ppm spray x 4	Heavy Metal – biweekly sprays had no effect plant height, but plants were thinner	North
		Dazide 85 WSG/ B-Nine	Not responsive 5,000 ppm spray x 2	Shenanadoah – not responsive	South
			5,000 ppm spray x 4	Heavy Metal – little effect of biweekly sprays	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 2	Shenanadoah – moderate response to biweekly sprays	South
			Not responsive at 3,000 + 1,500 ppm spray x 4	Heavy Metal – biweekly sprays had no effect plant height	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	80 ppm spray x 1	Shenanadoah – moderate response	South
			Less than 60 ppm spray x 4	Heavy Metal – biweekly sprays caused excessive growth reduction with little height control; Plants were very thin; Reduce frequency of application	North
			5 to 18 ppm drench x 1	Apache Rose and Cheyenne Sky – 5 ppm drench; Heavy Metal – 12 to 18 ppm drenches are more effective; Drench volume and mg a.i. affected by container size	
		Concise/Sumagic	Not responsive at 60 ppm spray x 1	Shenandoah – not responsive	South
			15 ppm spray x 4	Heavy Metal – biweekly sprays caused excessive growth reduction with little height control; Plants were very thin; Reduce frequency of application	North
			1 to 2 ppm drench x 1	Apache Rose and Cheyenne Sky – apply 1 ppm drench x 1; Heavy Metal – 2 ppm drenches are more effective; Drench volume and mg a.i. affected by container size	
		Topflor	60 ppm spray x 1	Shenanadoah – moderate response	South
			10 to 15 ppm drench x 1	Drenches are more effective than sprays; Drench volume and mg a.i. affected by container size	North
	To increase tillering	**Configure**/ **Configure 9.5 SC**	Not responsive at 500 ppm spray x 4	Heavy Metal – not responsive to biweekly sprays; Plants much thinner than untreated	Branching

* Mixing Rate Table on page 75

Color Code: Gold = Sunbelt sources; Blue = Northern sources; White = No specification; Pink = Increase branching recommendations

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Papaver orientale (Oriental Poppy)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 ppm spray x 2 to 3	Weekly sprays	North
			Tank mix	Tank mix spray of 2,000 ppm daminozide + 3 ppm uniconazole x 1	
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	160 ppm spray x 1	Royal Wedding – growth reduction was moderate and short term; Princess Victoria – not responsive under nursery conditions	South
		Concise/Sumagic	30 to 45 ppm spray x 1	Royal Wedding and Princess Victoria – moderate growth reduction under nursery conditions	South
Penstemon barbatus (Beardlip Penstemon, Bearded Tongue) ***Penstemon digitalis*** (Foxglove Beardtongue) ***Penstemon × mexicali hybrids*** (Penstemon)	To control plant growth	**Collate 2L**/Florel	500 ppm spray x 1	Pike's Peak Purple – moderate control of plant height, increased branching but delayed flowering by 7 days	South
		Dazide 85 WSG/ B-Nine	1,500 to 2,500 ppm spray x 1	Husker Red, Firebird, Carillo Series, Pinacolada	Unspecified
			5,000 ppm spray x 1	Pike's Peak Purple – moderate height control, but reduced flowering	South
			2,500 ppm spray x 1 to 3	Pensham Laura, Red Riding Hood or Rock Candy Series may require multiple applications; Effective on Midnight Masquerade	North
			Tank Mix	Rock Candy Series – Tank mix spray of 2,000 ppm daminozide + 3 ppm uniconazole x 1 to 2	
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	2,500 + 1,000 ppm spray x 2	Multiple applications required for hybrids	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Less than 160 ppm spray x 1	Husker Red – excessive growth regulation with 160 ppm spray x 1; Pike's Peak Purple – moderate height control of with 80 ppm spray x 1	South
			Less than 8 ppm drench x 1	Husker Red – excessive growth regulation with 8 ppm drench x 1; Drench applied at 10 fl. oz. per trade gallon pot. Drench volume and mg a.i. will vary with container size	
			10 to 16 ppm liner soak x 1	Laura – moderate growth regulation with liner soak; May need additional control	
			2 ppm liner drench x 1	Red Rocks or Pike's Peak Purple – good growth regulation with 2 ppm liner drench at 0.3 fl. oz. per liner in 72-cell tray	
			5 to 30 ppm spray x 1 to 2	Midnight Masquerade – 5 to 10 ppm; Pensham Laura or Red Riding Hood – 20 to 30 ppm sprays; May require multiple applications	North
			5 to 15 ppm spray x 1	Husker Red or Firebird – 5 to 10 ppm x 1; Pinacolada 15 ppm x 1	Unspecified
			2 to 3 ppm drench x 1	Pinacolada; Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	5 ppm spray x 1 to 2	Pensham Laura or Red Riding Hood – may require multiple applications	North
			30 ppm spray x 1	Pike's Peak Purple – good growth regulation	South
			5 to 10 ppm spray x 1 to 3	Multiple applications required for hybrids	Unspecified
	To increase basal branching	**Configure**/ **Configure 9.5 SC**	600 ppm spray x 1	Husker Red and vernalized Prairie Dusk – increased basal branching; unpinched Pike's Peak Purple – increased lateral branching and number of flower stalks; Red Rocks – increased lateral branching	Branching

(PGRs in **bold typeface** are from Fine Americas, Inc.)

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
***Perovskia atriplicifolia* [*Salvia yangii*]** (Russian Sage)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Abide**/A-Rest	25 to 100 ppm spray x 3	Weekly 25 to 50 ppm sprays. Apply 50 ppm sprays early in production and 100 ppm sprays later under better growing conditions; Multiple applications may be required; Excellent control with three 100 ppm sprays at 10 day intervals	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2	Apply at 10- to 14-day intervals; Slight delay in flowering	South
			3,750 to 5,000 ppm spray x 2 to 3	Apply 3,750 ppm sprays early in production and 5,000 ppm sprays later under better growing conditions; Multiple applications at 10-day intervals	North
			2,000 to 5,000 ppm spray x 1	Blue Steel – apply 2,500 to 5,000 ppm as needed	Unspecified
			Tank Mix	Tank mix spray of 2,500 ppm daminozide + 3 ppm uniconazole x 1 to 3	North
		Citadel/Altercel	1,250 to 1,500 ppm spray x 3	Good control with three 1,500 ppm sprays at 10-day intervals or weekly 1,250 ppm sprays	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Good control; Multiple applications may be necessary	South
			2,500 + 1,000 ppm spray x 2 to 3	Weekly sprays	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	30 to 40 ppm spray x 1	Longin – required higher rate of 80 ppm sprays; May require multiple applications	South
			2 ppm liner soak x 1	Good control	
			30 to 45 ppm spray x 2 to 3	Three 30 ppm sprays at 10-day intervals gave excellent control	North
			6 ppm drench x 1	Drench volume and mg a.i. will vary with container size	
		Concise/Sumagic	15 to 30 ppm spray x 1 to 2	Good control; Multiple spray applications may be necessary	South
			1 ppm liner soak x 1	Good control	
			5 to 15 ppm spray x 2 to 3	Apply 5 ppm sprays early in production and 10 ppm sprays later under better growing conditions; Multiple applications may be required;15 ppm spray x 3 at 10-day intervals gave excessive growth regulation, reduce rate or frequency of application	North
			5 to 20 ppm spray x 1 to 2	Multiple applications may be required	Unspecified
		Topflor	35 to 45 ppm spray x 1	Multiple applications may be required	South
			Less than 2 ppm liner soak x 1	This liner soak rate gave excessive early height reduction, but plants grew out by 7 weeks after treatment	
		Collate 2L	125 to 500 ppm drench x 1	Apply 10 days after transplant; Controlled plant height and plant diameter; Severe stunting occurred with ≥500 ppm; Delay in flowering occurred; Drench volume varies with container size	North
Persicaria microcephala (Knotweed, Fleece Flower)	To control plant growth	**Concise**/Sumagic	45 ppm spray x 1	Red Dragon – good control	South
			0.5 ppm drench x 1	Red Dragon – good control; Drench applied as 10 fl. oz. per trade gallon pot; Drench volume and mg a.i. will vary with container size	
Phlox paniculata (Garden Phlox)	To root cuttings	**Advocate**/Hortus IBA	200 to 400 ppm x 1 spray	Flame Red and Flame Pink – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Abide**/A-Rest	Not responsive at 100 ppm spray x 4	Mt. Fuji – not responsive to 4 sprays at 2-week intervals	North
		Collate 2L/Florel	Not responsive at 500 ppm spray x 1	Starfire liners – treated just after removal of cuttings from mist were not responsive to sprays; No effect on finished plants	South
			500 or 1,000 ppm spray x 1 to 3	Mt. Fuji – biweekly sprays provided no growth control nor increased branching, but increased the number of inflorescences per pot	North

* Mixing Rate Table on page 75

Color Code: Gold = Sunbelt sources; Blue = Northern sources; White = No specification; Pink = Increase branching recommendations

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Phlox paniculata (Garden Phlox) *continued*	To control plant growth *continued*	**Collate 2L**	125 to 500 ppm drench x 1	Flame Red – apply 10 days after transplant. Controlled plant height and plant diameter; Leaf chlorosis at ≥500 ppm; A delay in flowering at ≥750 ppm; Drench volume varies with container size	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2	Blue Boy, Bright Eyes and David – moderate response; Charles Curtis – not responsive; Apply at 10- to 14-day intervals	South
			2,500 to 3,750 ppm spray x 2 to 3	To control plant growth, begin applications early in crop cycle as stems are rapidly elongating; Mt. Fuji – not responsive to 5,000 ppm spray x 4 at 2-week intervals	North
			Tank Mix	Tank mix spray of 2,500 ppm daminozide + 3 to 5 ppm uniconazole x 1 to 3; Opening Act – responsive	
		Citadel/Altercel	Not responsive at 4,000 ppm spray x 1	Blue Boy and Charles Curtis – not responsive	South
			750 to 1,250 ppm spray x 2 to 3	Apply 750 ppm early in production and 1,000 ppm later under better growing conditions; Multiple applications may be required; Weekly sprays of 1,250 ppm; Mt. Fuji was stunted with 4 applications of 1,500 ppm at 2-week intervals	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 4,000 ppm spray x 1	Blue Boy and Charles Curtis – good control; Multiple applications required; David – not responsive	South
			5,000 + 1,500 ppm spray x 1	Label rate: Blue Boy and Charles Curtis; Multiple applications may be required (max 3) (Altercel)	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Not responsive at 160 ppm spray x 1	Blue Boy – not responsive to spray	South
			4 ppm liner soak x 1	Blue Boy and Bright Eyes – moderate growth control of with liner soak	
			45 to 60 ppm spray x 2 to 3	Begin applications early in crop cycle as stems are rapidly elongating; Weekly 45 ppm sprays as necessary; Mt. Fuji – good control of with 60 ppm spray x 4 at 2-week intervals	North
			10 ppm drench x 1	Control with single drench; Drench volume and mg a.i. vary with container size	
			3 to 4 ppm drench x 1	Peacock – drench volume and mg a.i. vary with container size	Unspecified
			45 ppm spray x 1 to 3	Multiple spray applications may be necessary	
			10 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	60 ppm spray x 1	David – moderate control; Blue Boy and Charles Curtis – not responsive to sprays	South
			2 ppm liner soak x 1	Blue Boy, Bright Eyes and David – moderate growth control with liner soaks	
			10 ppm spray x 1	Opening Act	Unspecified
			5 to 15 ppm spray x 2 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required; Weekly 10 ppm sprays; Mt. Fuji – stunted with 15 ppm spray x 4 at 2-week intervals; Cloudburst tall cushion phlox and Kung Fuchsia – apply 10 ppm spray x 1	North
		Topflor	75 ppm spray x 1	David – moderate growth control; Multiple applications may be required	South
	To increase lateral branching	**Configure**/ **Configure 9.5 SC**	600 ppm spray x 1 to 2 on liners and finished plants	Single spray on finished plants: Franz Schubert – increased number of shoots; David, Laura – not responsive; This rate was our screening rate; Higher rates or multiple applications may be effective; On liners: Bright Eyes treated twice (26 days after sticking and 5 days after transplant) had increased lateral branches with no reduction in growth or flowering	Branching

