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GROWERTALKS

A Guide to Growing High-Quality Perennials

Growth Regulators for Containerized Herbaceous Perennial Plants

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2024-25

By W. Garrett Owen, The Ohio State University

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GreenProfit Supplement Enclosed



Dear friends and partners,

Our years of success in PGR specialization have taught us to recognize a bright future when we see one and we're looking at one right now. We are leaders, we are innovators and we find technologies that help growers do well in every aspect of their businesses. Our commitment to helping growers meet and exceed their growing goals has never been stronger. This 2024-25 Perennials PGR Guide is the latest tool that expresses the bright future we want to share with you.

It begins with the new research we've recently completed specific to the use of PGRs in perennials. This will create new opportunities for growers as we look to the future. Bolstering that success is our ever-evolving line of products and innovative label expansions and uses that help growers get the most from their perennials ... and their bottom lines. In this edition of the Perennials PGR Guide, we are excited to reveal the test results of our new rooting hormone, ADVOCATE® (IBA), as well as our soon-to-be-approved Collate® 2L drench application.

While everyone's perennials are growing and evolving, our company is, too. We're excited to share the news that our long-time president, Greg Johnson, has transitioned into a new position as chairman. Since 2004, Greg has ushered in the culture of integrity, product quality and PGR leadership that we enjoy today.

With this legacy in place, he has handed the leadership reins to our incoming president, Damian Eldred, who has been part of our family since 2018—viewing the company from sales, marketing and business operations perspectives in his time with Fine. We look forward to him leading us into a new era of increased accomplishment for all of our grower customers and their plants. The future is indeed bright.

As you open this Perennials PGR Guide, we also want to recognize our invaluable university research partners and their ongoing participation in developing these annual guides. We owe a debt of gratitude for their extensive support in creating these long-standing informative publications.

Sincerely,



Gregory Johnson,
Chairman



Damian Eldred,
President



Collate 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 (21.7% ethephon) or Florel (3.9% ethephon). Collate 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 can be used to promote lateral branching and manipulate flowering dates, such as inducing flowering of bromeliads or aborting flowers of floriculture species. (For a concise summary of how to use Collate safely and maximize efficacy, check out “Collate Use Tips” on page 74 of this guide.)

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 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 drenches such as substrate pH and substrate temperature.

First, growers should be aware that Collate solution pH and air temperature influences efficacy. Solutions containing higher concentrations of Collate will have a lower pH because of the acidifiers in the Collate solution. However, solutions containing lower concentrations of Collate will have a higher pH, which might cause rapid deactivation of Collate 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. After four weeks, 100 ppm Collate controlled plant growth of both species, however, for verbena, they found an interaction between substrate pH and the Collate drench treatment had occurred.

In general, Collate drench efficacy decreased with increasing substrate pH, yet verbena plants drenched with 100 ppm Collate 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 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 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 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 substrate drenches controlled growth regardless of substrate temperature, meaning efficacy was not reduced by ►



Cutting-Edge PGRs

the range of substrate temperatures from 55F to 82F 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 species to increasing Collate 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 #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) or 125, 250, 500, 750 or 1,000 ppm Collate. Throughout the trials, plants were fertilized with 150 ppm N provided by 15-5-15 Cal-Mag (J.R. Peters) 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 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 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 drenches cannot be enacted until EPA approval. Nonetheless, applying Collate 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 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.



Dazide

You can return to the greenhouse today. Or you can stand around until tomorrow. Your plants are waiting.

Waiting outside your greenhouse after a treatment is not a recipe for success. That's why we created the only Daminozide PGR with a 12-hour REI. Our newly formulated Dazide allows for quicker absorption, so you get greener, stronger crops, and you're able to return to them up to 12-hours sooner than with other daminozides. Now hurry. Your plants are calling.

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fine-americas.com Excellence in PGR technology

Ascot Rainbow Euphorbia Collate (ppm)

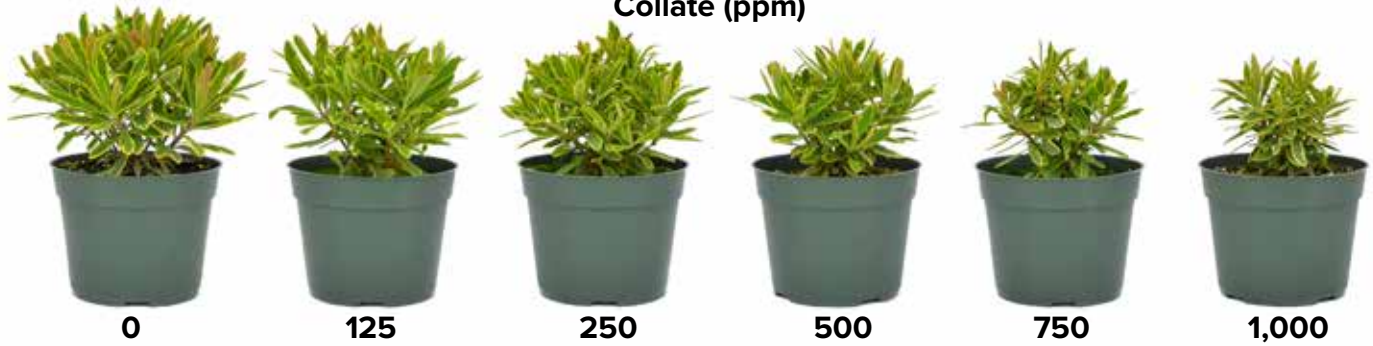


Figure 1. Ascot Rainbow *Euphorbia × martinii* drenched with 10 fl. oz. of solution containing 0, 125, 250, 500, 750 or 1,000 ppm Collate. Photos taken six weeks after drench application.

Siskiyou Pink Oenothera Collate (ppm)



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. Photos taken four weeks after drench application.

Salvia yangii Collate (ppm)

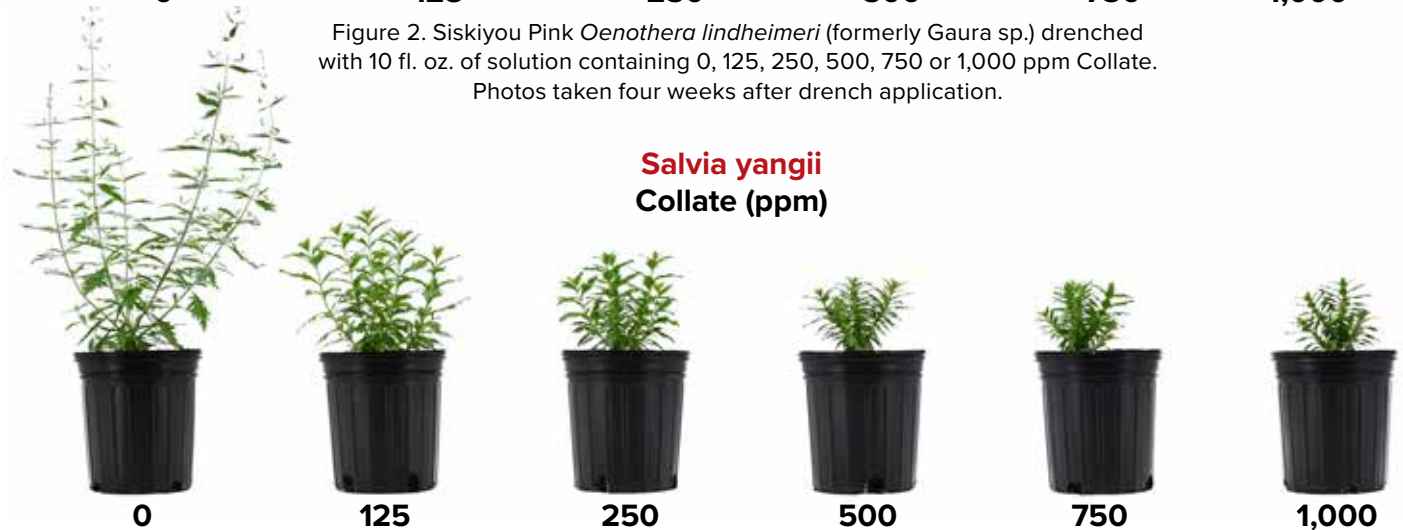


Figure 3. *Salvia yangii* (formerly *Perovskia atriplicifolia*) drenched with 10 fl. oz. of solution containing 0, 125, 250, 500, 750 or 1,000 ppm Collate. Photos taken four weeks after drench application.

Pink Mist Scabiosa Collate (ppm)



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

Brunnera Growth Control Using Concise Sprays & Drenches

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



Heartleaf brunnera (*Brunnera macrophylla*) are woodland perennials with dark green leaves that are heavily frosted, displaying their intricately detailed leaf venation. In addition, the plants are adorned with clusters of baby blue flowers in mid- to late-spring. These plant characteristics and the ability to thrive in shade as a groundcover make them great landscape plants for consumers. However, in greenhouse and nursery production, growth control may be needed.

While various environmental and cultural practices may be deployed to control growth, plant growth regulators (PGRs) are excellent tools that can be utilized. Therefore, we wanted to evaluate foliar sprays and substrate drenches of Concise (uniconazole) at increasing concentrations to control growth of heartleaf brunnera.

The Ohio State University Trial

Jack Frost Brunnera liners (72-cell) were received from Walters Gardens and transplanted into trade gallon containers (2.9 qt.) filled with a pre-moistened commercial soilless bark-based substrate (SunGro Metro-Mix 852). Plants were grown under a constant 68F (20C) and ambient daylight supplemented with $\approx 125 \mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ delivered from light-emitting diode arrays to create a 16-hour photoperiod. The average air temperature, daily light integral and relative humidity were 68F, $14 \text{ mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$ and 70%, respectively. Throughout

Brunnera 'Jack Frost' Foliar Spray Concise (ppm)

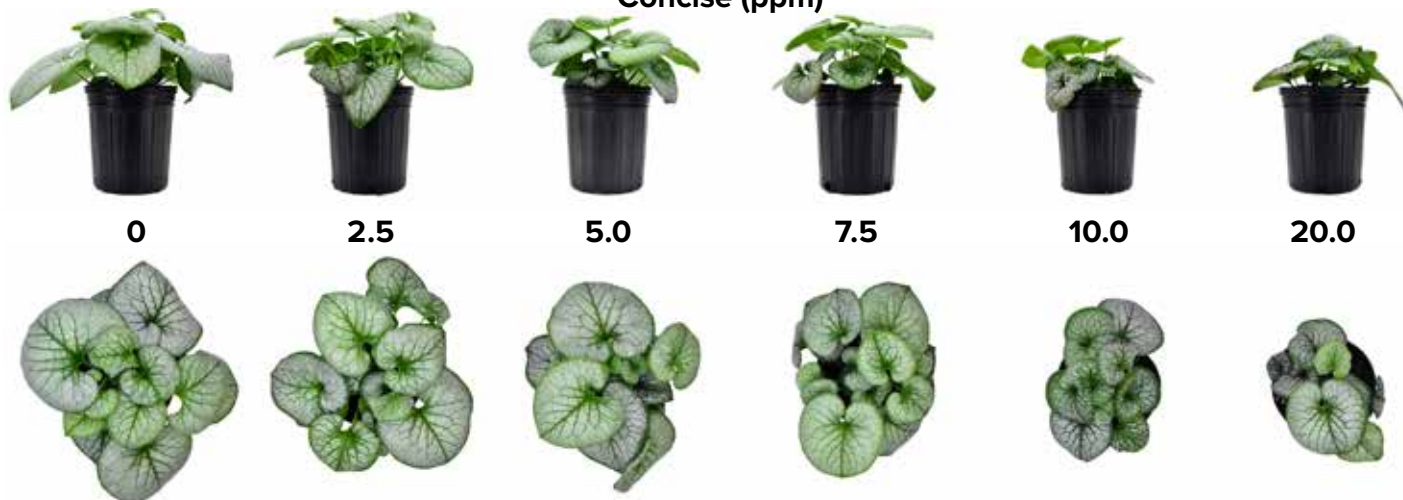


Figure 1. Jack Frost *Brunnera macrophylla* sprayed with 0, 2.5, 5, 7.5, 10 or 20 ppm Concise at a volume of 2 qt. per 100 sq. ft. Photos taken seven weeks after spray application.

the trial, plants were fertilized with 150 ppm N provided by 17-4-17 (J.R. Peters). Plants also received monthly Epsom salt drench applications at 1 lb. per 100 gallons of water.

At 10 days after transplant, Concise was applied as a foliar spray or substrate drench. Eight single-plant replications received a foliar spray of solution containing deionized water (0 ppm; control) or 2.5, 5, 7.5, 10 or 20 ppm Concise at a volume of 2 qt. per 100 sq. ft.

In a separate trial, eight single-plant replications received a substrate drench of 9 fl. oz. (266 mL) of solution containing deionized water (0 ppm) or 0.25, 0.875, 1.75, 2.5, 5, 7.5 or 10 ppm Concise. Plants were grown seven weeks where data was collected, including plant height, diameter (taken in two directions and averaged) and plant dry weight. For substrate drenches, we also washed the roots to determine the effects on root growth and development, and thus dry weight.

Spray results. Concise foliar spray applications didn't provide any substantial plant height control. For instance, as spray applications of Concise increased from 0 to 20 ppm, plant height was suppressed by 0.4 in. (6%). However, the greatest growth control was observed for plant diameter and overall plant size.

Compared to untreated plants, Concise at 5 to 10 ppm decreased Jack Frost Brunnera plant diameter and plant size by 15% to 21% (1.9 to 2.8 in.) and 13% to 20% (1.4 to 2.2 in.), respectively (Figure 1). Leaf number and shoot dry weight were unaffected by increasing Concise foliar spray applications. Plants were terminated before flowering, so further investigations are needed to evaluate time to flower, especially if growers plan to sell flowering plants in spring.

Drench results. Increasing Concise substrate drench concentrations effectively controlled Jack Frost Brunnera plant height, diameter and thus overall plant size, leaf number, and shoot and root dry weights. In general, 0.875 to 5 ppm Concise substrate drenches were determined to be optimal concentrations depending on the level of control desired.

For example, compared to untreated plants, 0.875 to 5 ppm Concise suppressed plant height by 15% to 51% (0.9 to 3 in.) and diameter by 22% to 40% (2.9 to 5.3 in.) with an overall growth control of 20% to 42% (2.2 to 4.5 in.), respectively (Figure 2). Plants drenched with 0.875 to 5 ppm Concise developed three to seven fewer leaves yet would still be desirable depending on your market. As expected, shoot and root dry weights were smaller as Concise concentrations increased, however, the root-to-shoot dry weight ratio of plants drenched with 0.875 to 5 ppm Concise revealed a 23% to 39% increase compared to the untreated plants. This suggests that 0.875 to 5 ppm Concise had more of an influence on shoot growth and development rather than root growth and development.

Conclusion & application

Concise foliar sprays of 5 to 10 ppm and substrate drenches of 0.875 to 5 ppm effectively controlled growth of Jack Frost Brunnera. 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, growers will need to determine the desired level of control and assess if rate adjustments may be needed based on their geographical location, growing conditions and cultivar. 🌱

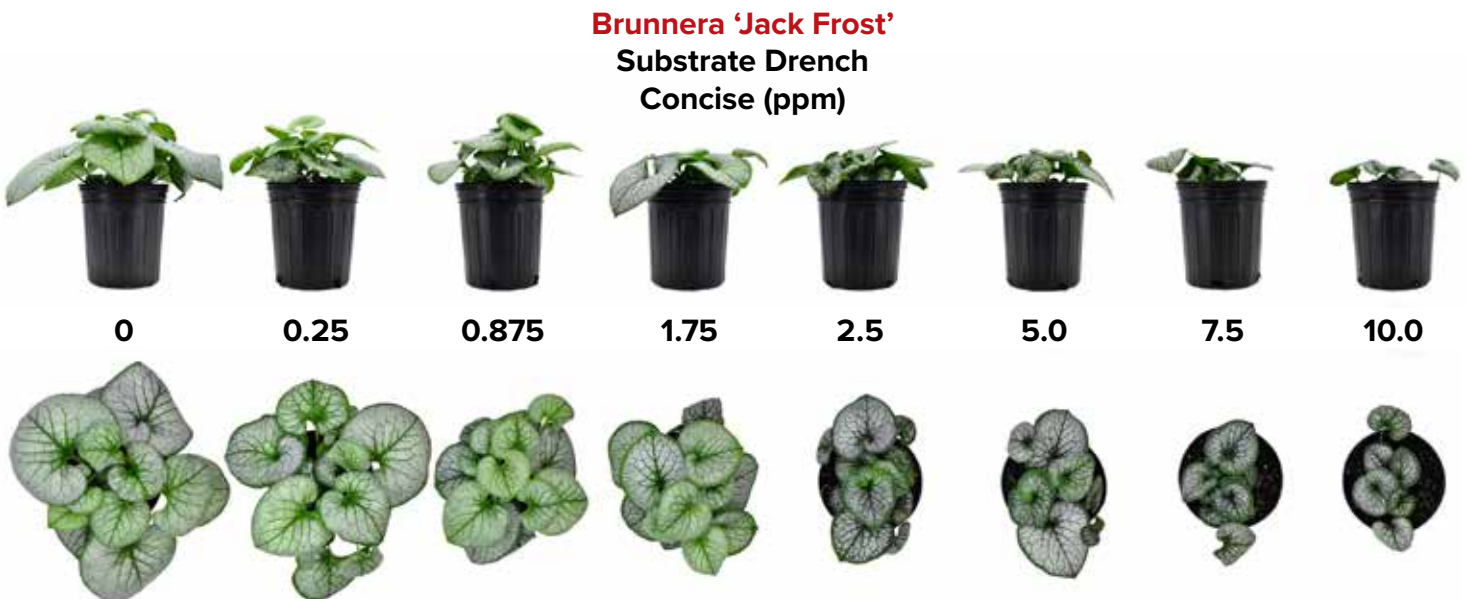


Figure 2. Jack Frost *Brunnera macrophylla* drenched with 9 fl. oz. of solution containing 0, 0.25, 0.875, 1.75, 2.5, 5, 7.5 or 10 ppm Concise. Photos taken seven weeks after drench application.

Controlling Buddleia Growth With Concise Drenches

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

Consumers appreciate all the new *Buddleia* spp. (butterfly bush) cultivars available ranging from dwarf to tall growth habits, compact to gigantic flower racemes, and novel flower colors attracting pollinators and hummingbirds. For growers, new introductions may mean adjusting cultural practices like plant growth retardant (PGR) concentrations to control plant growth. Therefore, we sought to evaluate Concise (uniconazole) substrate drench concentrations for growth control of two popular buddleia cultivars.

The Ohio State University Trial

Grand Cascade and Prince Charming Buddleia liners (72-cell) were received from Walters Gardens and transplanted into trade gallon containers (2.9 qt.) filled with a pre-moistened commercial soilless bark-based substrate (SunGro Metro-Mix 852). Plants were grown under a constant 68F (20C) and ambient daylight supplemented with $\approx 125 \mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ delivered from light-emitting diode arrays to create a 16-hour photoperiod. The average air temperature, daily light integral and relative humidity were 68F, $14 \text{ mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$ and 70%, respectively. Throughout the trial, plants were fertilized with 150 ppm N provided by 17-4-17 (J.R. Peters).



Buddleia 'Grand Cascade' Substrate Drench Concise (ppm)

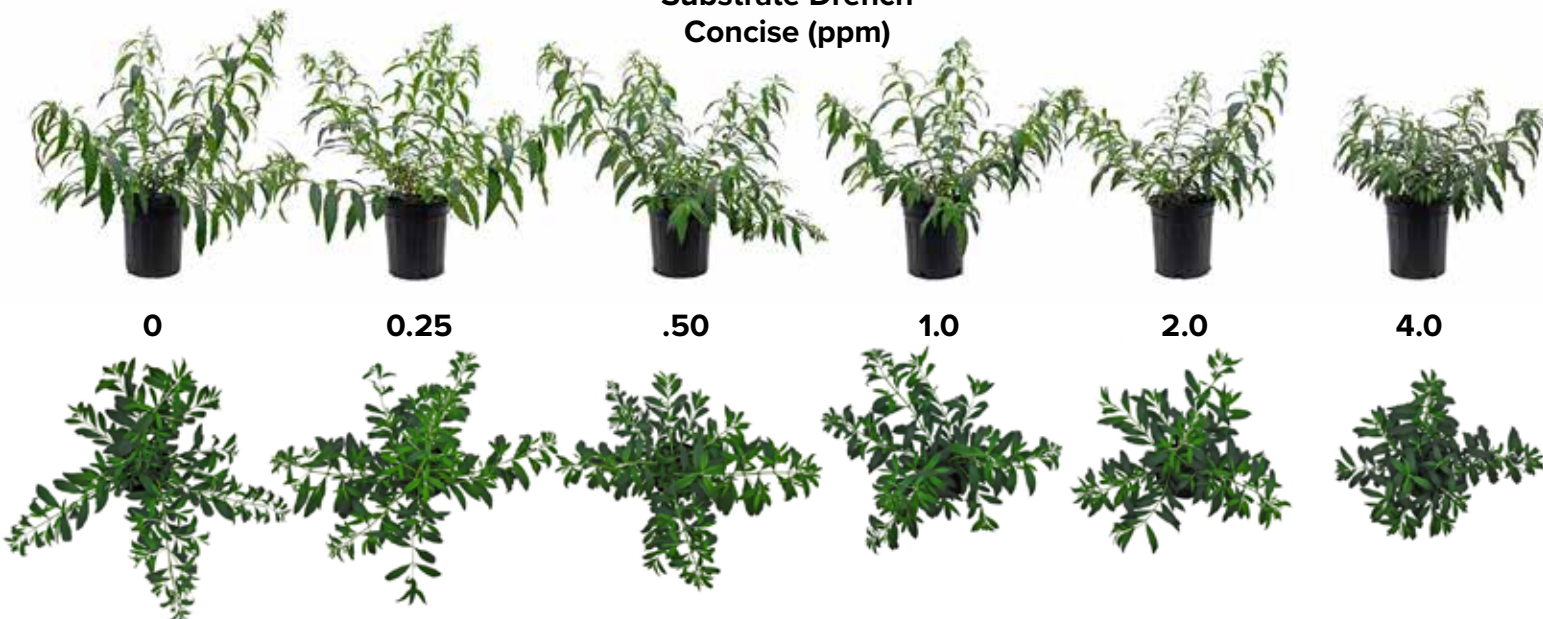


Figure 1. Grand Cascade Buddleia drenched with 9 fl. oz. of solution containing 0, 0.25, 0.5, 1, 2 or 4 ppm Concise. Photos taken five weeks after drench application.