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Phlox subulata (Thirft, Moss Pink, Creeping Phlox)	To control plant growth	**Abide**/A-Rest	Less than 100 ppm spray x 6	Emerald Blue – excessive growth reduction; Reduce rate or frequency	North
		Dazide 85 WSG/ B-Nine	Not responsive at 5,000 ppm spray x 2	Apple Blossom – not responsive	South
			2,500 to 5,000 ppm spray x 6	Emerald Blue – good control with weekly applications	North
		Citadel/Altercel	1,500 ppm spray x 6	Emerald Blue – stunted; Reduce rate or frequency	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Apple Blossom – moderate control	South
			2,500 + 1,000 ppm spray x 1 to 2		Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	120 ppm spray x 1	Apple Blossom – moderate control; Multiple applications may be required	South
			Less than 90 ppm spray x 6	Emerald Blue – excessive growth reduction; Reduce rate or frequency	North
		Concise/Sumagic	15 ppm spray x 1	Apple Blossom – good control	South
			5 to 15 ppm spray x 2 to 3	Emerald Blue – stunted with 15 ppm spray x 6 weekly; Reduce rate or frequency	North
		Topflor	30 ppm spray x 1	Apple Blossom – good control	South
Platycodon grandiflorus (Balloon Flower)	To control plant growth	**Abide**/A-Rest	25 to 100 ppm spray x 1 to 4	25 to 50 ppm sprays applied once or twice at weekly intervals; Sentimental Blue – excellent growth control with 100 ppm spray x 4 at 2-week intervals	North
		Collate 2L/Florel	500 ppm spray x 4	Sentimental Blue – biweekly sprays reduced growth with slight delay in flowering	North
		Dazide 85 WSG/ B-Nine	2,500 to 3,750 ppm spray x 1 to 3	2,500 ppm sprays once or twice 14-days apart; Apply lower rates early in production and higher rates later under better growing conditions; Sentimental Blue – excessive growth reduction with 5,000 ppm spray x 4 at 2-week intervals; reduce rate or frequency	North
			Tank Mix	Tank mix spray of 2,000 ppm daminozide + 3 ppm uniconazole x 1 to 2	
			1,000 ppm spray x 1 to 3	Miss Tilly – multiple applications as needed to control plant habit; Higher rates may burn leaf edges; Begin applications 2 to 3 weeks after transplant	Unspecified
		Citadel/Altercel	750 to 1,500 ppm spray x 1		South
			1,500 ppm spray x 4	Sentimental Blue – good growth control with 4 applications at 2-week intervals	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	3,000 + 1,500 ppm spray x 4	Sentimental Blue – excessive growth reduction with 4 applications at 2-week intervals; Reduce frequency or rate	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	30 to 60 ppm spray x 1 to 4	30 ppm sprays applied once or twice at weekly intervals; Sentimental Blue – excellent growth control with 60 ppm spray x 4 at 2-week intervals	North
			4 ppm drench x 1	Good control with a single drench; Drench volume and mg a.i. will vary with container size	
		Concise/Sumagic	5 ppm spray x 1 to 2	Weekly sprays; Sentimental Blue – excessive growth reduction with 15 ppm spray x 4 at 2-week intervals, reduce frequency or rate	North
	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	Phyto on liners	Single foliar spray at 300 ppm resulted in significant phytotoxicity to liners	Branching

* Mixing Rate Table on page 75

Color Code: Gold = Sunbelt sources; Blue = Northern sources; White = No specification; Pink = Increase branching recommendations

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Polemonium caeruleum (Jacob's Ladder) ***Poleminium reptans*** (Creeping Jacob's Ladder)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 to 3,750 ppm spray x 2 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Weekly applications of 2,500 ppm	North
			Tank Mix	Heavenly Blue – excellent growth control with a tank mix spray of 1,250 ppm daminozide + 3.75 ppm uniconazole x 3 at weekly intervals	
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	2,500 + 1,500 ppm spray x 1	Label rate (Altercel)	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	30 ppm spray x 2 to 3	Weekly sprays	North
		Concise/Sumagic	5 to 8 ppm sprays x 2 to 3	Weekly sprays	North
		Topflor	6 ppm drench x 1	Drench volume and mg a.i. will vary with container size	North
Primula forbesii (Baby Primrose)	To control plant growth	**Citadel**/Altercel	500 ppm spray x 2	Fragrant Luolan and Red Star – Apply at time of visual emergence of inflorescence and 20 days later	Unspecified
		Concise/Sumagic	25 ppm spray x 2	Fragrant Luolan and Red Star – Apply at time of visual emergence of inflorescence and 20 days later	Unspecified
Primula polyanthus (Polyanthus Primrose)	To control plant growth	**Concise**/Sumagic	5 ppm spray x 2 to 3	Weekly sprays	North
Pycnanthemum flexuosum (Appalachian Mountain Mint)	To control plant growth	**Piccolo**/**Piccolo 10 XC**/Bonzi/Pac O	50 ppm drench x 1	Good height control with a single drench, but flowering reduced; Drench volume and mg a.i. will vary with container size	North
Pycnanthemum virginianum (Virginia Mountain Mint)	To control plant growth	**Piccolo**/**Piccolo 10 XC**/Bonzi/Pac O	34 to 68 ppm drench x 1	Good height control with a single drench, but flowering reduced; Drench volume and mg a.i. will vary with container size	North
Rosa sp. (Rose)	To control plant growth	**Piccolo**/**Piccolo 10 XC**/Bonzi/Pac O	60 ppm sprays x 2 to 6	Knock Out – Multiple applications required	North
		Concise/Sumagic	45 to 60 ppm spray x 1	Knock Out roses had short-term response to sprays; Multiple spray applications required	South
			0.25 ppm drench x 1	Knock Out roses – Drench controlled growth through 6 weeks after treatment, reduced height 35% without reducing width; Drench applied at 10 fl. oz. per trade gal. pot; Drench volume and mg a.i. will vary with container size	
	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	100 ppm spray x 2 or more	Foliar spray 2 to 32 times; Slight increase in branching and increase in the length of the side branches; Subsequent flowering was increased; Effect was better than pinching	Branching
Rosmarinus officinalis (Rosemary)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 ppm spray x 2 to 3	Weekly sprays	North
			5,000 ppm spray x 2	Hill Hardy – moderate growth control	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	2,000 + 1,000 ppm spray x 2 to 3	Weekly sprays	North
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	30 ppm spray x 2 to 3	Weekly sprays	North
		Concise/Sumagic	5 ppm spray x 2 to 3	Weekly sprays	North

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Rosmarinus officinalis (Rosemary) *continued*	To increase lateral or branching	**Collate 2L**/Florel	Not responsive at 500 ppm spray x 1on liners	Hill Hardy – liners treated 2 weeks after removal from mist; Liners not responsive to spray; No significant increase in branching on liners or finished plants	Branching
		Configure/ **Configure 9.5 SC**	300 ppm spray x 2 on liners	Applied approximately 28 days after sticking; Moderately rooted; Increased numbers of shoots and branches and shoot growth of liners	Branching
Rudbeckia fulgida var. sullivantii Goldsturm (Orange Coneflower, Black-eyed Susan)	To control plant growth; begin applications as flower stalks near leaf canopy as they bolt rapidly	**Abide**/A-Rest	50 ppm spray x 2 to 3	Begin applications as flower stalks near leaf canopy, as they bolt rapidly; 6 weekly 100 ppm sprays stunted plants; Reduce rate or frequency	North
		Collate 2L/Florel	Not responsive at 500 ppm spray x 1	No growth control and no flowering data	South
		Dazide 85 WSG/ B-Nine	2,000 to 5,000 ppm spray x 2 to 6	Apply 2 to 3 weekly applications of 3,750 ppm spray; Apply lower rates (3,750 ppm) early in production and higher rates later under better growing conditions; Good control with 5,000 ppm x 6 at weekly intervals	North
			Tank Mix	Tank mix spray of 2,500 ppm daminozide + 5 ppm uniconazole x 2 to 3 at weekly intervals	
		Citadel/Altercel	Not responsive at 4,000 ppm spray x 1	Not responsive	South
			1,000 to 1,500 ppm spray x 2 to 3	Apply 1,000 ppm early in production and 1,250 ppm later under better growing conditions; Multiple applications may be required; Excellent control with 1,500 ppm sprays x 6 at weekly intervals	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	1,250 to 2,500 + 1,000 to 1,250 ppm spray x 2 to 3	Apply 1,250 + 750 ppm early in production and 2,500 + 1,250 ppm x 2 to 3 weekly later under better growing conditions	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	80 to 120 ppm spray x 1	Multiple applications may be necessary	South
			10 to 45 ppm spray x 2 to 3	Goldsturm – apply 10 ppm early in production and 20 ppm later under better growing conditions; Multiple applications may be required; Weekly 45 ppm sprays as necessary	North
			20 to 30 ppm spray x 1	Goldsturm	Unspecified
			6 to 10 ppm drench x 1	Drench volume and mg a.i. will vary with container size	North
		Concise/Sumagic	30 ppm spray x 1	Good control	South
			1 ppm liner soak x 1	Good control	
			2 ppm drench x 1	Good control; Drench applied as 2 fl. oz. per qt. pot; Drench volume and mg a.i. will vary with container size	
			5 to 10 ppm spray x 2 to 3	Goldsturm – apply 2 to 3 weekly sprays; 15 ppm x 6 weekly sprays caused excessive growth reduction; Reduce rate or frequency	North
	Induce lateral or basal branching on liners	**Configure**/ **Configure 9.5 SC**	300 ppm spray x 1	Single foliar spray increased basal branching with significant early phytotoxicity	Branching
			600 ppm spray x 1 on liners	Viette's Little Suzie – no increase in branching, but decreased plant width	
Rudbeckia hirta (Black-eyed Susan)	To control plant growth; apply PGRs just after bloom initiation, but before bud has formed to reduce flower delay	**Dazide 85 WSG**/ B-Nine	2,500 to 5,000 ppm spray x 1	Denver Daisy – apply just after bloom initiation, but before bud has formed to reduce flower delay	Unspecified
			2,500 to 5,000 ppm spray x 1	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North

* Mixing Rate Table on page 75

Color Code: Gold = Sunbelt sources; Blue = Northern sources; White = No specification; Pink = Increase branching recommendations

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Rudbeckia hirta (Black-eyed Susan) *continued*	To control plant growth; apply PGRs just after bloom initiation, but before bud has formed to reduce flower delay *continued*	**Citadel**/Altercel	Phyto at 1,500 ppm spray x 1	Indian Summer – excessive phytotoxicity	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	Phyto at 5,000 + 1,500 ppm spray x 1	Indian Summer – excessive phytotoxicity	South
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	160 ppm spray x 1	Indian Summer – little control; Multiple applications or higher rates required	South
			30 ppm spray x 1 1 to 5 ppm drench x 1	Denver Daisy – apply just after bloom initiation, but before bud has formed to reduce flower delay	Unspecified
			5 to 10 ppm drench x 1	Autumn Colors, Cherokee Sunset, Cherry Brandy, Denver Daisy, Glowing, Happy, Indian Summer, Prairie Sun, and Sunny – apply drench at 2 weeks after transplant; Drench volume and mg a.i. vary with container size	South
		Concise/Sumagic	10 ppm spray x 1	Denver Daisy	Unspecified
			25 ppm spray x 1	Good control under outdoor conditions	South
	To increase basal branching	**Configure**/ **Configure 9.5 SC**	200 ppm spray x 1	Denver Daisy, spray to glisten	Branching
			Not responsive to 50 to 1,600 ppm spray x 1	Single foliar spray applied 4 weeks after potting controlled plant height but did not affect branching; 800 or 1,600 ppm caused phytotoxicity	
Salvia farinacae hybrids (Mealy Cup Sage)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 ppm spray x 1	Spray day after sticking. Follow with tank mix if necessary and repeat daminozide at weeks 4 and 5 if needed	Unspecified
			Tank mix	Tank mix spray of 2,500 ppm daminozide + 10 ppm ancymidol x 1 if needed after daminozide application	
	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	250 ppm spray x 1	Controlled height and increased branching	Branching
Salvia guaranitica (Anise Sage)	To control plant growth	**Concise**/Sumagic	30 ppm spray x 1 at transplant	Black and Blue – very responsive to foliar spray immediately after transplant	South
			1 ppm liner soak or drench x 1	Black and Blue – very responsive to liner soak or drench (0.3 oz. per 72-size cell) before transplant	
Salvia leucantha (Velvet Sage, Mexican Sage)	To control plant growth	**Dazide 85 WSG**/ B-Nine	5,000 ppm spray x 3	Apply at 10- to 14-day intervals	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Multiple applications may be necessary	South
			2,500 ppm spray x 2 to 3	Apply at weekly intervals as needed	North
		Citadel/Altercel	2,250 ppm spray x 1		South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	60 ppm spray x 1		South
		Concise/Sumagic	30 ppm spray x 1	No landscape persistence	South
		Topflor	30 ppm spray x 1		South
Salvia nemorosa (Perennial Sage)	To root cuttings	**Advocate**/Hortus IBA	200 to 400 ppm x 1 spray	East Friesland and Salute Pink – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Collate 2L**	125 to 500 ppm drench x 1	East Friesland – apply 10 days after transplant; Controlled plant height and plant diameter; A delay in flowering observed with ≥500 ppm; Drench volume varies with container size	North

(PGRs in **bold typeface** are from Fine Americas, Inc.)