Plants also received monthly Epsom salt drench applications at 1 lb. per 100 gallons of water.

At 10 days after transplant, eight single-plant replications received a substrate drench of 9 fl. oz. (266 mL) of solution containing deionized water (0 ppm) or 0.25, 0.5, 1, 2 or 4 ppm Concise. Plants were grown for five weeks where data was collected, including plant height, diameter (taken in two directions and averaged) and plant dry weight.

Drench results. In our trial, Grand Cascade and Prince Charming Buddleia responded similarly to increasing Concise concentrations, therefore, growers can use the same concentration to control growth of both cultivars. Increasing Concise substrate drench concentrations effectively controlled buddleia plant height, diameter, and thus overall plant size and shoot dry weights. We determined optimal substrate drench concentrations to be 1 to 4 ppm Concise depending on the level of control desired. Compared to untreated plants, substrate drenches of 1 to 4 ppm Concise controlled overall plant growth

by 11% to 26% (2.7 to 6.2 in.), respectively (Figures 1 and 2). Shoot dry weight of plants drenched with 1 to 4 ppm Concise was 24% to 34% smaller than untreated plants. Time to visible bud and flower was not negatively influenced by increasing Concise concentrations, however, growers should trial rates and adjust as needed for desired market dates.

Conclusion & application

Concise substrate drenches of 1 to 4 ppm effectively controlled growth of Grand Cascade and Prince Charming Buddleia. Growers will need to determine the desired level of control and consider market dates when selecting substrate drench concentrations of Concise. Additional substrate drench applications may be necessary. Adjustments to substrate drench concentrations and applications may be needed based on your geographical location, growing conditions and cultivar. For other buddleia cultivar introductions, consider these rates as starting points for in-house trials. 🌱

Buddleia 'Prince Charming' Substrate Drench Concise (ppm)

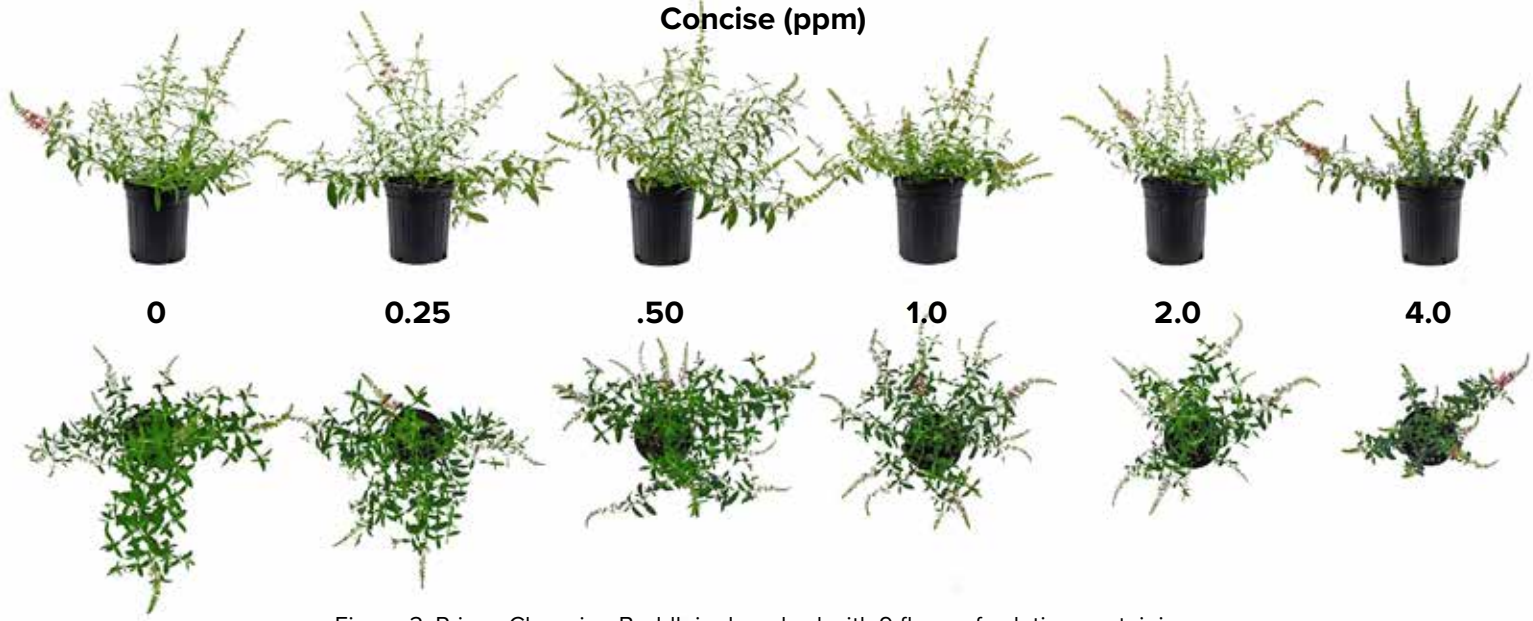


Figure 2. Prince Charming Buddleia drenched with 9 fl. oz. of solution containing 0, 0.25, 0.5, 1, 2 or 4 ppm Concise. Photos taken five weeks after drench application.

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

Wide Assortment of Available PGRs

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

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

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 is an overview of the PGRs now available for use on ornamental crops.

Ancymidol

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

Ancymidol readily moves through the plant and is usually used on crops where other chemicals aren't effective (most notably in bulb crops) or on very high-value crops (i.e., plugs). Growers often prefer the use of ancymidol on plugs because of the lack of phytotoxicity and it's a "safer" PGR to apply (because its limited residual activity allows the plugs to grow out of the growth control effects after being transplanted).

Chlormequat chloride

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

For ornamental crops, it's most commonly used on poinsettias, geraniums, osteospermum and hibiscus. Foliar chlormequat chloride applications can result in a phytotoxic response (chlorosis), but the symptoms are acceptable because they're usually covered up with new leaf growth. In certain crops (i.e., poinsettias, geraniums and herbaceous perennials), a mixture of daminozide and chlormequat chloride (both may be used or applied at reduced rates) may be used. This usually provides for greater height control and reduces the potential for phytotoxicity. Substrate drenches are also effective, but not cost effective.

Daminozide

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

This material 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 will rapidly move 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 growth of seedlings in plug flats and it's most effective in cooler climates. Note: The Dazide label now has a 12-hour REI instead of the 24-hour REI previously required.

Dikegulac sodium

(Commercial name: Atrimmec)

Although Augeo, the greenhouse version of dikegulac sodium, is no longer on the market, Atrimmec has been available and registered for greenhouse and nursery use for a long time. Dikegulac sodium temporarily stops shoot elongation, thereby promoting lateral branching. Thus, it is a growth retardant and a pinching agent for ornamental crops, including azaleas, bougainvillea, clerodendron, fuchsia, grape ivy, geranium, 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 be cautious—especially at higher rates—and allow sufficient time for new plant growth to cover any damaged leaves.

Ethephon phosphonic acid

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

This material is absorbed by the plant tissue, and due to a change in pH once absorbed into the plant cells, releases ethylene. Collate and Florel are used to promote flower bud abortion and vegetative branching in crops. Collate and Florel are applied as a foliar spray at concentrations of 250 to 500 ppm. Although ethephon has soil activity, it's not labeled for use as a drench or liner soak application. ▶

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 , B-Nine
Dikegulac sodium	Atrimmec
Ethephon	Collate , Florel
Flurprimidol	Topflor
Paclobutrazol	Piccolo , Piccolo 10 XC , Bonzi, Pac O, Downsize (drenches only)
Uniconazole	Concise , Sumagic
Benzyladenine (BA)	Configure
Gibberellin (GA3)	Florgib , ProGibb T&O
BA+GA4+7	Fresco , Fascination
Indole-3-butyric Acid	Advocate , Hortus IBA

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, B-Nine	—	—	Collate, Florel	Topflor	Piccolo, Piccolo 10 XC, Bonzi, Downsize, Pac O	Concise, Sumagic
Active ingredient (%)	0.03%	11.80%	85.0%	—	—	21.7%/3.9%	0.38%	0.4%/4% (Piccolo 10 XC)	0.06%
Restricted-entry interval (REI in hours)	12	12	12	12	12	48	12	12	12
Activity level	++	+	+	++	++	+	+++	+++	+++
Multiple applications needed	++	+++	+++	++	++	++	+	+	+
Application type¹									
Foliar spray	yes	yes	yes	yes	yes	yes	yes	yes ¹	yes
Substrate drench	yes	yes	no	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	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 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

Flurprimidol

(Commercial name: Topflor)

Flurprimidol is a relatively recent introduction into the U.S. market, although it's been available in Europe since the 1990s. Flurprimidol is chemically closely related to ancymidol, but it has a greater degree of activity. Flurprimidol is also one of the most cost-effective growth retardants to use as a drench, with recommended use rates in a range similar to uniconazole on most plants. Flurprimidol is also available in a granular formulation for containerized ornamentals.

Paclobutrazol

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

Paclobutrazol is the most widely used growth retardant for greenhouse-grown floriculture crops in the U.S. 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 control of growth or as a low-dose drench of 0.1 to 1 ppm to provide temporary control of plant growth.

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 perennials because it's highly effective on a very broad range of plant species.

Cautions

Both paclobutrazol and uniconazole are triazole-type chemicals. Ancymidol and flurprimidol are in a different chemical class, but have similar characteristics. These chemicals don't readily move within the plant since they're transported in the xylem and not in the phloem. Therefore, these four chemicals are absorbed by the leaves, but aren't readily transported out of the leaves to other parts of the plant. Thus, foliar sprays are applied with sufficient volume of water (2 qt. per 100 sq. ft.) to have some stem and soil activity.

The activity of flurprimidol, paclobutrazol and uniconazole are long lasting and at very low rates, thus the potential for error and crop overdose is greater than with other PGRs. Also note, ancymidol, flurprimidol, paclobutrazol and uniconazole are persistent on plastic surfaces and in soil. Do not reuse flats, pots or soil 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**)

Benzyladenine (BA) is used to promote branching and increase flower set. Configure has specific label recommendations for Christmas cactus, echinacea and hostas, 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 has been very effective in improving branching of many herbaceous perennial crops, as both liners and finished plants. Benzyladenine doesn't readily move within the plant, therefore, complete coverage is required.

Gibberellins

(Commercial names: **Florgib** 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.

Indole-3-butyric Acid

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

Indole-3-butyric acid is used to promote adventitious root formation in vegetative 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.