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Salvia hybrids (Meadow Sage) ***Salvia nemorosa*** (Perennial Sage) ***Salvia officinalis*** (Garden Sage) ***Salvia × sylvestris*** (Wood Sage)	To control plant growth	**Abide**/A-Rest	25 to 100 ppm spray x 2 to 6	2 to 3 sprays at 25 to 50 ppm; Good control of growth of Blue Queen with 100 ppm x 6 weekly	North
			1 to 2 ppm drench x 1	Drench volume and mg a.i. vary with container size	Unspecified
		Collate 2L/Florel	Not responsive at 400 ppm spray x 4	May Night – all sprays phytotoxic; Did not reduce flower buds; Reduced growth	North
			125 to 500 ppm spray x 1 or 2 on liners and finished plants	Aurea liners – just after removal from mist with 125 to 500 ppm sprays gave no growth control; There were no persistent effects on finished plants. Biweekly 500 ppm sprays gave moderate growth control and increased number of inflorescences of May Night	South
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2	Indigo Spires – not responsive; Blue Queen – stunted with delayed flowering; May Night – controlled growth and increased flower number	South
			2,500 to 5,000 ppm spray x 2 to 3	Daminozide Is very effective on salvia; Apply 2,500 ppm sprays 2 to 3 times weekly; Apply low rates early in production and 5,000 ppm later under better growing conditions; Blue Queen – stunted with 5,000 ppm sprays x 6 weekly; reduce rate or frequency	North
			1,500 to 3,750 ppm spray x 1 to 3	Salvatore Blue and New Dimensions Series – 1,500 to 2,000 ppm sprays; Bordeaux and Color Spires – 2,500 ppm sprays; S. officinalis Aurea – 2,500 to 3,750 ppm sprays; Multiple applications may be required	Unspecified
			Tank Mix	Tank mix spray of 2,000 daminozide + 3 ppm uniconazole x 2 to 3	
		Citadel/Altercel	750 to 1,500 ppm spray x 2 to 6	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required; Blue Queen – good control of growth with 1,500 ppm sprays x 6 weekly	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	80 ppm spray x 1	Cultivar differences: Blue Queen – good control with single spray at 80 ppm; Indigo Spires – not responsive at 60 ppm x 1; Blue Hill and May Night – not responsive at 160 x 1	South
			30 ppm spray x 2 to 3	Weekly sprays as necessary; Blue Queen – not responsive to 90 ppm spray x 6 weekly	North
			2 to 6+ ppm drench x 1	As needed; Drench volume and mg a.i. will vary with container size	
			40 to 60 ppm spray x 1	40 to 60 ppm spray is the label rate.	Unspecified
		Concise/Sumagic	10 to 60 ppm spray x 1	Single application 10 ppm spray early in production; Indigo Spires – very responsive at 15 ppm, but may require multiple applications; Blue Queen – good control with 60 ppm spray x 1; May Night – not responsive to 20 ppm spray x 1	South
			5 to 15 ppm spray x 2 to 6	Color Spires – 5 to 7 ppm spray x 1; Blue Queen – excellent control of growth with 15 ppm spray x 6 weekly; Apply 5 ppm early in production and 10 ppm later under better growing conditions; Multiple applications may be required	North
	To increase lateral branching	**Configure**/ **Configure 9.5 SC**	300 ppm spray x 1 or 2 on liners	May Night liners – single or multiple foliar sprays applied after removal from mist increased basal branching; Apply after liners are well rooted	Branching
			400 ppm spray x 1 on finished plants	Branching increased with single spray 2 weeks after potting; Flowering delayed with higher rates	
Scabiosa columbaria (Pincushion Flower)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Pink Mist – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North

* Mixing Rate Table on page 75

Color Code: Gold = Sunbelt sources; Blue = Northern sources; White = No specification

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Scabiosa columbaria (Pincushion Flower) *continued*	To control plant growth; apply PGRs as flower stalk starts to elongate or if rosette appears to be elongating with flowers	**Abide**/A-Rest	25 to 50 ppm spray x 2 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required; Butterfly Blue – not responsive to 100 ppm sprays x 4 at 2-week intervals	North
			1 to 2 ppm drench x 1	Drench volume and mg a.i. vary with container size	Unspecified
		Collate 2L/Florel	Not responsive at 400 ppm spray x 4	Giant Blue – All sprays phytotoxic; Butterfly Blue – not responsive to 500 ppm sprays x 4 at 2 week intervals	North
			500 ppm spray x 2	Butterfly Blue – moderate growth control and slightly delayed flowering	South
		Collate 2L	125 to 500 ppm drench x 1	Pink Mist – apply 10 days after transplant; Controlled plant height and plant diameter; Leaf purpling and shoot tip death at ≥500 ppm; A delay in flowering observed at ≥250 ppm; Drench volume varies with container size	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 3 to 4	Butterfly Blue – good growth control; Pink Mist – moderate control of overwintered plants	South
			2,500 to 5,000 ppm spray x 2 to 3	Weekly 2,500 ppm sprays; Apply 2,500 ppm early in production and 3,750 ppm later under better growing conditions; Multiple applications may be required; Butterfly Blue – good control with 5,000 ppm sprays x 4 at 2-week intervals	North
		Citadel/Altercel	Not responsive at 1,500 ppm spray x 1	Pink Mist not responsive	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Butterfly Blue – moderate control; Pink Mist – little control of overwintered plants; Test multiple applications	South
			2,500 to 4,000 + 1,000 to 1,500 ppm spray	Scabiosa – responsive to tank mix	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	60 ppm spray x 1	Pink Mist – moderate control	South
			30 ppm spray x 2 to 3	Weekly applications; Butterfly Blue – stunted with 60 ppm sprays x 4 at 2-week intervals; Reduce rate or frequency	North
			3 ppm drench x 1	Drench volume and mg a.i. vary with container size	Unspecified
		Concise/Sumagic	20 to 30 ppm spray x 1	Butterfly Blue – good growth regulation with 20 ppm x 1; Pink Mist – required higher rates or multiple applications	South
			5 to 10 ppm spray x 2 to 3	Weekly sprays at 5 ppm; Butterfly Blue – stunted with 15 ppm sprays x 4 at 2-week intervals; Reduce rate or frequency	North
		Topflor	30 to 45 ppm spray x 1	Pink Mist – moderate control; Test multiple applications as necessary; High rates (60 to 75 ppm) reduced flowering	South
	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	Not responsive at 50 to 800 ppm spray x 1	Single foliar spray applied 2 weeks after potting had no effect on branching	Branching
Scutellaria hybrid (Skullcap)	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	Not responsive to 50 to 800 ppm spray x 1	Not responsive to single foliar spray applied 2 weeks after potting	Branching
Sedum sp. (Sedum, Stonecrop)	To control plant growth	**Abide**/A-Rest	Not responsive at 100 ppm spray x 4	Autumn Joy – not responsive to 4 sprays at 2-week intervals	North
		Collate 2L/Florel	500 ppm spray x 4	Autumn Joy – moderate growth control with biweekly sprays	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2	Autumn Joy – moderate growth control; Apply at 10- to 14-day intervals	South
			2,500 to 5,000 ppm spray x 2 to 4	2 to 3 weekly sprays at 2,500 ppm; Autumn Joy – good growth control with 5,000 ppm sprays x 4 at 2-week intervals	North
			Tank Mix	Tank mix spray of 2,000 ppm daminozide + 15 ppm paclobutrazol as needed	

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Sedum sp. (Sedum, Stonecrop) *continued*	To control plant growth *continued*	**Citadel**/Altercel	Not responsive at 4,000 ppm spray x 1	Autumn Joy – not responsive	South
			Not responsive at 1,500 ppm spray x 4	Autumn Joy – not responsive to 4 sprays at 2-week intervals	North
		Collate 2L/Florel	300 to 500 ppm spray x 1	To help control growth and increase branching or delay flowering	Unspecified
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Autumn Joy – moderate growth control; Multiple applications may be required	South
			2,000 + 1,000 ppm spray x 2 to 3	Weekly applications	North
			2,500 to 3,500 + 750 to 1,000 ppm spray	Tank mix will help control growth; Multiple applications may be required	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	80 to 160 ppm spray x 1 to 2	Autumn Joy – good growth control with a single 80 ppm spray; Matrona – requires multiple applications at higher rates	South
			Less than 10 ppm drench x 1	Autumn Joy – stunted with 10 ppm drench at 2 fl. oz. per quart pot; Drench volume and mg a.i. vary with container size	
			30 to 60 ppm spray x 2 to 4	2 to 9 weekly 30 ppm sprays; Autumn Joy – excellent control with 60 ppm sprays x 4 at 2-week intervals	North
			6 to 10 ppm drench x 1	Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	15 to 45 ppm spray x 1	Autumn Joy – rates higher than 30 ppm caused persistent reductions in plant growth in the landscape; Matrona – requires higher rates and/or multiple applications	South
			5 to 15 ppm spray x 2 to 4	2 to 3 weekly 5 ppm sprays; Autumn Joy – excellent control with 15 ppm sprays x 4 at 2-week intervals	North
		Topflor	37 to 60 ppm spray x 1	Autumn Joy – good growth control with a single 37 ppm spray; may require multiple applications; Matrona height was not reduced with a single 120-ppm spray, but width was reduced with a single 60-ppm spray	South
	To increase lateral branching	**Configure**/ **Configure 9.5 SC**	600 ppm spray x 2 on liners	On liners: Autumn Joy treated twice (18 days after sticking and 5 days after transplant) had double the number of shoots and 3 times as many lateral branches with no reduction in growth	Branching
		Collate 2L/Florel	500 ppm spray x 1 on liners	Increased branching	Branching
Sedum lineare (Showy Stonecrop)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Autumn Fire – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Collate 2L**	250 to 500 ppm drench x 1	Autumn Fire – apply 10 days after transplant; Controlled plant height and plant diameter; Leaf cupping observed with ≥125 ppm; Drench volume varies with container size	North
Sedum spurium (Two Row Stonecrop)	To control plant growth	**Piccolo**/**Piccolo 10 XC**/Bonzi/Pac O	10 to 20 ppm spray x 2 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
		Concise/Sumagic	5 to 10 ppm spray x 2 to 3	Apply lower rates early in production and higher rates later under better growing conditions; Multiple applications may be required	North
Sempervivum (Hens and Chicks)	To increase number of offsets	**Configure**/ **Configure 9.5 SC**	200 to 400 ppm spray x 1	Increased offsets; Did not affect subsequent rooting of offsets; Cultivars varied in the number of offsets produced	Branching
Sorghastrum nutans (Indiangrass)	To control plant growth	**Dazide 85 WSG**/ B-Nine	5,000 ppm spray x 2	Indian Steel – moderate growth control	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 2	Indian Steel – good height control	South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	160 ppm spray x 1	Indian Steel – moderate growth control	South
		Concise/Sumagic	45 ppm spray x 1	Indian Steel – moderate growth control; May require multiple applications	South

* Mixing Rate Table on page 75

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Stokesia laevis (Stokes Aster)	To control plant growth	**Abide**/A-Rest	100 ppm spray x 4	Klaus Jelitto – biweekly sprays gave excellent growth control	North
		Collate 2L/Florel	500 ppm spray x 4	Klaus Jelitto – biweekly sprays gave excellent growth control and plants appear more well branched	North
		Citadel/Altercel	1,500 ppm spray x 4	Klaus Jelitto – moderate growth control	North
		Dazide 85 WSG/ B-Nine	5,000 ppm spray x 2	Purple Parasols and Klaus Jelitto – responsive; Apply at 10- to 14-day intervals	South
			5,000 ppm spray x 4	Klaus Jelitto – biweekly sprays gave excellent growth control	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 to 2,250 ppm spray x 1	Purple Parasols and Klaus Jelitto – responsive; May require multiple applications	South
			2,000 + 1,000 ppm spray x 1	Multiple cultivars	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	40 to 80 ppm spray x 1	Purple Parasols – good control	South
			Not responsive at 40 to 80 ppm spray x 1	Klaus Jelitto – not responsive at 80 ppm spray x 1	
			Not responsive to 2 ppm drench x 1	Klaus Jelitto – not responsive to drench applied at 2 fl. oz. per quart pot; Drench volume and mg a.i. vary with container size	
			Less than 60 ppm spray x 4	Klaus Jelitto – biweekly sprays gave excessive growth reduction; Reduce frequency	North
		Concise/Sumagic	Less than 60 ppm spray x 1	Silver Moon – Excessive control at 60 ppm; Purple Parasols and Klaus Jelitto – not responsive at this rate	South
			Less than 15 ppm spray x 4	Klaus Jelitto – biweekly sprays gave excessive growth reduction; Reduce frequency	North
	To induce lateral branching	**Configure**/ **Configure 9.5 SC**	Not responsive at 600 ppm spray x 1	Silver Moon – not responsive; This rate was our screening rate; Higher rates may be effective	Branching
Tradescantia virginiana (Virginia Spiderwort)	To control plant growth	**Dazide 85 WSG**/ B-Nine	5,000 ppm spray x 2	Red Cloud and Blue Stone – moderate growth control; Multiple applications necessary	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 2	Red Cloud – moderate growth control; Blue Stone – not responsive to single spray; Multiple applications necessary	South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	40 to 80 ppm spray x 1	Red Cloud – use higher rate	South
		Concise/Sumagic	15 to 30 ppm spray x 1	Red Cloud – Use higher rate	South
		Topflor	15 to 45 ppm spray x 1	Red Cloud – responsive to low rate; Blue Stone – use higher rate	South
Verbena bonariensis (Tall Verbena, Brazilian Verbena)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 to 5,000 ppm spray x 1	Buenos Aires – additional sprays may be required	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	80 ppm spray x 1	Lollipop – moderate height control with single treatment	South
			10 ppm drench x 1	Drench at 2 fl. oz. per quart pot; Drench volume and mg a.i. will vary with container size	
	To induce lateral branching	**Collate 2L**/Florel	500 ppm spray x 1 on liners	Lollipop – spray applied 2 days after removal of cuttings from mist; Increased lateral branching (3.5 times) of liners with moderate growth regulation; No persistent effect on finished plants	Branching
		Configure/ **Configure 9.5 SC**	300 ppm spray x 2 on liners	Lollipop – increased lateral branching (2.5 times) of liners; First spray applied 13 days after sticking, second spray 14 days later; No persistent effect on finished plants	Branching
Verbena canadensis (Clump Verbena)	To root cuttings	**Advocate**/Hortus IBA	200 ppm x 1 spray	Homestead Purple – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	North
	To control plant growth	**Collate 2L**/Florel	500 ppm spray x 1 to 2	Homestead Purple and Taylortown Red – moderate growth reduction; May delay flowering	South

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Verbena canadensis (Clump Verbena) *continued*	To control plant growth *continued*	**Collate 2L**	125 to 1,000 ppm drench x 1	Homestead Purple – apply 10 days after transplant; Controlled plant diameter but not height; No significant delay in flowering; Drench volume varies with container size	North
		Dazide 85 WSG/ B-Nine	Not responsive at 5,000 ppm spray x 2	Homestead Purple – not responsive	South
			2,500 ppm spray x 1 to 2	Multiple applications may be necessary	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Homestead Purple – good control, but multiple applications may be required	South
			2,000 + 1,000 ppm spray x 2 to 3	Weekly sprays as necessary	North
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	45 ppm spray x 2 to 3	Weekly sprays as necessary	North
			3 to 5 ppm drench x 1	Drench volume and mg a.i. will vary with container size	
			120 to 160 ppm spray x 1	Multiple applications may be necessary	Unspecified
		Concise/Sumagic	15 to 60 ppm spray x 1	Homestead Purple – 15 ppm spray x 1 had very short-term effect; Multiple applications required; Homestead Red Carpet – 60-ppm spray x 1 gave moderate control, but 60 ppm spray x 2 caused stunting	South
			8 ppm drench x 1	Homestead Red Carpet – moderate control; Test higher rates; Drench applied at 10 fl. oz. per trade gal. pot, drench volume and mg a.i. will vary with container size	
			2 ppm liner soak x 1	Homestead Red Carpet – moderate control; Test higher rates	
	Induce lateral or basal branching	**Configure**/ **Configure 9.5 SC**	250 to 1,000 ppm spray x 1	Single foliar sprays immediately after pinching increased lateral branching; 1,000 ppm reduced shoot elongation	Branching
Verbena rigida (Upright Verbena, Tuberous Vervain)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,000 to 2,500 ppm spray x 1	Santos Purple – multiple applications may be necessary	Unspecified
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	2,000 + 750 ppm spray x 1	Santos Purple – multiple applications may be necessary	Unspecified
	To induce lateral branching	Atrimmec	800 ppm spray x 1	Increased branching; Little height control	Branching
		Configure/ **Configure 9.5 SC**	600 ppm spray x 1	Increased number of shoots and branches	Branching
		Collate 2L/Florel	Not responsive at 500 ppm spray x 2	Higher rates reduced height slightly, but there was no increased branching	Branching
Veronica longifolia (Speedwell)	To root cuttings	**Advocate**/Hortus IBA	200 to 400 ppm x 1 spray	First Love – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	South
Veronica longifolia (Long-Leaf Speedwell) ***Veronica hybrids*** (Speedwell) ***Veronica spicata*** (Spike Speedwell)	To control plant growth	**Abide**/A-Rest	25 to 100 ppm spray x 2 to 4	One or two weekly sprays at 25 ppm; Apply 50 ppm early in production and 75 ppm later under better growing conditions; Multiple applications may be required; Blue – 100-ppm sprays x 3 at 10-day intervals gave excellent control	North

* Mixing Rate Table on page 75

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Veronica longifolia (Long-Leaf Speedwell) ***Veronica hybrids*** (Speedwell) ***Veronica spicata*** (Spike Speedwell) ***continued***	To control plant growth ***continued***	**Dazide 85 WSG**/ B-Nine	5,000 ppm spray x 2	Red Fox – good control	South
			2,500 to 5,000 ppm spray x 1 to 4	1 or 2 weekly 2,500 ppm sprays as necessary; Blue – 5,000 ppm sprays x 3 at 10-day intervals gave moderate control; Blue Bouquet – excellent control with 5,000 ppm sprays x 4 weekly	North
			2,000 to 3,000 ppm spray	Red Fox – effective	Unspecified
		Citadel/Altercel	Not responsive at 4,000 ppm spray x 1	Red Fox – not responsive	South
			1,500 ppm spray x 3 to 4	Blue Bouquet – 1,500 ppm sprays x 4 weekly sprays gave good control, Blue – no control with 1,500 ppm sprays x 3 at 10-day intervals	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm sprays x 2	Red Fox – responsive	South
			2,000 + 1,000 ppm spray x 1 to 2	Weekly sprays	North
			2,500 + 1,000 ppm spray	Red Fox – effective	Unspecified
		Piccolo/**Piccolo 10 XC**/Bonzi/ Pac O/Downsize (drenches only)	Less than 40 ppm spray x 1	Red Fox – sensitive, test lower rates; First Love – sensitive, test lower rates	South
			30 ppm spray x 1 to 2	Weekly sprays; Blue – not responsive to 60 ppm sprays x 3 at 10-day intervals; Blue Bouquet – severely stunted by 90-ppm sprays x 4 weekly	North
			Not responsive at 80 ppm spray x 1	Pink Panther – not responsive to spray	South
			Less than 4 ppm drench x 1	Pink Panther – use lower drench rates; Drench applied at 10 fl. oz. per trade gallon pot; Drench volume and mg a.i. will vary with container size	
			2 to 3 ppm liner soak x 1	Pink Panther – moderate growth control with liner soak	
			15 to 30 ppm spray	Red Fox – 15 to 20 ppm spray; Multiple spray applications may be necessary	Unspecified
			2 to 6 ppm drench x 1	As needed; Drench volume and mg a.i. vary with container size	
		Concise/Sumagic	10 ppm spray x 1	Red Fox – very sensitive	South
			6 to 8 ppm spray x 1 to 2	Mona Lisa Smile and Magic Show – effective rates; Blue and Blue Bouquet – severely stunted by multiple applications at 15 ppm spray	North
	To increase lateral branching	**Collate 2L**/Florel	125 to 500 ppm spray x 1 on liners	Treatments applied the day after removal of cuttings from mist. Goodness Grows liners – no height control of liners or finished plants, but liners had 4 times the number of basal branches with 500 ppm spray x 1; No effect on finished plants.	Branching
				First Love – liners not responsive to 125 to 500 ppm sprays x 1, but finished plants had 3 times the number of leaders and a greater number of lateral branches	
			500 ppm spray x 4	Icicle – biweekly sprays did not significantly affect height, but increased branching and flowering. Blue Bouquet – 750 ppm spray x 4 weekly caused excessive growth reduction and delayed flowering	
		Configure/ **Configure 9.5 SC**	500 ppm spray x 4	Icicle – biweekly sprays increased branching with moderate reduction in plant height	Branching
			600 ppm spray x 1 on liners	First Love – increased number of branches on liners; No effect on finished plants	
			300 ppm spray x 2 on liners	Goodness Grows – treated twice (approximately 28 days after sticking and 2 weeks later) had 4 times the number of lateral branches; Shoot height was slightly reduced on liners; No effect on finished plants	

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Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Veronica x Sunny Border Blue (Hybrid Speedwell)	To control plant growth	**Dazide 85 WSG**/ B-Nine	5,000 ppm spray x 2	Multiple applications required; Apply at 10- to 14-day intervals	South
			Tank mix	Tank mix spray of 2,500 ppm daminozide + 20 ppm paclobutrazol x 1 to 2 gave good control	
		Citadel/Altercel	750 to 1,000 ppm spray x 1	Higher rates cause persistent delay of growth in the landscape	South
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Good control; Multiple applications may be required	South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	20 ppm spray x 1	Very sensitive	South
		Concise/Sumagic	10 ppm spray x 1	Very sensitive; Persistent reductions in plant growth continue in the landscape at 15 ppm	South
			Less than 1 ppm drench x 1	Drench applied at 4 fl. oz. per qt. pot; Drench volume and mg a.i. will vary with container size	
		Topflor	30 ppm spray x 1	Moderate control; Multiple applications may be required	South
	To increase lateral branching	**Collate 2L**/Florel	500 ppm spray x 1 on liners	No effect on growth or branching of liners or finished plants	Branching
			400 ppm spray x 4	Sunny Border Blue stock plants – weekly sprays reduced growth and flower buds, but increased branching; Higher rates were phytotoxic	
Vinca major (Greater Periwinkle)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 ppm spray x 1 to 2	Variegata – multiple applications may be required	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	2,500 + 1,000 ppm spray x 1	Apply to liners when removed from mist	
		Concise/Sumagic	5 to 6 ppm sprays x 1 to 2	Variegata – apply 2 to 3 ppm sprays when plants come off mist; Apply higher rates to finish plants; Multiple applications may be required	
	To increase lateral branching	**Collate 2L**/Florel	500 to 1,000 ppm sprays x 1	For increased branching on finished plants	Branching
Vinca minor (Lesser Periwinkle)	To control plant growth	**Dazide 85 WSG**/ B-Nine	2,500 to 5,000 ppm spray x 2	5,000 ppm spray x 2 gave excessive reductions under nursery conditions; Reduce rate or frequency	South
			2,500 ppm spray x 1	May require multiple applications	North
		Dazide 85 WSG/ B-Nine + **Citadel**/ Altercel Tank Mix	5,000 + 1,500 ppm spray x 1	Moderate reductions under nursery conditions; May require multiple applications	South
		Piccolo/**Piccolo 10 XC**/Bonzi/Pac O	40 ppm spray x 1	Moderate effect under nursery conditions; May require multiple applications	South
		Concise/Sumagic	15 ppm spray x 1	Moderate effect under nursery conditions; May require multiple applications	South
			5 to 6 ppm spray x 1	May require multiple applications	North
	To increase lateral branching	**Collate 2L**/Florel	500 to 1,000 ppm spray x 1	For increased branching of finished plants	Branching
		Configure/ **Configure 9.5 SC**	Not responsive at 1,200 ppm spray x 1	Sterling Silver – not responsive	Branching

* Mixing Rate Table on page 75

Collate 2L Drenches for Herbaceous Perennials

By W. Garrett Owen, The Ohio State University

In floriculture crop production, plant growth regulators (PGRs) are commonly used to either encourage adventitious rooting, control or promote growth, or improve branching. Growers most often utilize growth retardant compounds to control stem elongation, thereby producing uniform, compact plants. There's a suite of growth retardant products available that can be applied as foliar sprays, substrate drenches, liner dips, or bulb soaks or dips to suppress undesirable stem elongation. These compounds generally have one primary purpose: inhibiting gibberellin biosynthesis. However, there's one PGR many growers utilize that elicits a range of responses on plants—ethephon.

Ethephon, an ethylene-releasing compound, was first discovered in 1965 and registered by the Environmental Protection Agency (EPA) in 1973. It has many agricultural uses, such as leaf removal and boll opening in cotton, fruit and mistletoe elimination from ornamental trees, and hybrid seed production in cucumber, squash and pumpkins. Ethephon research on floriculture crops began as early as 1980, but significant contributions to expanding our knowledge by Dr. Peter Konjoian and use of ethephon foliar spray applications for bedding plant production occurred in the 1990s.

In floriculture production, ethephon is most notably known by the trade name Collate 2L (21.7% ethephon) or Florel (3.9% ethephon). Collate 2L is widely used on floriculture species because it acts like an antigibberellin compound, restricting stem elongation and preventing stem topple in hyacinth and narcissus. Additionally, Collate 2L can be used to promote lateral branching and manipulate flowering dates, such as inducing flowering of bromeliads or aborting flowers of floriculture species. Today, ethephon is registered by the EPA for only foliar spray applications, but could registration of substrate drenches be on the horizon? To prepare for EPA approval of Collate 2L substrate drenches, researchers at Virginia Tech and The Ohio State University have conducted a series of trials focused on containerized herbaceous perennials.

Virginia Tech Research Trials

In the 2016-17 Growth Regulators for Container Herbaceous Perennial Plants Guide, Dr. Joyce Latimer and colleagues reported on research experiments evaluating factors affecting the efficacy of Collate 2L drenches such as substrate pH and substrate temperature.

First, growers should be aware that Collate 2L solution pH and air temperature influences efficacy. Solutions containing higher concentrations of Collate 2L will have a lower pH because of the acidifiers in the Collate 2L solution. However, solutions containing lower concentrations of Collate 2L will have a higher pH, which might cause rapid deactivation of Collate 2L and thus reduced efficacy. This is a major consideration for growers who have high levels of alkalinity in their water source and adjustments need to be made to maintain ethephon efficacy. Therefore, we know solution pH influences ethephon stability in solution and efficacy of foliar spray applications. For substrate drenches, does the phenomena occur, too?

Substrate pH

Researchers at Virginia Tech conducted a trial growing Lollipop *Verbena bonariensis* and Goodness Grows *Veronica spicata* at substrate pHs of 4.5, 5.0, 5.5, 6.0, 6.5 or 7.0 and drenched with 10 fl. oz. of water (0 ppm) or 100 ppm Collate 2L. After four weeks, 100 ppm Collate 2L controlled plant growth of both species, however, for verbena, they found an interaction between substrate pH and the Collate 2L drench treatment had occurred.

In general, Collate 2L drench efficacy decreased with increasing substrate pH, yet verbena plants drenched with 100 ppm Collate 2L at substrate pH 7.0 were significantly smaller and flowered later than untreated plants at substrate pH 7.0. They concluded that substrate pH within the recommended range of 5.5 to 6.5 would not reduce Collate 2L drench efficacy, however, growers may experience increased or reduced efficacy when substrate pHs are below or above the recommended pH range, respectively. Furthermore, like all PGR applications, different species will respond differently.