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. 🌱



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

Attributes	Plant Growth Regulator			
	Chemical	Benzyladenine	Gibberellins	Benzyladenine + Gibberellins
Trade name(s)	Configure	Florgib, ProGibb T&O	Fresco, Fascination	Advocate, Hortus IBA
Active ingredient (%)	2.0%	4.0%	1.8% + 1.8%	20.0%
Restricted-entry interval (REI in hours)	12	4	4	12
Activity level	++	++	+++	++
Multiple applications needed	++	+	+	++
Application type¹				
Foliar spray	yes	yes	yes	Unrooted cuttings
Substrate drench	no	yes	only Fresco	Unrooted cuttings
Dips/Soaks	no	yes	no	Unrooted cuttings
Chemical absorption				
Ease of absorption	++	+++	+++	+++
Time (hours)	<4	<4	<4	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)	50-3,000	0.5-50	1/1-5/5	100-400
Drench (mg active ingredient per pot)	-	unknown	<5	-
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
Shelf life				
In the bottle (years)	<3	<3	<3	<2
Mixed solution	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 lists labeled rates of plant growth regulators (PGRs) for containerized herbaceous perennials crops, as well as recommendations based on research at The Ohio State University, Virginia Tech, and other published sources or growers and suppliers. Recommendations are color coded according to 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 degree 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, keeping 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
<i>Achillea millefolium</i> (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/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/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/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		

Disclaimer: The information and listed table rates of plant growth regulators are current as of January 2024. They are based on label rates, research-based articles from North Carolina State University, other university researchers and recommendations by suppliers. These recommendations may not be appropriate for all conditions and locations and may not comply with laws and regulations in every state. Individuals who use agricultural chemicals are responsible for ensuring that the intended use complies with current regulations and conforms to the product label. Be sure to obtain current information about usage regulations and examine a current product label before purchasing or applying any chemical. The use of brand trade names and any mention or listing of commercial products or services in this publication does not imply endorsement by Ball Publishing, the author, or North Carolina State University, nor discrimination against similar products or services not mentioned. This project is part of Hatch Project 02672, Growth Enhancement of Floriculture Species.

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) <i>continued</i>	To control plant growth <i>continued</i>	Piccolo/Piccolo 10 XC/Bonzi/Pac O/Downsize (drenches only)	96 to 120 ppm spray x 1	Coronation Gold and 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	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 phyto	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/Florel	500 ppm spray x 4	Blue Fortune – excessive height control, but no delay in flowering; Applied at 2-week intervals	North	
			5,000 ppm spray x 2 to 3	Blue Fortune	South	
		Dazide/B-Nine	1,200 to 5,000 ppm spray x 1 to 3	All hybrids; Weekly applications as necessary	North	
			5,000 + 1,500 ppm spray x 1	Blue Fortune	South	
		Dazide/B-Nine + Citadel/Altercel Tank Mix	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		
		Concise/Sumagic	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	South	
			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	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

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/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/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/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/B-Nine	Not responsive at 5,000 ppm spray x 2	Not responsive	South
		Dazide/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	Not responsive at 50 to 400 ppm spray x 1	Single foliar spray applied 2 weeks after potting	Branching
Agave hybrid (<i>A. guiengola</i> <i>A. gemniflora</i>)	Increase offsets	Configure	Not responsive at 100 to 800 ppm spray x 2	Two foliar sprays applied 1 month apart, starting 6 weeks after potting	Branching

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
<i>Alpinia purpurata</i> (Red Ginger)	Induce lateral or basal branching	Configure	Not responsive at 100 ppm soak x 1	Foliar soak of rooted plants	Branching
<i>Aquilegia x hybrida</i> (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/Florel	Not responsive at 750 ppm sprays x 5	Pink & White – height and flowering not responsive to weekly sprays	North
		Dazide/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/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		
<i>Aquilegia flabellate</i> (Columbine)	Induce lateral or basal branching	Configure	Not responsive at 50 to 1,600 ppm spray x 1	No effect of single foliar spray applied 2 weeks after potting	Branching
<i>Aquilegia vulgaris</i> (Columbine)	To control plant growth	Dazide/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	Not responsive at 600 ppm spray x 1	Winky Purple White – no effect with our screening rate; Test multiple applications or higher rates	Branching
<i>Arenaria montana</i> (Sandwort)	To control plant growth	Piccolo/Piccolo 10 XC/Bonzi/Pac O	5 ppm spray x 1 on liners	Avalanche – liners were responsive	South

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Artemisia arborescens (Powis Castle)	To control plant growth	Collate /Florel	300 to 500 ppm spray x 1 on liners	Liners	Unspecified
		Dazide /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	
Artemisia schmidtiana (Wormwood, White Sage)	To control plant growth	Collate /Florel	300 to 500 ppm spray x 1 on liners	Liners	Unspecified
		Dazide /B-Nine	5,000 ppm spray x 2	Silver Mound – moderate control with multiple applications	South
		Dazide /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 /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 /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: 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	Not responsive at 600 ppm spray x 1	Higher rates or multiple applications may be effective	Branching	

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		
<p>Aster dumosus [<i>Symphotrichum dumosum</i>] (Bushy Aster)</p> <p>Aster x frikartii (Frikart's Aster)</p> <p>Aster novae-angliae (New England Aster)</p>	To control plant growth	Dazide/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	South		
				Dazide/B-Nine + Citadel/Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 1	<i>A. dumosus</i> Sapphire – not responsive to this rate	South
				Piccolo/Piccolo 10 XC/Bonzi/Pac O/Downsize (drenches only)	80 ppm spray x 1	<i>A. dumosus</i> Sapphire; <i>A. x frikartii</i> Monarch and Monch – not responsive to 240 ppm spray x 1	South
					2 to 16 ppm drench x 1	<i>A. x frikartii</i> Monarch and Monch – responsive; Drench applied at 2 fl. oz. per quart pot; Volume and mg a.i. vary with container size	South
					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	Unspecified
					30 to 50 ppm sprays x 1	Multiple applications may be required	Unspecified
				Concise/Sumagic	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	Unspecified
					30 ppm spray x 1	<i>A. dumosus</i> Sapphire; <i>A. x frikartii</i> 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	Unspecified
				Topflor	Not responsive at 60 ppm spray x 1	<i>A. dumosus</i> Sapphire – not responsive in fall trial	South
	To induce lateral branching	Collate/Florel	300 to 500 spray x 1 on liners	Liners responsive	Branching		
		Configure	Phytotoxic at 600 ppm spray x 1	Significant phytotoxic response with a single spray applied to liners or transplanted plants	Branching		
<p>Astilbe x arendsii (False Spirea)</p> <p>Astilbe chinensis (Chinese Astilbe)</p> <p>Astilbe thunbergii (False Spirea)</p>	To control plant growth	Abide/A-Rest	100 ppm spray x 6	<i>A. thunbergii</i> Ostrich Plume – weekly applications; <i>A. arendsii</i> Granat – no control with 4 sprays at 2-week intervals	North		
			Collate/Florel	500 ppm spray x 4	Granat – stunting with 4 sprays at 2-week intervals; Did not delay flowering	North	

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION		
<i>Astilbe x arendsii</i> (False Spirea) <i>Astilbe chinensis</i> (Chinese Astilbe) <i>Astilbe thunbergii</i> (False Spirea) <i>continued</i>	To control plant growth <i>continued</i>	Dazide/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	<i>A. chinensis</i> Purpurkerze – stunted, use lower rate and/or fewer applications; <i>A. x arendsii</i> Elizabeth Bloom – not responsive to 5,000 ppm x 2	South		
			5,000 ppm spray x 6	<i>A. thunbergii</i> Ostrich Plume – weekly applications; <i>A. arendsii</i> Granat – no control with 4 sprays at 2-week intervals	North		
		Dazide/B-Nine + Citadel/Altercel Tank Mix	Less than 5,000 + 1,500 ppm spray x 1	<i>A. chinensis</i> Purpurkerze stunted; Reduce both daminozide and chlormequat rates	South		
		Citadel/Altercel	1,500 ppm spray x 1	<i>A. chinensis</i> 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; <i>A. thunbergii</i> Ostrich Plume – weekly applications of 1,500 ppm x 6; <i>A. arendsii</i> 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	<i>A. chinensis</i> Purpurkerze – good control with 40 ppm x 1; <i>A. x arendsii</i> 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	<i>A. thunbergii</i> Ostrich Plume – weekly applications; <i>A. arendsii</i> Granat – no control with 4 sprays at 2-week intervals			
		Concise/Sumagic	25 to 35 ppm spray x 1 to 2	<i>A. chinensis</i> Purpurkerze – good control with 1 spray; <i>A. x arendsii</i> Elizabeth Bloom – use multiple applications	South		
			15 ppm spray x 6	<i>A. thunbergii</i> Ostrich Plume – 15 ppm spray x 6 weekly resulted in excellent control; <i>A. arendsii</i> Granat – 15 ppm spray x 4 at 2-week intervals resulted in stunting	North		
			5 ppm spray x 2 to 3	Apply to <i>A. arendsii</i> 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			
		<i>Baptisia australis</i> (Blue Wild Indigo) <i>Baptisia hybrids</i> (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, <i>Baptisia</i> hybrids – apply when plants are 6-inches tall; Multiple applications required	North
					6 to 18 ppm drench x 1	Decadence, <i>Baptisia</i> 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			
<i>Bellis perennis</i> (Common Daisy)	To control plant growth	Dazide/B-Nine	1,000 to 2,000 ppm spray x 1 to 2	Multiple applications may be required	North		
<i>Boronia heterophylla</i> (Red Boronia)	Induce lateral or basal branching	Configure	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			

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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
<i>Boronia metastigma</i> (Brown Boronia)	Induce lateral branching and additional cuttings	Configure	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
<i>Brunnera macrophylla</i> (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	
<i>Buddleia davidii</i> (Butterfly Bush)	To control plant growth	Collate /Florel	300 to 500 ppm spray x 1 on liners	Liners responsive	Unspecified
		Dazide /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 /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	Unspecified
			5 to 40 ppm spray x 2	Multiple applications as needed	
		Concise /Sumagic	6 ppm drench x 1	Drench volume and mg a.i. vary with container size	North
			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		
<i>Buddleia fallowiana Lochinch</i> (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	
<i>Buddleia weyeriana Honeycomb</i> (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
<i>Caladium bicolor</i> (Caladium)	To control plant growth	Dazide /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				

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Calamagrostis x acutifolia Karl Foerster (Feather Reed Grass)	To control plant growth	Dazide/B-Nine	Not responsive at 5,000 ppm spray x 2	Not responsive	South
		Dazide/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
		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)	To control plant growth <i>C. carpatica</i> 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	<i>C. carpatica</i> or <i>C. persicifolia</i> may require 50 ppm sprays, especially later in the spring; Multiple applications may be required	North
100 ppm spray x 6			<i>C. glomerata</i> : Very good control on Kent Belle and Birch Hybrid with weekly applications; Superba not responsive; Cherry Bells stunted		
Collate/Florel		500 ppm spray x 4		<i>C. glomerata</i> 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/B-Nine		2,500 to 3,750 ppm spray x 1 to 2	<i>C. carpatica</i> or <i>C. persicifolia</i> 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	<i>C. carpatica</i> ; Multiple applications may be required	North	
		Less than 1,500 ppm spray x 3	Label rate <i>C. carpatica</i> ; 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	<i>C. carpatica</i> – cultivars are very sensitive to paclobutrazol; Multiple applications may be required, especially later in the spring	North	
		15 ppm spray x 1 to 3	<i>C. carpatica</i> : 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	<i>C. carpatica</i> 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 x generalis (Canna Lily)	To control plant growth	Dazide/B-Nine	Not responsive at 7,500 ppm spray x 1	No growth reduction, but delayed flowering	South
Canna x orchoides (Hybrid Canna)		Piccolo/Piccolo 10 XC/Bonzi/Pac O/Downsize (drenches only)	66 to 99 ppm spray x 1	<i>C. x orchoides</i> requires higher rates	South
		Topflor	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
			Less than 50 ppm spray x 1	<i>C. x orchoides</i> 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		

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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
Carex buchananii (Leatherleaf Sedge)	To control plant growth	Concise /Sumagic	20 ppm spray x 1	Moderate height control of <i>C. flagellifera</i> Toffee Twist with an increase in early tillers. Use lower rate on <i>C. buchananii</i> and <i>C. comans</i> Frosted Curls; This rate stunted both cultivars and reduced number of tillers on Frosted Curls	South
	To increase tillering	Configure	Not responsive at 500 or 1,000 ppm spray x 1	No increase in number of tillers on <i>C. buchananii</i> , <i>C. comans</i> Frosted Curls and <i>C. flagellifera</i> Toffee Twist up to 8 weeks after treatment; No effect on plant height	Branching
Carex comans (Hair Sedge)					
Carex flagellifera (Weeping Brown Sedge)					
Caryopteris x clandonensis (Bluebeard)	To control plant growth	Dazide /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 /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
		Concise /Sumagic	5 to 40 ppm spray x 1 to 2	Multiple spray applications may be necessary	Unspecified
			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 /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
Coreopsis auriculata (Lobed Tickseed)	To root cuttings	Advocate /Hortus IBA	200 ppm x 1 spray	Limoncello Golden – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	South
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 /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 1 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		

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Coreopsis grandiflora (Tickseed) <i>continued</i>	To control plant growth <i>continued</i>	Dazide /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
		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	North
			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	
			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 1 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 /B-Nine	1,500 to 2,500 ppm spray x 1
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	North
	6 ppm drench x 1			Drench volume and mg a.i. vary with container size	
90 ppm spray x 6	Good control of growth of Sweet Dreams and the hybrid Limerock Ruby with 6 weekly applications			South	
Concise /Sumagic	40 ppm spray x 1				Moderate control of American Dream; Multiple applications may be required
	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

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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
<i>Coreopsis verticillata</i> (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	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 . Rates of Configure 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 /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
		Dazide /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	Moonbeam 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 /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 – 5 to 7 ppm uniconazole spray x 1 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
<i>Coreopsis sp.</i>	Induce lateral or basal branching on liners or finished plants	Configure	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

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
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	Not responsive to 500 or 1,000 ppm spray x 1	Rosea – not responsive in increasing number of tillers	Branching
Delosperma cooperi (Iceplant)	To control plant growth	Dazide/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
		Concise/Sumagic	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	
		Configure	3 to 4 ppm spray x 1 to 3	Multiple applications may be necessary	Unspecified
	To induce lateral branching	Configure	Not responsive at 600 ppm spray x 2	Not responsive; Higher rates or multiple applications may be effective	Branching
Delphinium x 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/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/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/B-Nine + Citadel/Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 1	Astolat – not responsive	South
		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

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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
<i>Delphinium x elatum</i> (Larkspur, Hybrid Bee Delphinium) <i>continued</i>	To control plant growth <i>continued</i>	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	Not responsive at 600 ppm spray x 1	Galahad – not responsive; Higher rates may be effective	Branching
<i>Delphinium grandiflorum</i> (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	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	North
			100 ppm spray x 4 to 5		
		Collate /Floreil	500 ppm spray x 4	Sky Blue – good growth control with 4 sprays at 2-week intervals; Little flower delay	North
		Dazide /B-Nine	2,500 ppm spray x 2	Tank mix sprays of 2,000 ppm daminozide + 15 ppm paclobutrazol x 2	North
			Tank mix		
			Tank mix		
			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	
		Dazide /B-Nine + Citadel /Altercel Tank Mix	2,500 + 1,000 ppm spray x 2		North

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<i>Delphinium grandiflorum</i> (Siberian Larkspur) <i>continued</i>	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 <i>continued</i>	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
<i>Dianthus gratianopolitanus</i> (Cheddar Pinks)	To control plant growth	Dazide/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
<i>Dianthus barbatus</i> (Sweet William) <i>Dianthus hybrida</i> (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/Florel	Not responsive at 500 ppm spray x 4	No response to 4 spray applications at 2-week intervals	North
		Dazide/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/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 Parfait 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 and Rockin' Red F1 – as needed	Unspecified
			5 ppm spray x 1 on liners	Stagiron (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				

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<i>Dicentra spectabilis</i> (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/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		
<i>Digiplexis</i> (Tender Foxglove)	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	
	To enhance lateral branching	Configure	600 ppm spray x 1	Illumination Flame – Enhanced lateral branching; Lower rates may be effective	Branching
<i>Digitalis purpurea</i> (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/Florel	500 ppm spray x 4	Foxy – good growth control with 4 sprays at 2-week intervals; Delayed flowering	North
		Dazide/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/B-Nine + Citadel/Altercel Tank Mix	Not responsive at 5,000 + 1,500 ppm spray x 1	Foxy – not responsive	South
Citadel/Altercel	1,500 ppm spray x 4	Foxy – good growth control with 4 applications at 2-week intervals	North		

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
<i>Digitalis purpurea</i> (Foxglove) <i>continued</i>	To control plant growth <i>continued</i>	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		
<i>Echinacea purpurea</i> (Purple Coneflower) <i>Echinacea hybrids</i> (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; 6 weekly applications at 100 ppm stunted Magnus	
		Collate/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 1,000 ppm x 3 reduced growth and delayed flowering slightly	North
		Dazide/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/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	Recommends after using Configure (see below), if additional height control is necessary on tissue culture Echinacea	Unspecified

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<i>Echinacea purpurea</i> (Purple Coneflower) <i>Echinacea hybrids</i> (Purple Coneflower) <i>continued</i>	To control plant growth <i>continued</i>	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	Unspecified	
			15 to 30 ppm spray x 2	Prairie Splendor – Use multiple spray applications		
			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	Unspecified		
		30 to 40 ppm spray x 1	Multiple applications of lower rate may be applied as necessary			
		22 to 45 ppm spray x 1 to 2	Ruby Star – short-term control; Multiple applications may be required			South
		Topflor	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		300 to 600 ppm spray x 1 to 2 on liners or finished plants
	<i>Erysimum linifolium</i> (Wallflower)	To control plant growth	Dazide/B-Nine	5,000 ppm spray x 2	Multiple applications at 10- to 14-day intervals	South
Dazide/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	
<i>Eupatorium coelestinum</i> (Hardy Ageratum)	To control plant growth	Dazide/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	South	
		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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Eupatorium rugosum [<i>Ageratina altissima</i>] (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	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/B-Nine	Not responsive at 5,000 ppm spray x 3	Efanthia and Despina – Not responsive	South
		Dazide/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 x grandiflora (Blanket Flower)	To root cuttings	Advocate/Hortus IBA	400 ppm x 1 spray	Spintop Red – 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	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 acymidol + 2.5 ppm uniconazole as needed	Unspecified
		Collate/Florel	500 ppm spray x 4	Burgundy – growth control and delayed flowering with 4 sprays at 2-week intervals	North
		Dazide/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/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

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Gaillardia x grandiflora (Blanket Flower) <i>continued</i>	To control plant growth <i>continued</i>	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 as 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/Florel	500 ppm spray x 1	One application after roots have established in final container to enhance branching	Branching
Configure		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	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 . 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/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	
	Dazide/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	

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Gaura lindheimeri (White Gaura, Wand Flower, Butterflies) <i>continued</i>	To control plant growth <i>continued</i>	Dazide /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	Corrie's Gold – moderate height control; Test multiple applications or higher rates	South
		To increase branching	Configure	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
	Geranium Rozanne (Cranesbill Geranium)	To control plant growth	Dazide /B-Nine	2,500 ppm spray x 1 to 3	Brookside – multiple applications as needed
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	600 ppm spray x 1	Not responsive at 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

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CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
<i>Gladiolus x hybridus</i> (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
<i>Hedera canariensis</i> (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	50 to 200 ppm spray x 3	Foliar spray every 2 weeks starting 2 weeks after potting increased branching	Branching
<i>Helenium autumnale</i> (Sneezeweed)	To control plant growth	Dazide/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/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	Not responsive to 600 ppm spray x 1 20 to 40 ppm spray x 3	Coppelia – not responsive; This was our test rate; Higher rates or multiple applications may be more effective Foliar sprays weekly in summer increased lateral branching and delayed flowering but increased flower number	Branching
<i>Helianthus simulans</i> (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
<i>Heliopsis helianthoides</i> (False Sunflower, Sunflower Heliopsis)	To control plant growth	Dazide/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/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	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	

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION	
<i>Helleborus x hybridus</i> (Lenten Rose)	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	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	
<i>Hemerocallis sp.</i> (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 /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 /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 Irish Elf responsive to 50 ppm spray x 1	South	
			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-in. 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	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	

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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/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	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/Florel	Less than 500 ppm spray x 4	Pink Champagne – biweekly sprays excessively reduced growth without increasing branching; Reduce number of applications	North
		Dazide/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/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/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 in.; Do not apply after visible bud	Unspecified

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Hibiscus moscheutos (Hardy Hibiscus Rose Mallow) <i>continued</i>	To control plant growth <i>continued</i>	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 in. 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 gallon 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	500 ppm spray x 4	Pink Champagne – biweekly sprays increased branching with reduction in plant height	Branching
Hosta sp. (Hosta)	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 /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 /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 /Florel	500 ppm spray x 4	Royal Standard – biweekly sprays increased branching with slight reduction in plant height
	Configure		500 to 3,000 ppm spray x 1 to 2	See Fine Configure 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		

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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
<i>Hypericum calycinum</i> (Aaron's Beard, St. John's Wort)	To control plant growth	Dazide /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 /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
<i>Iris germanica</i> <i>Iris hybrids</i> (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 /B-Nine	Not responsive at 5,000 ppm spray x 6	Immortality – not responsive to weekly sprays	North
		Dazide /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	100 ppm spray x 1	Slight increase in basal branching	Branching	
<i>Iris siberica</i> (Siberian Iris)	To control plant growth	Dazide /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
<i>Jovibarba hirta</i> (Hens and Chicks)	Induce lateral or basal branching	Configure	1,600 ppm spray x 1	Increased number of offsets	Branching

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 /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 /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 /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 /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	Nancy Red – 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	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 . Rates of Configure 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 /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 /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

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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
Lamium maculatum (Spotted Dead Nettle) <i>continued</i>	To control plant growth <i>continued</i>	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 be 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
Lantana camara (Lantana)	To control plant growth	Dazide /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	Unspecified
		Concise /Sumagic	20 to 30 ppm spray x 1	Moderate growth control	Unspecified
Collate /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
			5,000 ppm spray x 1	Provence – moderate control applied once in liner stage	South
		Dazide /B-Nine	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	Unspecified
			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
Lavandula x intermedia (Lavender)	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	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 . Rates of Configure up to 400 ppm controlled liner growth. No branching stimulated. (Trial rates)	South
	To control plant growth	Dazide /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	

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) <i>continued</i>	To control plant growth <i>continued</i>	Dazide /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	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 x superbum (Shasta Daisy)	To root cuttings	Advocate /Hortus IBA	200 to 400 ppm x 1 spray	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 /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
		Dazide /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 /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
		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	