Substrate temperature

A research trial was also conducted at Virginia Tech to determine if substrate temperature reduced efficacy of Collate 2L drenches, especially if early spring drench applications are desired and substrate temperatures are cooler. Hummingbird Coral Nymph *Salvia coccinea* and Buenos Aires *Verbena bonariensis* liners were grown under 70F (21C) air temperature and drenched with 200 ppm Collate 2L at root zone temperatures of 55F (13C), 64F (18C), 73F (23C) or 82F (28C).

After six days of root zone temperature treatment, plants were transplanted into trade gallons to evaluate growth and flowering. They found Collate 2L substrate ▶

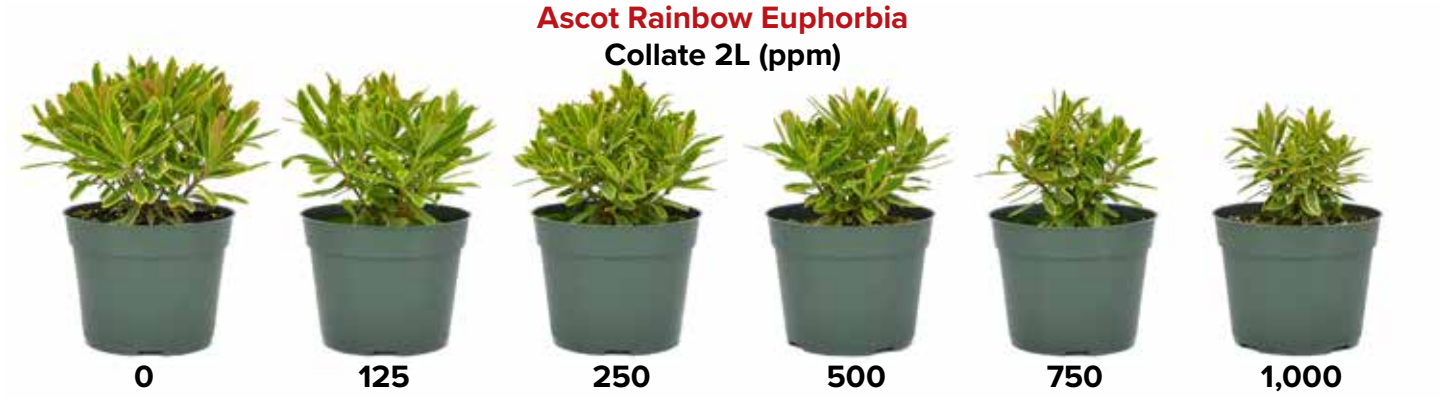

Figure 1. Ascot Rainbow *Euphorbia × martinii* drenched with 10 fl. oz. of solution containing 0, 125, 250, 500, 750 or 1,000 ppm Collate 2L. Photos taken six weeks after drench application.

Figure 2. Siskiyou Pink *Oenothera lindheimeri* (formerly Gaura sp.) drenched with 10 fl. oz. of solution containing 0, 125, 250, 500, 750 or 1,000 ppm Collate 2L. Photos taken four weeks after drench application.

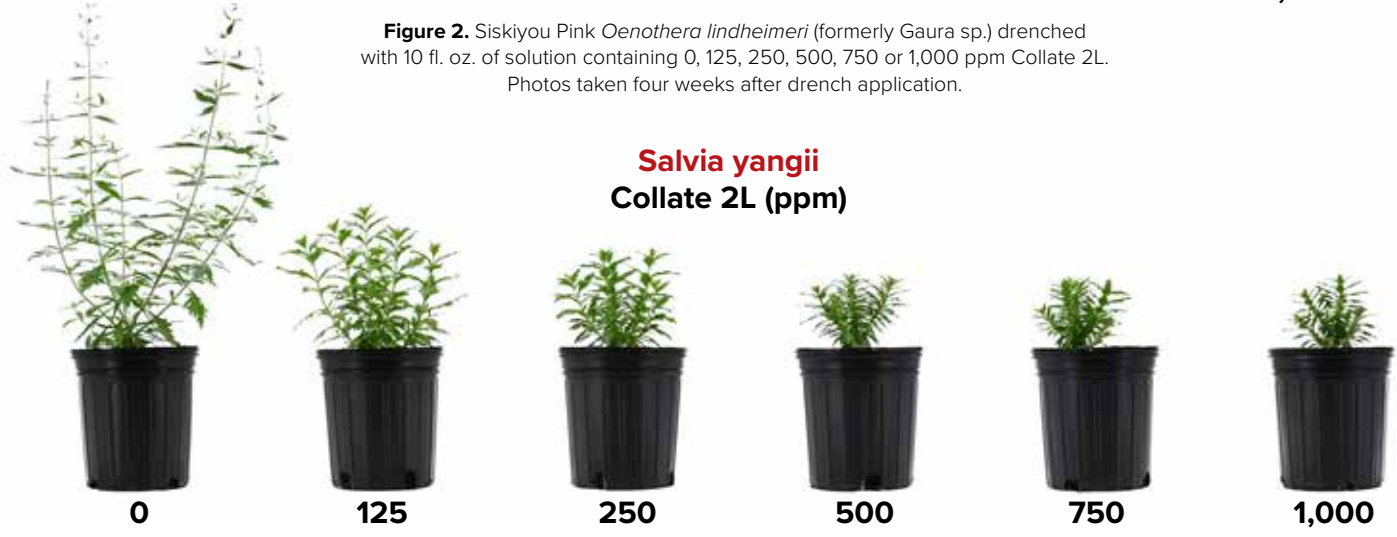

Figure 3. *Salvia yangii* (formerly *Perovskia atriplicifolia*) drenched with 10 fl. oz. of solution containing 0, 125, 250, 500, 750 or 1,000 ppm Collate 2L. Photos taken four weeks after drench application.

Figure 4. Pink Mist *Scabiosa columbaria* drenched with 10 fl. oz. of solution containing 0, 125, 250, 500, 750 or 1,000 ppm Collate 2L. Photos taken six weeks after drench application.

Photos by: Dr. W. Garrett Owen, The Ohio State University.

drenches controlled growth regardless of substrate temperature, meaning efficacy was not reduced by the range of substrate temperatures from 55 to 82F (13 to 28C) deployed at drench. While growers should perform in-house trials, the temperature trialed reflects root zone temperatures of containerized perennials placed under protection.

The Ohio State University Research

In research trials at The Ohio State University, we've evaluated the responses of 20 herbaceous perennials and 12 annual bedding plant taxa to increasing Collate 2L drench concentrations.

Species evaluations

In our herbaceous perennial trials, unrooted cuttings were received from a commercial supplier (Dümmen Orange) and propagated in 105-cell trays under mist at 70F (21C) air temperature, 74F (23C) root-zone temperature, 70% relative humidity and 12 mol•m^{-2}•d^{-1} achieved by deploying a 16-hour photoperiod for 28 days. Perennial liners were transplanted into trade gallon containers (2.9 qt.) filled with a pre-moistened commercial soilless peat-based substrate (SunGro Sunshine Mix #1). Plants were grown under a constant 68F (20C) and 14 mol•m^{-2}•d^{-1} achieved by deploying a 16-hour photoperiod.

At 10 days after transplant, plants received a substrate drench of 10 fl. oz. (296 mL) of solution containing deionized water (0 ppm; control) or 125, 250, 500, 750 or 1,000 ppm Collate 2L. Throughout the trials, plants were fertilized with 150 ppm N provided by 15-5-15 Cal-Mag (J.R. Peters, Inc.) and received monthly Epsom salt drench applications at 1 lb. per 100 gallons of water. Plants were grown for varying durations before collecting data, including plant height and plant diameter, branch number, visible bud and flower dates, and shoot and root dry weights.

Our trials found Collate 2L drenches do effectively control growth of the herbaceous perennial species trialed. For example, compared to untreated plants, substrate drenches containing 125 to 1,000 ppm Collate 2L suppressed overall growth of Ascot Rainbow *Euphorbia × martinii* (Figure 1), Siskiyou Pink *Oenothera lindheimeri* (formerly *Gaura* sp., Figure 2), *Salvia yangii* (formerly *Perovskia atriplicifolia,* Figure 3) and Pink Mist *Scabiosa columbaria* (Figure 4) by 9% to 27% (0.7 to 2.1 in.), 11% to 34% (2.3 to 7.1 in.), 44% to 68% (7.4 to 11.5 in.) and 7% to 52% (1 to 6.8 in.), respectively. Growth, development, lateral branching and flowering differences did occur among herbaceous perennials, which is to be expected.

While these studies allow us to determine species- and cultivar-specific responses and establish concentration recommendations, Collate 2L drenches cannot be enacted until EPA approval. Nonetheless, applying Collate 2L as a substrate drench can alleviate numerous issues commonly associated with ethephon foliar sprays, potentially resulting in more consistent responses among our herbaceous perennial crops. ■

NOTE: These are research results. Although Fine Americas has applied for a Collate 2L label expansion at the time of this publication, you must verify that drench applications have been approved and added to the label for your state before using this application method.

Using Advocate and Advocate Tank Mixes During Perennial Propagation

By W. Garrett Owen & W. Tyler Rich, The Ohio State University

Many herbaceous perennials can successfully be propagated from unrooted cuttings. Growers must maintain a favorable propagation environment and implement cultural practices to promote root initiation, growth and development.

While many growers may be challenged with managing and maintaining optimal environmental conditions, most all growers can easily implement rooting hormone applications. Rooting hormones can accelerate root initiation, improve rooting uniformity, aid in rooting of moderate to difficult-to-root species, and ultimately, reduce shrink and propagation time. For these reasons, rooting hormones are a great addition to any propagator's toolkit.

Traditionally, rooting hormones were applied by quickly dipping the excised end of the cutting in a talc powder prior to cutting stick, or weighing and dissolving a powder to form a solution. Now, liquid-based products are available, which can be sprayed on the foliage within 24 hours after cutting stick. Furthermore, growers must understand rooting hormones vary in formulations and contain different ingredients, such as indole-3-butyric acid (IBA). Recently, Fine Americas introduced Advocate, a liquid 20% IBA compound, which allows growers to easily dose the desired concentrate for mixing and application.

While North Carolina State University researchers evaluated Advocate applications for annual bedding plants (refer to the Annuals PGR Guide) at The Ohio State University, we evaluated foliar application rates of Advocate and tank mixes containing Advocate + Configure (benzyladenine). Here's how we conducted the research and highlights of our findings.

Research Trials

For each trial, unrooted cuttings were received from Dümmen Orange. Cuttings were individually inserted into 105-cell propagation trays (30-mL individual cell vol.) filled with a pre-moistened commercial peat-based substrate (LM-111; Lambert Peat Moss) amended with (by vol.) 50% coarse perlite. Unrooted cuttings were placed in a propagation environment under ≈56% shade cloth where ambient daylight was supplemented with ≈74 µmol•m^{-2}•s^{-1} delivered from 600 W high-pressure sodium lamps to create a 16-hour photoperiod and benches providing root-zone heating of 72F (22C).

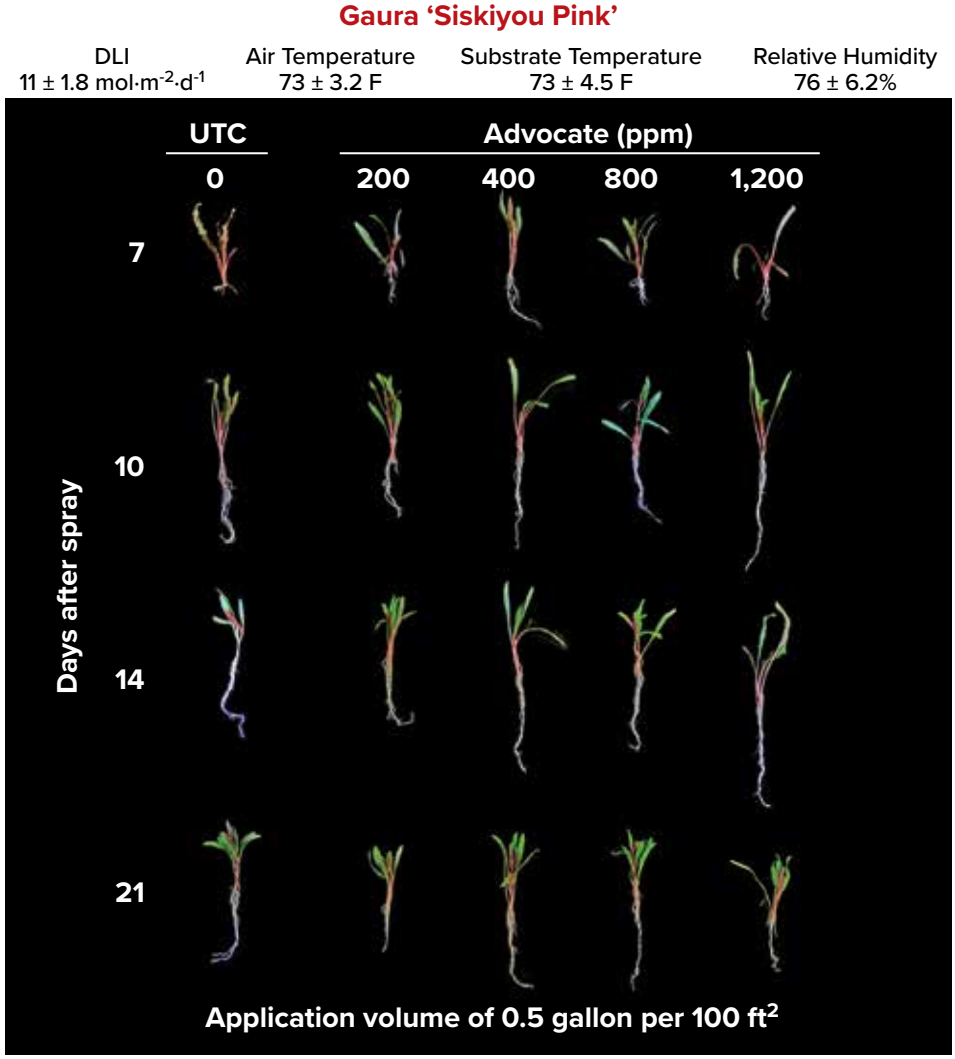

Figure 1. Gaura Siskiyou Pink cuttings at 7, 10, 14 and 21 days of propagation that received foliar spray applications of deionized water (0 ppm; control) or 200, 400, 800 or 1,200 ppm Advocate at a rate of 0.5 gal. per 100 sq. ft. with a handheld spray bottle from 6:00 to 7:00 a.m.

Photo by W. Garrett Owen, The Ohio State University.

After 24-hours, unrooted cuttings of each species received foliar spray applications of deionized water (0 ppm; control), Advocate or Advocate + Configure with a handheld spray bottle from 6:00 to 7:00 a.m. Solutions were sprayed until the leaves were saturated, slightly dripping, and allowed to dry before misting resumed.

At 10 days, cuttings were irrigated daily with water supplemented with sulfuric acid to control alkalinity and fertilized with 75 ppm N provided by 17-4-17. For each trial, environmental data and Advocate or Advocate + Configure tank mix results are reported for 21-day-old cuttings.

Advocate

In this initial trial, easy-, moderate- and difficult-to-root herbaceous perennial species were evaluated, including agastache, coreopsis, gaillardia, gaura, lavender, leucanthemum, perovskia, phlox, salvia and veronica. Cuttings of each species received a single foliar application containing either 0, 200, 400, 800 or 1,200 ppm Advocate at a rate of 0.5 gal/100 sq. ft. After 21 days, propagation daily light integral, air temperature, substrate temperature and relative humidity were 11 ± 1.8 mol•m^{-2}•d^{-1}, 73 ± 3.2F, 73 ± 4.5F and 76 ± 6.2%, respectively.

In general, the magnitude of root initiation and rooting uniformity varied by species. For example, regardless of Advocate application, gaura (Figure 1) cuttings exhibited significant root development and uniformity as early as seven days, while rooting in phlox (Figure 2) occurred by 14 days with enhanced rooting uniformity among cuttings sprayed with 400 and 800 ppm Advocate.

Throughout the trial, we observed epinasty or twisted growth among all species sprayed with 1,200 ppm Advocate (Figure 3). Though this concentration didn't inhibit root development, it did however reduce the aesthetic value of the rooted cuttings. Nonetheless, ▶

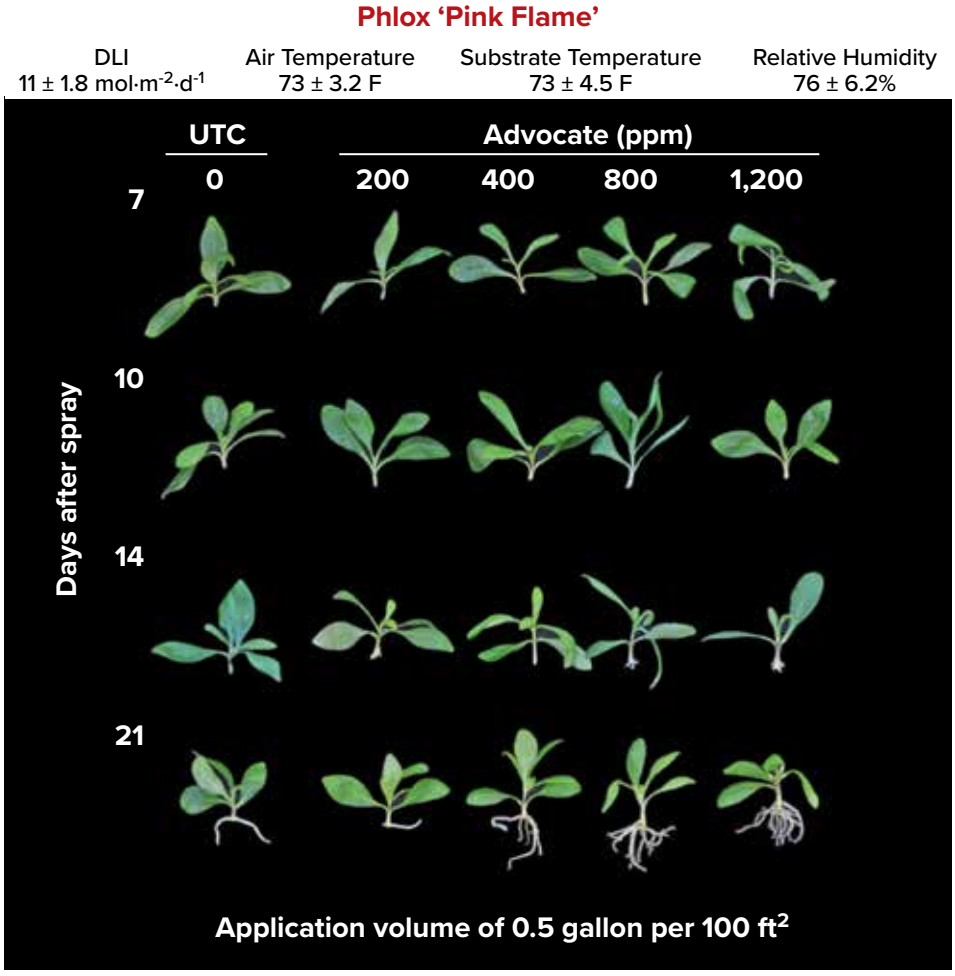

Figure 2. *Phlox paniculata* Flame Pink cuttings at 7, 10, 14 and 21 days of propagation that received foliar spray applications of deionized water (0 ppm; control) or 200, 400, 800 or 1,200 ppm Advocate at a rate of 0.5 gal. per 100 sq. ft. with a handheld spray bottle from 6:00 to 7:00 a.m.

Photo by W. Garrett Owen, The Ohio State University.

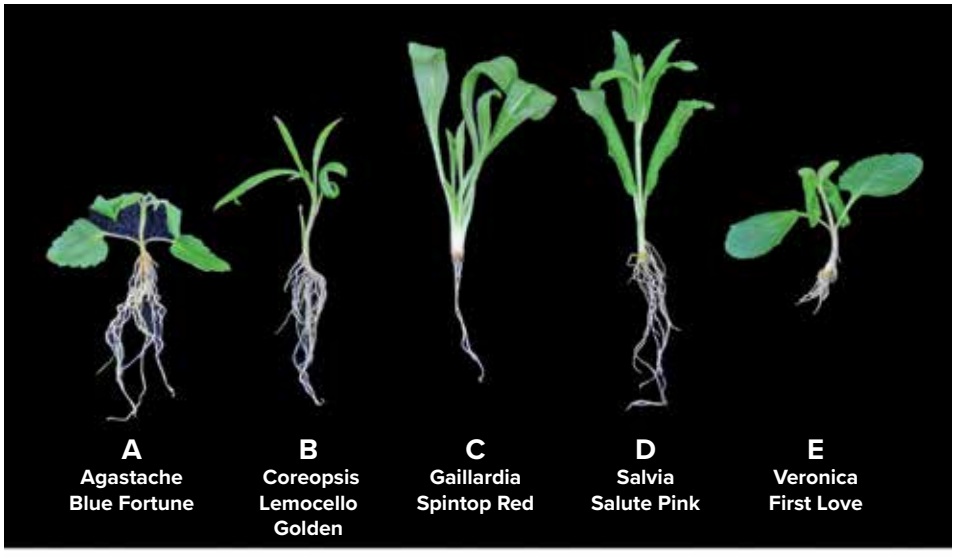

Figure 3. Epinasty or twisted growth of A) Agastache Blue Fortune; B) Coreopsis Lemocello Golden; C) Gaillardia Spintop Red; D) Salvia Salute Pink; and E) Veronica First Love cuttings sprayed with 1,200 ppm Advocate. Photos taken 14 days after foliar spray application at a rate of 0.5 gal. per 100 sq. ft.

Photo by W. Garrett Owen, The Ohio State University.

by 21 days, shoot and root metrics were similar among all Advocate concentrations. Therefore, based on this trial, we concluded:

- Recommended foliar applications rates are between 200 to 800 ppm Advocate.
- Do not exceed 800 ppm Advocate.
- Root initiation response will vary among species.
- Uniform rooting will occur among cuttings with the potential to reduce propagation time by seven or 14 days.
- Growers should conduct trials to evaluate Advocate concentrations that work for species not listed here.
- Results may vary by propagation environmental conditions.

Advocate + Configure

In this initial trial, herbaceous perennial species that often require growth control and branching were evaluated, including coreopsis, gaura, lamium and lavender. Cuttings of each species received a single foliar application containing 200 ppm Advocate at a rate of 0.5 gal. per 100 sq. ft., sprayed 24 hours after cutting stick. At 12 days after initial Advocate spray application, cuttings received a second foliar spray application of 200 ppm Advocate + Configure at concentrations of 0, 50, 100, 200, 300, 400, 600 or 800 ppm at a rate of 0.5 gal. per 100 sq. ft. After 21 days, propagation daily light integral, air temperature, substrate temperature and relative humidity were 12 ± 1.8 mol•m^{-2}•d^{-1}, 70 ± 2.2F, 73 ± 2.5F and 70 ± 3.2%, respectively.

In general, the magnitude of extension growth control and branching varied by species while enhancing rooting in response to the PGR applications. For example, increasing from 50 to 400 ppm Configure significantly controlled extension growth of gaura (Figure 4) and lamium (Figure 5) while increasing axillary shoot number.

Meanwhile, little to no growth control or promotion was observed for coreopsis or lavender. Furthermore, we observed epinastic (twisted) growth among all species sprayed with 600 and 800 ppm Configure. Visually, root mass appeared to be less at higher concentrations of Configure, though we didn't measure any negative effects. Therefore, based on this trial, we concluded:

- Suggested foliar tank mix applications containing 200 ppm Advocate + 50 to 400 ppm Configure can be used.
- Do not exceed 600 ppm Configure on young plants.
- Growth control and improved branching will vary among species.
- Growers should conduct trials to evaluate Advocate + Configure tank mix concentrations that work for species not listed here.
- Results may vary by propagation environmental conditions.

Overall, these trials demonstrated the ease and effectiveness of using Advocate for rooting herbaceous perennial cuttings. Growers should consider implementing Advocate into their propagation program to enhance rooting, improve rooting uniformity and reduce propagation time. Please note—species and cultivar variation will occur, therefore growers should always consider performing in-house trials. ■

Gaura 'Siskiyou Pink'

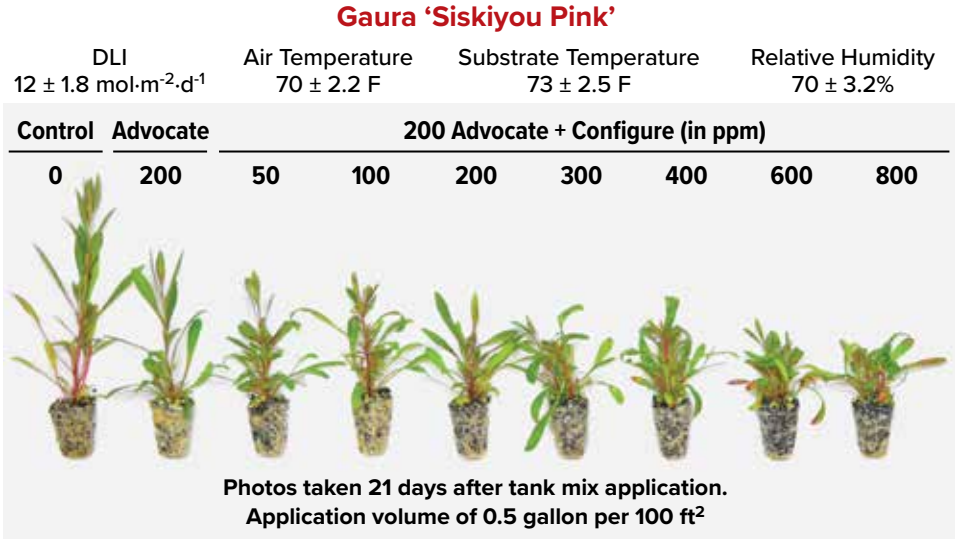

Figure 4. Gaura Siskiyou Pink cuttings at 21 days of propagation that received foliar spray applications of deionized water (0 ppm; control) or 200 Advocate + 0, 50, 100, 200, 300, 400, 600 or 800 ppm Configure at a rate of 0.5 gal. per 100 sq. ft. with a handheld spray bottle from 6:00 to 7:00 a.m.

Photo by W. Garrett Owen, The Ohio State University.