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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
<i>Leucanthemum x superbum</i> (Shasta Daisy) <i>continued</i>	To increase basal branching	Configure	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	
<i>Liatis spicata</i> (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/Florel	Not responsive at 500 to 1,000 ppm spray x 1 to 3	Kobold – not responsive to biweekly sprays	North
		Dazide/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		
<i>Lobelia cardinalis</i> (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/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/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
		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	600 ppm spray x 1	This rate was our screening rate; Lower rates may be effective	Branching

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
<i>Lobelia x speciosa</i> (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/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	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	
<i>Lupinus sp.</i> (Lupine)	To tone or control plant growth	Dazide/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	
	To increase lateral branching	Configure	175 ppm spray x 1	Staircase series – apply about 5 weeks after transplanting, when plant is well rooted	Branching
<i>Lysimachia sp.</i> (Loosestrife)	To control plant growth	Dazide/B-Nine	5,000 ppm spray x 2	Snow Candles – moderate control; Apply at 10- to 14-day intervals	South
		Dazide/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	100 to 150 ppm spray x 1 on liners	Increased branching	Branching
<i>Malva alcea</i> (Hollyhock Malva)	To control plant growth	Dazide/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

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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
Miscanthus sinensis (Maiden grass)	To control plant growth	Citadel /Altercel	1,500 ppm spray x 4	Weekly sprays reduced plant height moderately	North
		Dazide /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 /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
		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 /FloreI	750 ppm spray x 4	Weekly sprays reduced plant height and increased number of tillers	Branching
		Configure	Not responsive 500 or 1,000 ppm spray x 1	Gracillimus – not responsive	Branching
	Monarda didyma (Bee Balm)	To control plant growth	Abide /A-Rest	25 ppm spray x 2 to 3	Weekly sprays
1 to 2 ppm drench x 1				Drench volume and mg a.i. vary with container size	Unspecified
Collate /FloreI			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					
Dazide /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	
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 /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

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) <i>continued</i>	To control plant growth <i>continued</i>	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	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 Not)	To control plant growth	Dazide/B-Nine + Citadel/Altercel Tank Mix	3,500 + 750 ppm spray x 1 to 3	May require multiple applications	North
Nepeta x faassenii (Catmint)	To control plant growth	Abide/A-Rest	25 ppm spray x 2 to 3	Weekly applications	North
			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
		Dazide/B-Nine	Tank Mix	Tank mix spray 2,000 ppm daminozide + 3 ppm uniconazole x 2 to 3	Unspecified
			Tank Mix	Tank mix spray 3,750 ppm daminozide + 6 to 8 ppm uniconazole x 2 to 3	
		Citadel/Altercel	1,500 ppm spray x 5	Walker's Low – weekly applications gave good control	North
		Dazide/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				

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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
<i>Nepeta x faassenii</i> (Catmint) <i>continued</i>	To control plant growth <i>continued</i>	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
	To increase lateral branching	Configure	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
<i>Oenothera fruticosa youngii</i> (Sundrops)	To control plant growth	Dazide /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	Not responsive to 50 to 1,600 ppm spray x 1	Not responsive to single spray applied 2 weeks after potting	Branching
<i>Opuntia microdasys</i> (Pricklypear Cactus)	Induce lateral branching	Configure	Not responsive to 100 to 200 ppm spray x 1	Not responsive	Branching
<i>Paeonia lactiflora</i> (Peony)	To control plant growth	Piccolo/Piccolo 10 XC /Bonzi/ Pac O/Downsize (drenches 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
			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	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	
<i>Panicum virgatum</i> (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 /Florel	Not responsive at 500 ppm spray x 4	Heavy Metal – biweekly sprays had no effect plant height, but plants were thinner	North
		Dazide /B-Nine	Not responsive 5,000 ppm spray x 2	Shenandoah – not responsive	South
			5,000 ppm spray x 4	Heavy Metal – little effect of biweekly sprays	North
		Dazide /B-Nine + Citadel /Altercel Tank Mix	5,000 + 1,500 ppm spray x 2	Shenandoah – 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

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION	
<i>Panicum virgatum</i> (Switchgrass) <i>continued</i>	To control plant growth <i>continued</i>	Piccolo/Piccolo 10 XC/Bonzi/Pac O/Downsize (drenches only)	80 ppm spray x 1	Shenandoah – 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	To control plant growth	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	Shenandoah – 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	Not responsive at 500 ppm spray x 4	Heavy Metal – not responsive to biweekly sprays; Plants much thinner than untreated	Branching
	<i>Papaver orientale</i> (Oriental Poppy)	To control plant growth	Dazide/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	
<i>Penstemon barbatus</i> (Beardlip Penstemon, Bearded Tongue) <i>Penstemon digitalis</i> (Foxglove Beardtongue) <i>Penstemon x mexicali hybrids</i> (Penstemon)	To control plant growth	Collate/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/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/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		

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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
<i>Penstemon barbatus</i> (Beardlip Penstemon, Bearded Tongue)	To control plant growth <i>continued</i>	Piccolo/Piccolo 10 XC /Bonzi/ Pac O/Downsize (drenches only) <i>continued</i>	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	Unspecified
<i>Penstemon digitalis</i> (Foxglove Beardtongue)		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
<i>Penstemon x mexicali hybrids</i> (Penstemon) <i>continued</i>	To increase basal branching	Configure	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
<i>Perovskia atriplicifolia</i> [<i>Salvia yangii</i>] (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	South
	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 /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 /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	South		
	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	South		
	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			

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
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 Pink – 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	Not responsive at 100 ppm spray x 4	Mt. Fuji – not responsive to 4 sprays at 2-week intervals	North
		Collate /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
		Dazide /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 /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				

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	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
<i>Phlox paniculata</i> (Garden Phlox) <i>continued</i>	To control plant growth <i>continued</i>	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	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
<i>Phlox subulata</i> (Thrift, 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 /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 /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		
<i>Platycodon grandiflorus</i> (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 /Florel	500 ppm spray x 4	Sentimental Blue – biweekly sprays reduced growth with slight delay in flowering	North
		Dazide /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

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
Platycodon grandiflorus (Balloon Flower) <i>continued</i>	To control plant growth <i>continued</i>	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 /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	Phyto on liners	Single foliar spray at 300 ppm resulted in significant phytotoxicity to liners	Branching	
Polemonium caeruleum (Jacob's Ladder) Poleminium reptans (Creeping Jacob's Ladder)	To control plant growth	Dazide /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 /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
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
	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	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	

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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
<i>Rosmarinus officinalis</i> (Rosemary)	To control plant growth	Dazide /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 /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
	To increase lateral or branching	Collate /Florel	Not responsive at 500 ppm spray x 1 on 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	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
<i>Rudbeckia fulgida var. sullivantii</i> 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 /Florel	Not responsive at 500 ppm spray x 1	No growth control and no flowering data	South
		Dazide /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 /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
		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	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	

Growth Regulators for Containerized Herbaceous Perennial Plants

CROP	PURPOSE	PRODUCT	APPLICATION RATE (PPM) X NUMBER OF APPLICATIONS*	PRECAUTIONS OR REMARKS	REGION
<i>Rudbeckia hirta</i> (Black-eyed Susan)	To control plant growth; apply PGRs just after bloom initiation, but before bud has formed to reduce flower delay	Dazide/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
		Citadel/Altercel	Phyto at 1,500 ppm spray x 1	Indian Summer – excessive phytotoxicity	South
		Dazide/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
	Concise/Sumagic	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	
		10 ppm spray x 1	Denver Daisy	Unspecified	
	To increase basal branching	Configure	25 ppm spray x 1	Good control under outdoor conditions	South
			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		
<i>Salvia farinacae hybrids</i> (Mealy Cup Sage)	To control plant growth	Dazide/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	250 ppm spray x 1	Controlled height and increased branching	Branching
<i>Salvia guaranitica</i> (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	
<i>Salvia leucantha</i> (Velvet Sage, Mexican Sage)	To control plant growth	Dazide/B-Nine	5,000 ppm spray x 3	Apply at 10- to 14-day intervals	South
		Dazide/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	
<i>Salvia nemorosa</i> (Perennial Sage)	To root cuttings	Advocate/Hortus IBA	200 to 400 ppm x 1 spray	Salute Pink – apply 0.5 gal. (2 quarts) per 100 sq. ft. of bench area within 24-hours after sticking unrooted cuttings	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	
Salvia hybrids (Meadow 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 intervals	North	
			1 to 2 ppm drench x 1	Drench volume and mg a.i. vary with container size	Unspecified	
Salvia nemorosa (Perennial Sage)		Collate/Florel	Not responsive at 400 ppm spray x 4	May Night – all sprays phytotoxic; Did not reduce flower buds; Reduced growth	North	
			Salvia officinalis (Garden sage)	Collate/Florel	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
Salvia x sylvestris (Wood Sage)		Dazide/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
			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 intervals; 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		
Salvia x sylvestris (Wood Sage)		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 intervals	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 intervals	North
				2 to 6+ ppm drench x 1	As needed; Drench volume and mg a.i. will vary with container size	Unspecified
40 to 60 ppm spray x 1		40 to 60 ppm spray is the label rate				
Salvia x sylvestris (Wood Sage)		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		
Salvia x sylvestris (Wood Sage)	To increase lateral branching	Configure	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		

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)	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/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
		Dazide/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/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	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	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/Florel	500 ppm spray x 4	Autumn Joy – moderate growth control with biweekly sprays	North
		Dazide/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) <i>continued</i>	To control plant growth <i>continued</i>	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 /Florel	300 to 500 ppm spray x 1	To help control growth and increase branching or delay flowering	Unspecified
		Dazide /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	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
	Collate /Florel		500 ppm spray x 1 on liners	Increased branching	Branching
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	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 /B-Nine	5,000 ppm spray x 2	Indian Steel – moderate growth control	South
		Dazide /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

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/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/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/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	
	Concise/Sumagic	Less than 60 ppm spray x 4	Klaus Jelitto – biweekly sprays gave excessive growth reduction; Reduce frequency	North	
		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	
	To induce lateral branching	Configure	Less than 15 ppm spray x 4	Klaus Jelitto – biweekly sprays gave excessive growth reduction; Reduce frequency	North
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/B-Nine	5,000 ppm spray x 2	Red Cloud and Blue Stone – moderate growth control; Multiple applications necessary	South
		Dazide/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/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/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	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

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
Verbena canadensis (Clump Verbena)	To control plant growth	Collate /Florel	500 ppm spray x 1 to 2	Homestead Purple and Taylortown Red – moderate growth reduction; May delay flowering	South
		Dazide /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 /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	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 /B-Nine	2,000 to 2,500 ppm spray x 1	Santos Purple – multiple applications may be necessary	Unspecified
		Dazide /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	600 ppm spray x 1	Increased number of shoots and branches	Branching
		Collate /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
			5,000 ppm spray x 2	Red Fox – good control	South
	Dazide /B-Nine	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 intervals	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	

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)	To control plant growth <i>continued</i>	Dazide /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
Veronica hybrids (Speedwell)		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 intervals	North
Veronica spicata (Spike Speedwell) <i>continued</i>		Piccolo / Piccolo 10 XC /Bonzi/Pac O/Downsize (drenches only)	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 /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. 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	Branching	
		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	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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	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
Veronica x Sunny Border Blue (Hybrid Speedwell)	To control plant growth	Dazide /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 /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 /Floreil	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 /B-Nine	2,500 ppm spray x 1 to 2	Variegata – multiple applications may be required	North
		Dazide /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 /Floreil	500 to 1,000 ppm sprays x 1	For increased branching on finished plants	Branching
Vinca minor (Lesser Periwinkle)	To control plant growth	Dazide /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 /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 /Floreil	500 to 1,000 ppm spray x 1	For increased branching of finished plants	Branching
		Configure	Not responsive at 1,200 ppm spray x 1	Sterling Silver – not responsive	Branching

Using Advocate and Advocate Tank Mixes During Perennial Propagation

By W. Garrett Owen & W. Ty Rich, University of Kentucky

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 University of Kentucky, 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 Dümme 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 envi-

ronment under ≈56% shade cloth where ambient daylight was supplemented with ≈74 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ delivered from 600 W high-pressure sodium lamps to create a 16-hour photoperiod and benches providing root-zone heating of 72F (22C).

After 24-hours, unrooted cuttings of each species received foliar spray applications of deionized water (0 ppm; control), Advocate or Advocate +

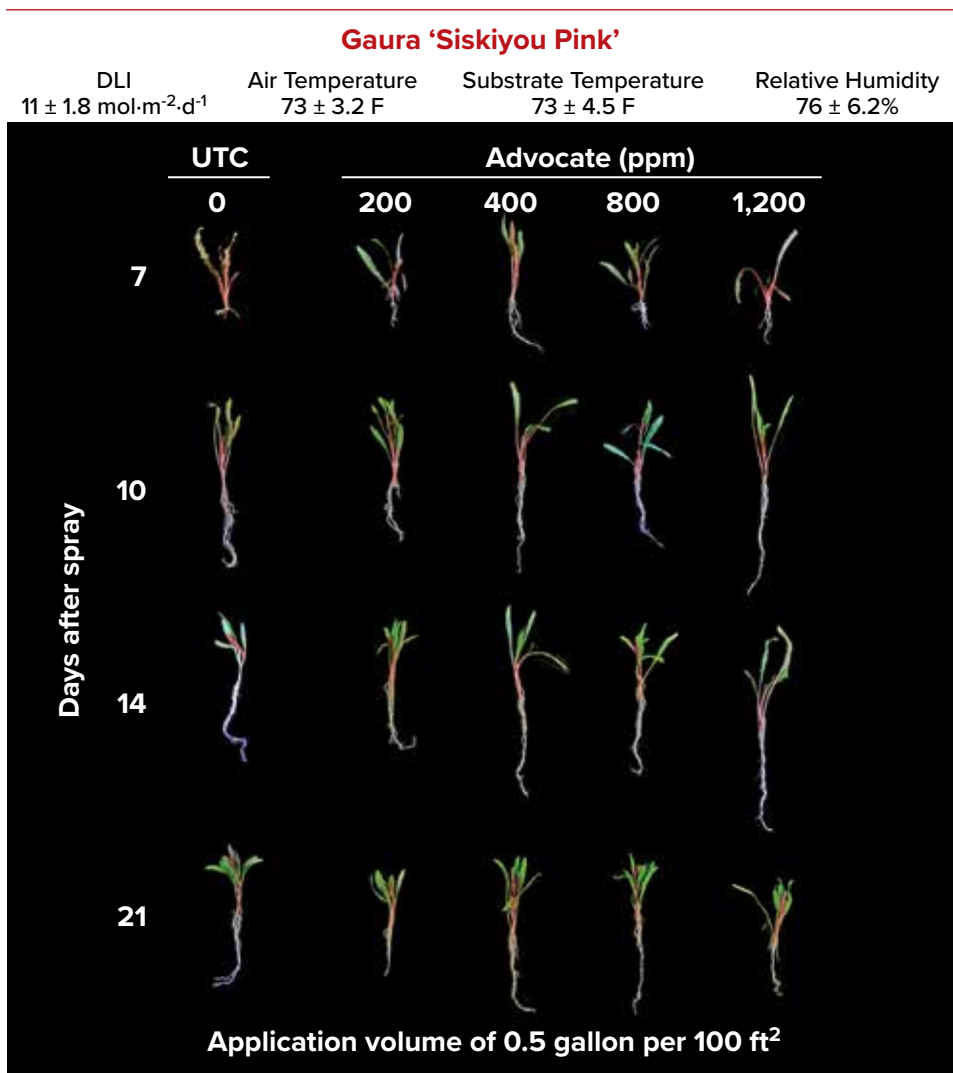


Figure 1. Gaura Siskiyou Pink cuttings at 7, 10, 14 and 21 days of propagation that received foliar spray applications of deionized water (0 ppm; control) or 200, 400, 800 or 1,200 ppm Advocate at a rate of 0.5 gal/100 sq. ft. with a handheld spray bottle from 6:00 to 7:00 a.m.

Photos by W. Garrett Owen.

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 ± 3.2 F, 73 ± 4.5 F and $76 \pm 6.2\%$, 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, 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. ▶

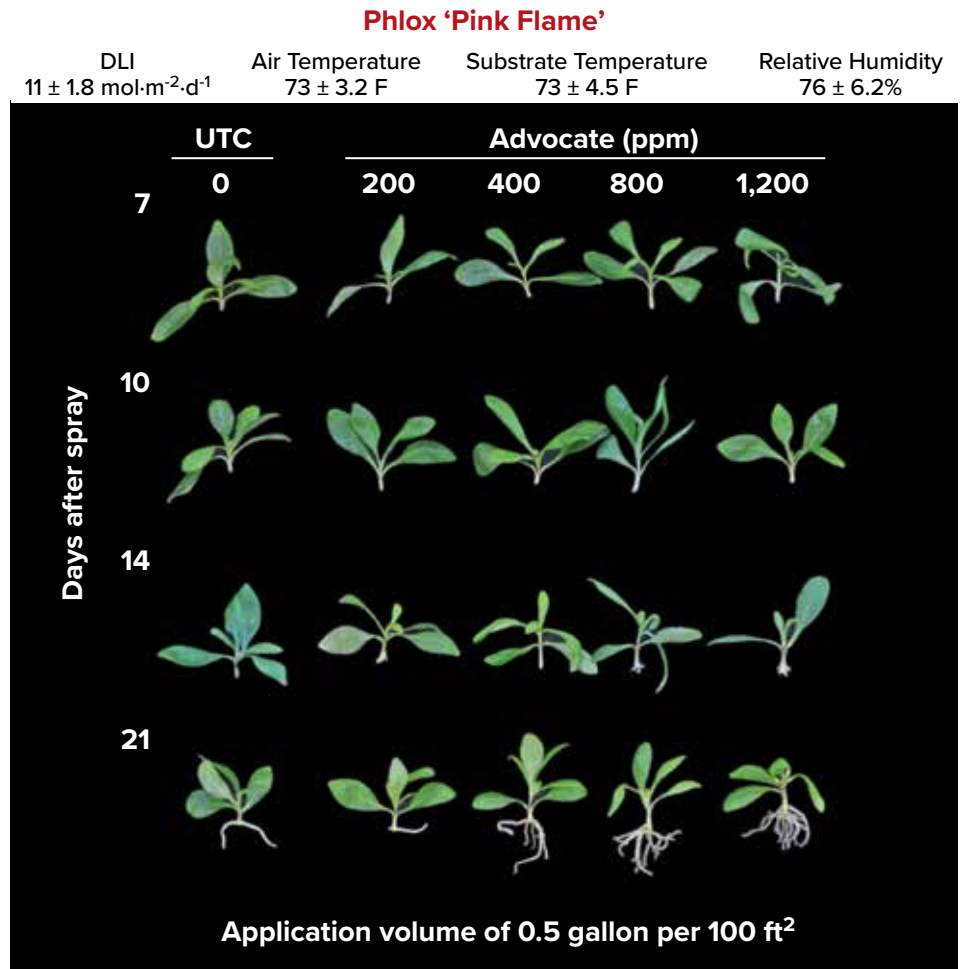


Figure 2. *Phlox paniculata* Flame Pink cuttings at 7, 10, 14 and 21 days of propagation that received foliar spray applications of deionized water (0 ppm; control) or 200, 400, 800 or 1,200 ppm Advocate at a rate of 0.5 gal/100 sq. ft. with a handheld spray bottle from 6:00 to 7:00 a.m.

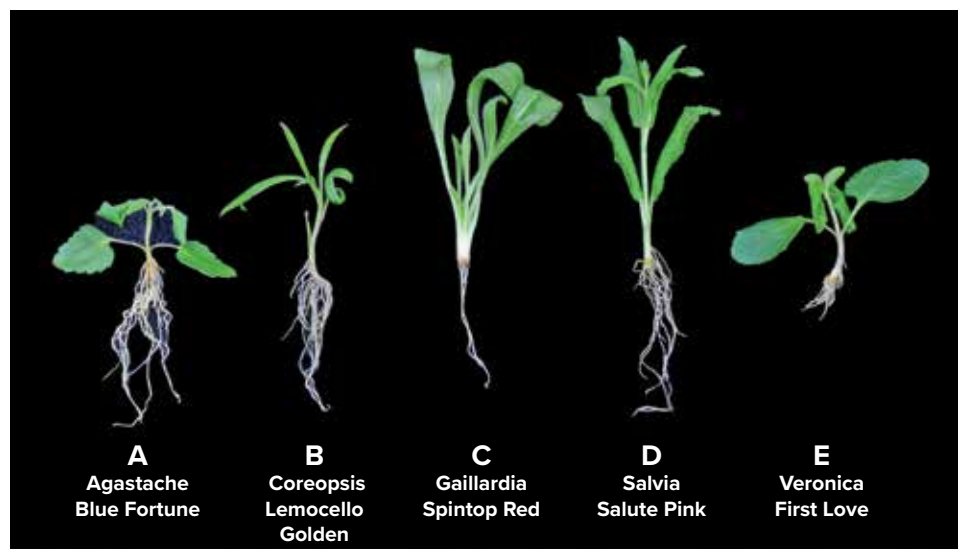


Figure 3. Epinasty or twisted growth of A) Agastache Blue Fortune; B) Coreopsis Lemocello Golden; C) Gaillardia Spintop Red; D) Salvia Salute Pink; and E) Veronica First Love cuttings sprayed with 1,200 ppm Advocate. Photos taken 14 days after foliar spray application at a rate of 0.5 gal/100 sq. ft.