Lamium 'Nancy Red'

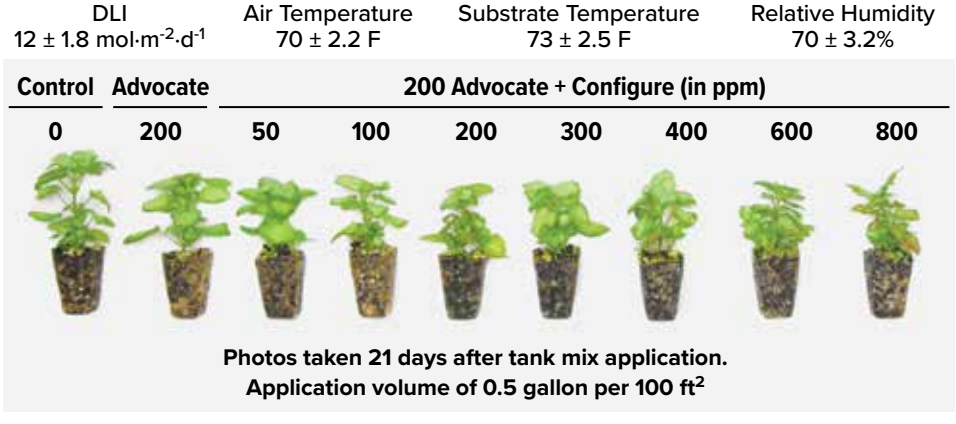

Figure 5. Lamium Red Nancy cuttings at 21 days of propagation that received foliar spray applications of deionized water (0 ppm; control) or 200 Advocate + 0, 50, 100, 200, 300, 400, 600 or 800 ppm Configure at a rate of 0.5 gal. per 100 sq. ft. with a handheld spray bottle from 6:00 to 7:00 a.m.

Photo by W. Garrett Owen, The Ohio State University.

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Additional Benefits of PGRs

Plant growth regulators provide more than just growth control—better water utilization, disease suppression and greener color make PGRs a best management strategy!

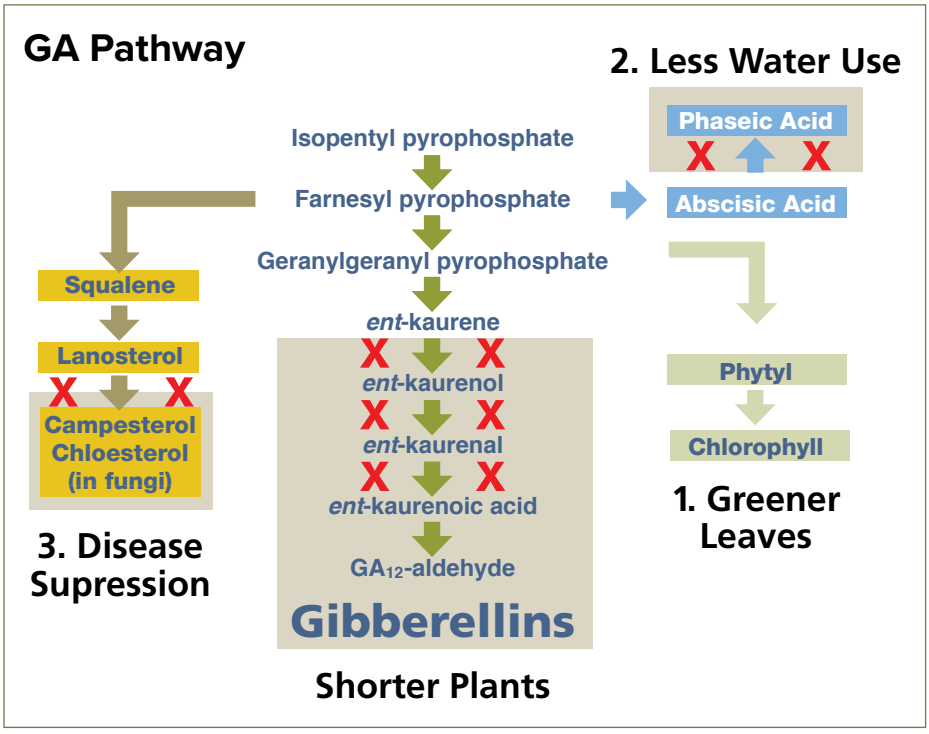
Brian E. Whipker, North Carolina State University

Greenhouse growers use plant growth regulators (PGRs) to control excessive plant growth. But did you know PGRs also provide additional benefits? This article highlights one of the best-kept secrets in floriculture about the additional advantages of using plant growth regulators to improve your crop quality.

So to be clear, the PGRs that I'm referring to are ones with a mode of action that block the biochemical pathway leading to the production of gibberellins (GA) (Figure 1). GA is the hormone that encourages cell elongation. By blocking that pathway, the plants are naturally shorter. The PGRs that block the GA pathway include: ancymidol (Abide/A-Rest), chlormequat chloride (Citadel/Chlormequat E-Pro/Altercel), daminozide (B-Nine/Dazide), flurprimidol (Topflor), and uniconazole (Concise/Sumagic). Chemicals that have a different mode of action—such as Augeo, Configure, Florel, Collate 2L, Fascination or Fresco—don't have these added attributes so this article doesn't apply to them.

There are three additional benefits of applying PGRs: 1) greener leaves, 2) less water use and 3) greater disease suppression.

Figure 1. An overview of the gibberellin biosynthesis pathway for controlling plant growth, with advantageous secondary benefits of greener leaves, less water use and greater disease suppression noted.



1. Greener leaves

Have you ever noticed how the plant leaves become greener after you apply a PGR? The darker green color suggests that the plant has a higher chlorophyll content. Why does this occur? There are two reasons.

First of all, with a PGR application, the new plant cells don't expand as much, so they're smaller. Smaller cells mean that the chlorophyll contained in the leaves is more densely packed, which makes the leaves darker green. In addition, applying a PGR—which blocks the GA pathway—results in some secondary effects. In this case, an up-regulation, or increase, in the amount of chlorophyll produced by the plant (Figure 1).

This illustration will explain how the GA pathway is blocked and how additional chlorophyll is produced. The GA pathway is a series of biochemical reactions in the leaf, which results in the production of gibberellins. Gibberellins encourage cell expansion. By blocking the pathway, plants are then more compact. That's why we use PGRs to manage growth.

So why do leaves become greener? Let's use the example of a beaver dam to explain it: When beavers build a dam on a creek, they don't totally stop the flow of water; some water still spills over the main part of the dam. That occurs when PGRs are used. You still get some plant growth, just not as much. The other thing that occurs is the water is diverted elsewhere by the beaver dam. The water backs up and then it spills over at some secondary place.

That also occurs with the GA pathway. With the blockage, other secondary biochemical reactions are then increased. One up-regulated reaction is an increase in the production of chlorophyll (Figure 1, see #1). So that's why plants become greener after a PGR application (Figure 2).

Figure 2. The plant on the left did not have a PGR application, while the plant on the right did. The use of anti-GA PGRs resulted in darker green plants.

2. Water use

Reduced water stress is also a secondary effect when one applies PGRs. It all goes back to the blocked GA pathway and up-regulation of the natural plant hormone abscisic acid (ABA), which helps plants control water loss through their leaves.

On the bottom of plant leaves there are doughnut-like openings in the leaf called stomates, which regulate gas exchange and water loss. An increase in ABA encourages the stomates to close and avoid water loss. Less water loss means it takes more time for the plants to wilt.

Utilizing the illustration of the GA pathway again (Figure 1, see #2), with the blockage of the pathway there's an up-regulation of ABA, which is beneficial to plants. In addition, there's also an up-regulation in the biochemical pathway of chemicals, which block the breakdown of ABA. So this also leads to an increased accumulation of ABA to help the plant better manage water loss. The end result is plants treated with PGRs use less water. In fact, a recent study at North Carolina State University by Ahmad et al. found that water use was 33% less when zinnia plants were treated with 1 mg a.i. drenches of paclobutrazol when compared with the untreated control (Figure 3). Being able to apply a water conservation treatment is an excellent best-management practice.

3. Disease reduction

A third attribute of PGRs is disease reduction. This attribute applies to paclobutrazol and flurprimidol and—to a lesser extent—to ancymidol, daminozide or chlormequat. It doesn't apply to uniconazole because of how it's manufactured by selecting for greater PGR activity; that process removes most of the disease reduction ability.

A side effect of the blocked GA pathway is also the blockage of a secondary pathway used by fungi (Figure 1, see #3). Paclobutrazol and flurprimidol act similarly as the mode of action as sterol biosynthesis inhibitor class of fungicides (SBIs). A secondary pathway leading off the GA pathway produces the building blocks used by fungi. Paclobutrazol and flurprimidol block that pathway, so the essential chemicals needed by fungi to grow aren't available. Therefore, the occurrence of disease is reduced (Figure 4).

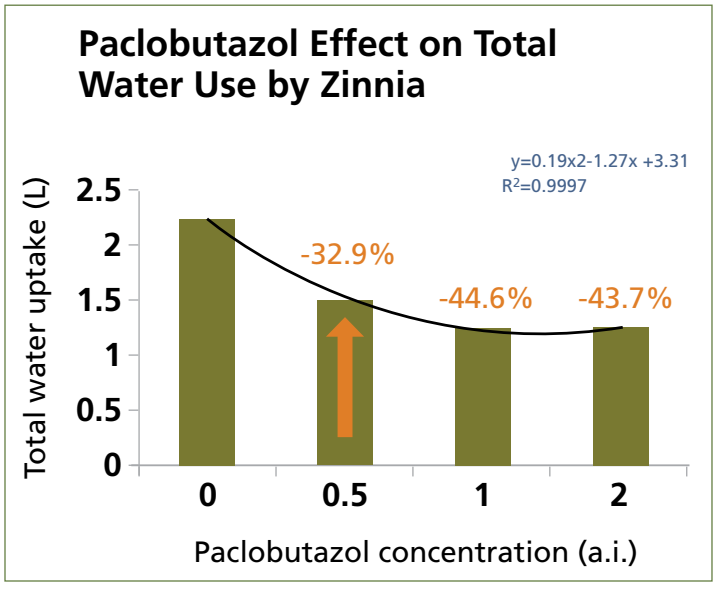


Figure 3. Data from a recent study at North Carolina State University in which the use of 1 mg a.i. palcobutrazol drenches resulted in zinnia plants requiring 33% less water over the production season as compared with the untreated control. Data source: Ahmad, Whipker and Dole, NCSU

Figure 4. Based on a height control experiment, one can clearly see powdery mildew starting to infect the untreated plant on the left, while the plant on the right had been given a PGR drench about 4 weeks prior to this date and a powdery mildew infection had been reduced. PGRs will not provide season-long protection against foliar diseases, but it turns out they can offer a first line of protection.

So in summary, there are a number of biochemical reactions always occurring in plants. With the use of GA-blocking PGRs, there's a resulting up-regulation and down-regulation of a number of other reactions. Of course, plant growth is more compact. Plants are also greener because of an increased concentration of chlorophyll. Plants are healthier because of the ability to reduce foliar diseases.

Finally, plants use less water, which helps avoid drought stress. There are additional benefits besides controlling excessive stretch when it comes to PGRs. This makes the use of PGRs a key component when it comes to best-management practices for floriculture crops. Please keep in mind that no plant growth regulators are labeled for control or supression of plant diseases. ■

Fresco Use Tips

By Brian Whipker, North Carolina State University

When one thinks of plant growth regulators (PGRs), the primary focus is on growth control mainly through regulating internode stretch. There are times when additional growth is needed; that's where a growth enhancement PGR, such as Fresco, should be considered.

Fresco is a combination of 1.8% gibberellins A_4+A_7 [GA_{4+7}] and 1.8% benzyladenine [6-BA]. This combination provides stimulation of intermodal elongation with the GA_{4+7} and enhancement of axillary shoot growth with the BA. When mixed together, the combination provides a controlled stimulation of enhanced plant growth.

The other labeled option for enhancing plant growth is Florgib 4L. It contains gibberellin A_3 and only the lowest label rates should be trialed and used to avoid excessive stretch. By far, the majority of growers prefer to use Fresco because it enhances elongation and fullness of the plant, while providing a wider window of safety for avoiding overdose applications.

In addition, Fresco can be used to enhance bract development on poinsettias and aid in avoiding lower leaf yellowing on lilies.

With Fresco being an excellent tool in providing growth enhancement and improving postharvest quality, it's a handy addition to have in your PGR toolbox. In order to obtain the most effect from Fresco, below are some application tips to consider.

Application tips

Preventing lower leaf yellowing of lilies—Fresco can be used to avoid lower leaf yellowing and necrosis when applied to lower leaves. It also delays flower senescence when applied to flower buds. Fresco can be used on Easter (*Lilium longiflorum*), LA Hybrid (*L. longiflorum-Asiatic* crosses) and oriental lilies, but use rates vary (see Fresco label for rates, timing and precautions before use). Fresco is used as a preventative application and doesn't correct leaf yellowing and flower senescence that's already occurred.

Bract enhancement of poinsettias—Fresco foliar sprays can be applied to poinsettias seven to 14 days before anthesis to increase bract size. Fresco may also be used at 3 ppm to promote bract expansion on plants treated with late season foliar applications of anti-GA PGRs (see Fresco label for rates, timing and precautions before use). Bract coloring on some red varieties may appear less intense immediately following a Fresco treatment. However, over time, the bracts should develop a more intense coloration. Use of Fresco may also result in an increase in plant height. Test on a few plants to determine the results. Bracts of white cultivars have been reported to develop a "whiter" appearance, with the use of a late-season application.

Growth enhancement—Fresco can be applied as a foliar spray, substrate drench or through chemigation. Typical recommended

Fresco for Overcoming PGR Overdose

Figure 1. Growth enhancement with the use of Fresco foliar sprays on New Guinea impatiens after the plants were stalled with an overdose paclo application

spray rates are in the range of 1 to 5 ppm. One should begin with the lowest rate, make the application and then wait seven days to determine if the desired level of growth enhancement is achieved. Re-application can be made if additional growth is desired. The goal is to apply only enough Fresco to promote sufficient growth or overcome the PGR effect or lack of growth. Too high of a rate will result in excessive stem or peduncle stretch and a light yellowing of the newly developing leaves. Growers have found that the 1 to 5 ppm range works in most cases, but growers have reported that the response rate can vary significantly by cultivar. So it's best to start with a small trial to determine optimal rates.

Fresco is the only GA_{4+7} and 6-BA product registered for drench applications. Drench applications have become increasingly popular because there's more even distribution of Fresco within the plant and less negative effect on leaf and flower growth.

Growth enhancement use tips—Foliar sprays

1. Initially begin with the lower end of the recommended range. The initial rate range for a foliar spray should be between 1 to 3 ppm. Avoid applying >10 ppm or excessive stretch may occur.
2. Complete coverage is required because Fresco applied to the leaves isn't easily transported throughout the plant.
3. Allow up to seven days to determine if plant growth is increased before making a second application. When reapplying, many growers will use half of the initial rate if the plants fail to take off.
4. When using Fresco for the first time, test it on a few plants to determine the results before applying it to your entire crop.
5. Excessive rates will result in undesirable stretch, often requiring an application of an anti-gibberellin plant growth regulator, such as Piccolo 10XC, to check the elongation.
6. Spray applications may cause bleaching of red bracts to a dusty pink coloration.
7. Follow the label recommendations, for it's the law.

Growth enhancement use tips—Drenches

1. Initially begin with the lower end of the recommended range. The initial rate range for a drench should be between 1 to 3 ppm. Avoid applying >10 ppm or excessive stretch can occur.
2. Apply Fresco drenches with a sufficient volume of water to allow complete coverage of the root system. Make applications to moist, but not wet, substrates. Drench applications provide the benefit of more even uptake by the plant if a sufficient volume of water is used. The volume of drench applied increases with the pot size. For example, typically 3 fl. oz. of drench solution is added to a 5-in. pot, 4 fl. oz. to a 6-in. pot and 10 fl. oz. to an 8-in. pot.
3. When applied as a drench through sub-irrigation, reduce rates normally used for top-of-the-pot applications by 25% to 50%.
4. Allow up to seven days to determine if plant growth is increased before making a second application. When reapplying, many growers will use half of the initial rate if the plants fail to take off.
5. Excessive rates will result in undesirable stretch, often requiring an application of an anti-gibberellin plant growth regulator, such as Piccolo 10XC, to check the elongation.
6. When using Fresco for the first time, test it on a few plants to determine the results before applying it to your entire crop.
7. Drench applications have been reported to be more effective than spray applications on poinsettias. Spray applications may cause bleaching of red bracts to a dusty pink coloration. If in doubt, test Fresco on a few plants to determine the results before applying it to your entire crop.

Figure 2. Lower leaf yellowing and necrosis on lilies. An application will help avoid this situation, especially under low light conditions.

8. Drench applications will only work if the plant has adequate roots for Fresco uptake.
9. Follow the label recommendations, for it's the law.

Timing. In order to reap the benefits of a Fresco application, application timing is critical. Most applications are targeted at a specific stage of development and number of days in which it's effective or requiring sufficient time to realize results. Those specific timings are outlined on the Fresco label for each use.

Avoid applications to stressed plants. Enhanced plant quality will occur if Fresco is used correctly. Avoid applying Fresco to plants that are temperature, water, nutrient or pest stressed. Fresco foliar sprays are best applied in the morning or late afternoon/evening, when leaf drying time will be slower, which allows greater uptake by the plant.

Optimal concentrations. Recommended use rates vary from 1 to 3 ppm foliar sprays for enhancing plant growth, 3 ppm for bract expansion, to 10 to 100 ppm, respectively, for avoiding early and late lower leaf yellowing with lilies. Refer to each species listed on the Fresco for specific details. For foliar spray applications, apply 1 gal. of spray solution uniformly over 200 sq. ft. of bench area. Avoid applying more than 15 ml of spray solution per plant.

Phytotoxicity. Overdoses of Fresco can result in excessive stretch. Therefore, utilize the lower recommended rate range and test on a few plants to determine the suitability of the rate.

Protective equipment and REI. Applicators must wear a long-sleeved shirt and long pants, wear chemical-resistant gloves, protective eyewear, socks and shoes, and chemical-resistant apron when mixing, loading or cleaning equipment. The restricted entry interval (REI) is 4 hours. ■

Apply Fresco to Recover PGR-Stunted Herbaceous Perennials

By Joyce Latimer & Daniel Jackson, Virginia Tech

Mistakes happen! Sometimes it's a calculation error. Sometimes it's overspray onto sensitive crops. Sometimes the liners came in that way. Sometimes your plants have been stunted by an overdose of PGRs. You've seen recommendations on using Fresco, the combo product of the gibberellins $GA_{4/7}$ + 6-BA (benzyladenine), to overcome that growth retardant effect and enhance the growth of stunted crops. Just in case you're still leery of using Fresco on your herbaceous perennials, we wanted to demonstrate the use of Fresco in enhancing the growth of herbaceous perennial plants previously stunted by the application of excessive growth retardant.

What we did

Commercial liners of the herbaceous perennials were potted into quart pots and allowed to establish for about three weeks before the growth retardant was applied. The growth retardants used were Piccolo 10 XC or Concise. Fresco was applied as a single foliar spray at 0, 2.5, 5, 10 or 15 ppm.

Gaura Siskiyou Pink pots were drenched with 2 fl. oz. of 40 ppm Piccolo 10 XC. Fresco was applied 18 days later. Plant height and width were measured 10 days after the Fresco application.

For Veronica First Love plants, 60 ppm Concise was applied as a foliar spray at the label recommended volume of 1 gal./200 sq. ft. Fresco was applied 18 days later. Plant height and width were measured 15 days after the Fresco application.

What we found

Gaura Siskiyou Pink plants were significantly stunted by the Piccolo 10 XC application with the height or width of treated plants only 47% or 50%, respectively, of that of untreated plants at 10 days after the Fresco treatment (Table 1). Height of plants treated with 10 ppm or 15 ppm Fresco was significantly greater than the height of those receiving no Fresco recovery treatment, but the 5 ppm Fresco treatment also produced saleable plants (Figure 1).

Veronica First Love plants were significantly stunted by the Concise application with the height or width of treated plants only 50% or 38%, respectively, of that of untreated plants at 15 days after the Fresco treatment (Table 2). All rates of the Fresco application restored growth of veronica with little differences in final height or salability (Figure 2). Plant width increased with increasing rates of Fresco, improving the appearance of the plants, but all plants were restored to saleable condition.

Fresco use tips

Notice how effective the low dose of 2.5 ppm Fresco was at restoring growth and salability of these PGR-stunted plants. We generally recommend spray rates of 1 to 5 ppm Fresco, depending on the severity of the stunting. Begin with the lower rates and wait seven days to determine if you've achieved the desired level of growth recovery. After seven days, if you have not seen the level of recovery desired, an additional application may be made to continue the recovery. Only apply enough Fresco to restore the growth rate to overcome the growth retardant effect. Too much Fresco will cause excessive growth/stretching of the stem and flower stalks and weaken the overall plant structure. You want to restore growth, not force it. Results vary with the crop and the degree of stunting, so always start with a small trial and adjust the rates accordingly.

If you're more comfortable with drench or subirrigation applications, be aware that Fresco is the only GA_{4+7} + 6-BA combination product registered for these applications. Drenches and subirrigation can provide more even distribution of PGRs throughout the substrate, and therefore, more uniform uptake and distribution of the active ingredients in the plant. For media drenches, start with 1 to 3 ppm in sufficient volume cover the entire root system. Evaluate recovery after one week. If necessary, reapply Fresco at one-half the initial rate. For subirrigation applications, reduce initial rates by 25% to 50%. Again, evaluate the effects on a few plants before you apply Fresco to your entire crop.

As always, read and follow all label recommendations. Plant growth regulators are still pesticides, subject to all the safety and use regulations listed on the label. ■

Gaura Siskiyou Pink

Stunted (yes/no)	Fresco rate (ppm)	Plant height (cm)	Plant width (cm)
No	0	24.5 a	38.3 a
Yes	0	13.0 b	19.3 b
Yes	2.5	18.2 ab	23.6 b
Yes	5	18.5 ab	22.9 b
Yes	10	21.3 a	26.3 b
Yes	15	22.8 a	27.3 ab
p-value*		<0.01	<0.01

*One-way ANOVA with mean separation by Tukey's HSD

Table 1. Height and width of Gaura Siskiyou Pink plants stunted with a 40-ppm drench of Piccolo 10 XC. Growth measured at 10 days after a spray application of Fresco at 0, 2.5, 5.0, 10 or 15 ppm.

Veronica First Love

Stunted (yes/no)	Fresco rate (ppm)	Plant height (cm)	Plant width (cm)
No	0	42.2 a	31.6 a
Yes	0	20.8 b	19.4 c
Yes	2.5	23.7 b	22.6 bc
Yes	5	23.2 b	24.4 b
Yes	10	22.8 b	25.3 b
Yes	15	24.7 b	26.8 ab
p-value*		<0.01	<0.01

*One-way ANOVA with mean separation by Tukey's HSD

Table 2. Veronica First Love plants stunted with a 60-ppm foliar spray application of Concise. Growth measured at 15 days after a spray application of Fresco at 0, 2.5, 5.0, 10 or 15 ppm.

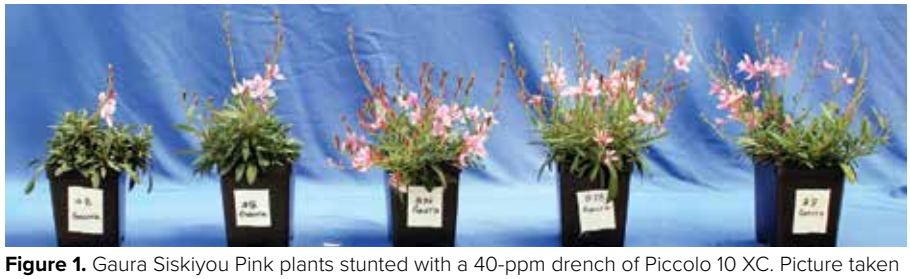


Figure 1. Gaura Siskiyou Pink plants stunted with a 40-ppm drench of Piccolo 10 XC. Picture taken 10 days after a recovery application of 0, 2.5, 5.0, 10 or 15 ppm Fresco foliar spray.

Figure 2. Veronica First Love plants stunted with a 60-ppm foliar spray application of Concise. Picture taken 15 days after a recovery application of 0, 2.5, 5.0, 10 or 15 ppm Fresco foliar spray.

Dilution Table

Formulated product per gallon of solution

PPM AI	Abide/ A-Rest (milliliters)	Dazide/ B-Nine (grams)	Citadel/ Altercel (milliliters)	Collate 2L (milliliters)	Concise/ Sumagic (milliliters)	Piccolo/ Bonzi/Pac O (milliliters)	Piccolo 10 XC (milliliters)	Topflor (milliliters)	Configure (milliliters)	Fresco/ Fascination (milliliters)	Advocate (milliliters)
0.5	7				4	0.5	0.05	0.48			
1	14				8	1	0.1	0.96		0.23	
5	72				38	5	0.5	4.8		1.14	
10	143				76	10	1	9.6		2.27	
25	359				189	25	2.5	23.9		5.68	
30	430				227	30	3	28.7		6.81	
40	573				303	40	4	38.2		9.08	
50	717			0.8	379	50	5	47.8	9	11.35	0.86
100	1433			1.6	758	100	10	95.5	18	22.7	1.73
150				2.3		150	15	143.3	27		2.59
200			6.5	3.1		200	20	191	36		3.46
300			9.7	4.7					54		5.18
400			13	6.2					72		6.91
500			16	7.8					90		8.64
600			19	9.4					108		10.4
800			26	12.5					144		13.8
900			29	14.1					162		15.5
1,000		4.5	32	15.6					180		17.3
1,250		5.6	40	19.5							21.6
1,500		6.8	48	23.5							25.9
2,000		9	64	31.2							34.6
2,500		11.1	80	39.3							43.2
5,000		22.3		79.4							

A syringe is a convenient method for measuring out small volumes of chemical. They can be purchased at most drug stores. Note that on a syringe 1 cc equals 1 ml.

When mixing PGRs, great care needs to be given to accurately measure and apply the chemical. As always, the label contains the legal mixing information.

Foliar sprays require a uniform application to obtain consistent results. For foliar sprays, measure out a known amount of chemical, add it to a known volume of water and apply the spray to a known bench area. Most sprays are applied at 1 gal. per 200 sq. ft. of bench area.

Sprenches are a way of supplying a greater dose of chemical as a foliar spray. Most sprenches are applied at 1.5 gal. per 200 sq. ft. of bench area. This extra volume of water provides control by uptake by the leaves, stems and roots.

Drench applications vary by pot size and desired dose, so refer to the product label for exact mixing instruction. For drench applications, measure out a known amount of chemical, add it to a known volume of water and apply a known volume of the drench solution to each pot. The volume of drench applied increases with the pot size (specifics are listed on each product label). For example, typically 3 fl. oz. of drench solution is added to a 5-in. pot, 4 fl. oz. to a 6-in. pot and 10 fl. oz. to an 8-in. pot. ■

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