- 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/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/100 sq. ft. After 21 days, propagation daily light integral, air temperature, substrate temperature and relative humidity were $12 \pm 1.8 \text{ mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$, $70 \pm 2.2\text{F}$, $73 \pm 2.5\text{F}$ and $70 \pm 3.2\%$, 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'

DLI $12 \pm 1.8 \text{ mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$ Air Temperature $70 \pm 2.2 \text{ F}$ Substrate Temperature $73 \pm 2.5 \text{ F}$ Relative Humidity $70 \pm 3.2\%$

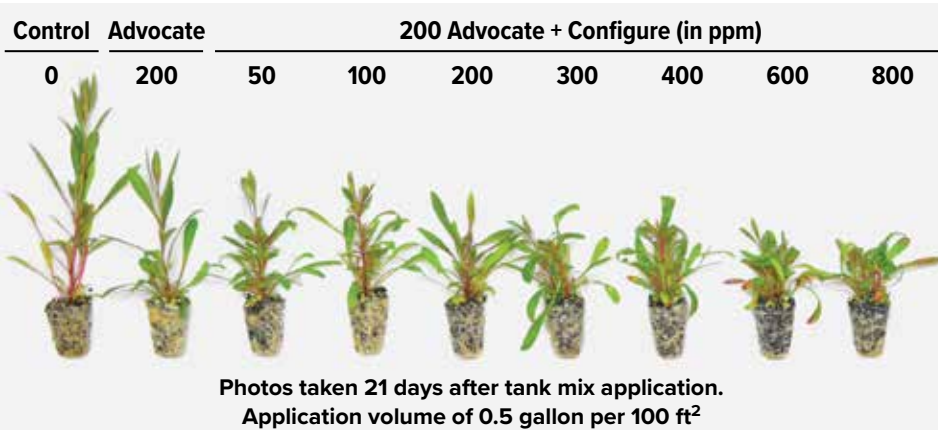


Figure 4. Gaura Siskiyou Pink cuttings at 21 days of propagation that received foliar spray applications of deionized water (0 ppm; control) or 200 Advocate + 0, 50, 100, 200, 300, 400, 600 or 800 ppm Configure at a rate of 0.5 gal/100 sq. ft. with a handheld spray bottle from 6:00 to 7:00 a.m.

Lamium 'Nancy Red'

DLI $12 \pm 1.8 \text{ mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$ Air Temperature $70 \pm 2.2 \text{ F}$ Substrate Temperature $73 \pm 2.5 \text{ F}$ Relative Humidity $70 \pm 3.2\%$

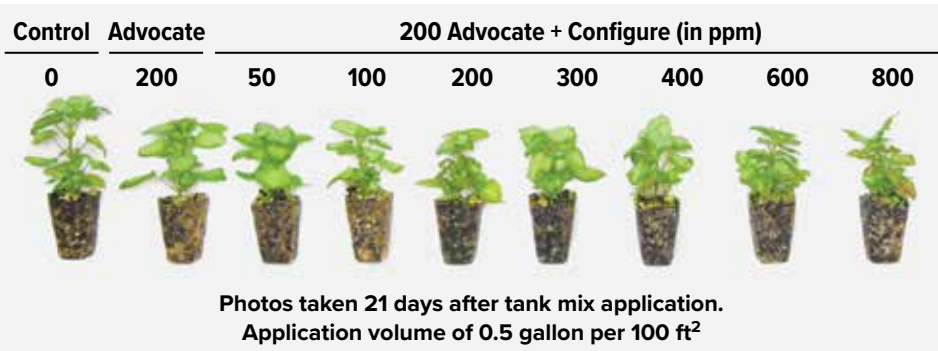


Figure 5. Lamium Red Nancy cuttings at 21 days of propagation that received foliar spray applications of deionized water (0 ppm; control) or 200 Advocate + 0, 50, 100, 200, 300, 400, 600 or 800 ppm Configure at a rate of 0.5 gal/100 sq. ft. with a handheld spray bottle from 6:00 to 7:00 a.m.

Advocate



Every plant tells a story.
This one is about really healthy roots.

Whether you're growing annuals, perennials, or woody ornamentals, our Advocate root accelerator is proven to get cuttings off to a healthier start than other PGRs. By stimulating root development and creating a larger mass, Advocate promotes greater nutrient uptake and reduces transplant shock. And that's a story every plant wants to tell.

fine

Additional Benefits of PGRs

Brian E. Whipker, North Carolina State University

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

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/Su-magic). Chemicals that have a different mode of action—such as Augeo, Configure, Florel, Collate, 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.

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

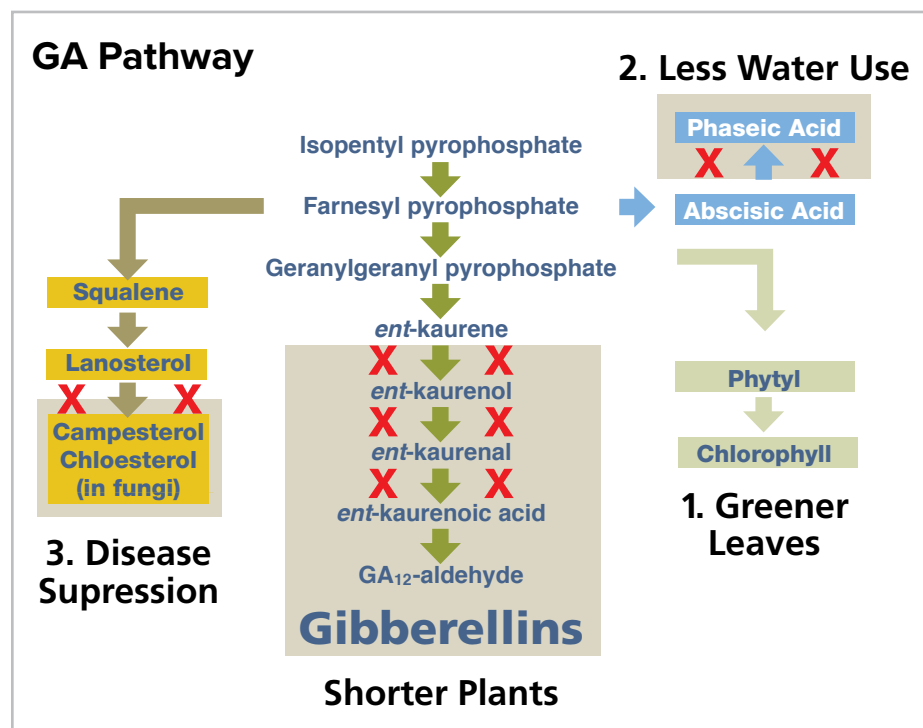
secondary effects. In this case, an up-regulation, or increase, in the amount of chlorophyll produced by the plant (Figure 1).

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 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.



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).

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 suppression of plant diseases. 🍄



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.

Figure 3. Data from a recent study at North Carolina State University in which the use of 1 mg a.i. paclobutrazol 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

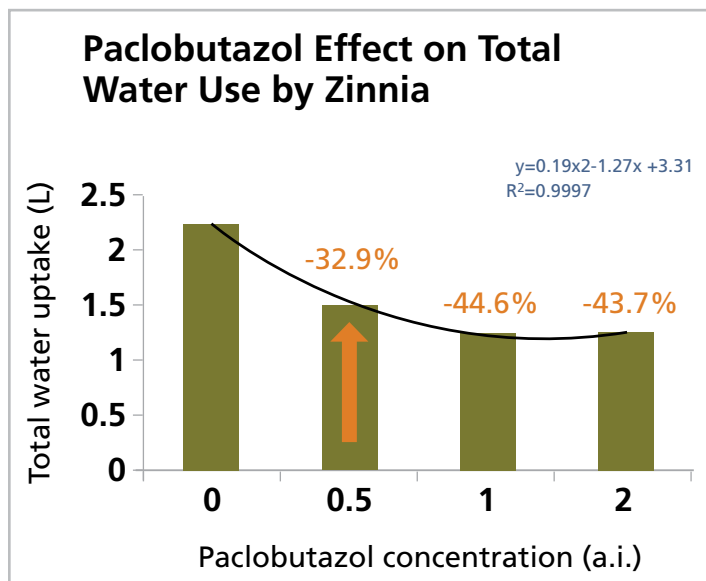


Figure 4. Based on a height control experiment, one can clearly see powdery mildew starting to infect the untreated plant on the left, while the plant on the right had been given a PGR drench about 4 weeks prior to this date and a powdery mildew infection had been reduced. PGRs will not provide season-long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

Controlling Growth of Rudbeckia Cultivars

By W. Tyler Rich & W. Garrett Owen, University of Kentucky

Rudbeckia spp. are becoming increasingly popular herbaceous perennials for late-summer and fall sales because of their complementary fall flower colors ranging from brilliant yellow to orange, red or brown. Growers who produce rudbeckia know that growth control is needed. While various environmental and cultural practices may be deployed to control growth, plant growth regulators (PGRs) are excellent tools that can be utilized. To address growth control needs of tried-and-true and new rudbeckia cultivars, we sought to evaluate Concise and Piccolo drenches.

Research

Liners of Autumn Colors, Cherry Brandy, Denver Daisy, Glowing, Happy, Indian Summer and Sunny Rudbeckia were transplanted between September 3 and 25, 2020. Plants were grown in 6.5-in. containers filled with a pre-moistened commercial soilless peat-based substrate formulated to contain (by vol.) 80% peat, 20% perlite and amended with limestone, wetting agent and a starter nutrient charge (Lambert Peat Moss LM-111). Plants were grown under a constant 68F (20C) and ambient daylight supplemented with $\approx 125 \mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ delivered from 600 W high-pressure sodium lamps to create a 16-h photoperiod.

The average air temperature, daily light integral and relative humidity were 68F, $14 \text{ mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$ and 70%, respectively. Throughout the trial, plants were irrigated with water supplemented with 93% sulfuric acid to control alkalinity and fertilized with 150 ppm N provided by 17-4-17. Plants also received monthly Epsom salt drench applications at 1 lb. per 100 gallons of water.

On October 14, PGR drench applications were applied. Six single-plant replications of each cultivar received a substrate drench of 5 fl. oz. (150-mL) of solution containing deionized water (0 ppm; control), 1, 2 or 4 ppm Concise (uniconazole), or 2.5, 5, 10 or 20 ppm Piccolo (paclobutrazol). For the trial, saucers were placed under each container, so no solution was leached. Plants were grown until visible pollen shed (anthesis) where data were collected, including plant height, diameter (taken in two directions and averaged) and plant dry mass. Time to flower was calculated from date of drench application to anthesis.

Results


In general, at the concentrations used, growth control was not achieved with the Concise substrate drench concentrations investigated for most all cultivars except Glowing. For Glowing, plant height was significantly shorter by 22% (4.6 in.) when plants were drenched with 0 to 4 ppm Concise without negatively affecting dry weight and time to flower (Figure 1). Further investigations with higher drench concentrations or multiple low-dose drench applications are needed.

In general, 5 to 10 ppm Piccolo drench applications effectively controlled growth for all cultivars, while the magnitude of control varied among cultivars for plant diameter, dry mass and time to flower. For example, plant height of Glowing and Happy drenched with 0 to 10 ppm Piccolo was controlled by 150% (13 in.) and 35% (3.3 in.), respectively (Figures 2 to 3). Increasing Piccolo drench concentration from 0 to 10 ppm significantly delayed flowering of Glowing by eight days (Figure 2), while the effect wasn't observed for Happy; plants flowered within two days regardless of Piccolo concentration (Figure 3).

Conclusion and application

Concise substrate drenches of 1 to 4 ppm didn't provide growth control for the cultivars trialed. The lack of growth control at the concentrations trialed was surprising. In general, uniconazole is the preferred PGR for perennial growth control. Higher concentrations may be required to achieve the desired level of growth control.

Piccolo drench concentrations of 5 to 10 ppm significantly controlled growth, but growers should be aware that drenches slightly delayed flowering, but effects vary by cultivar. (Please note: Growers will need to determine the desired level of control when selecting the optimal drench concentration of Piccolo.)

Furthermore, drench concentrations were determined under Kentucky-greenhouse growing conditions (38°N Latitude), but adjustments may be needed for other locations. For example, growers in northern locations may want to use ≤ 5 ppm Piccolo, while southern growers may want to utilize up to 10 ppm Piccolo. 

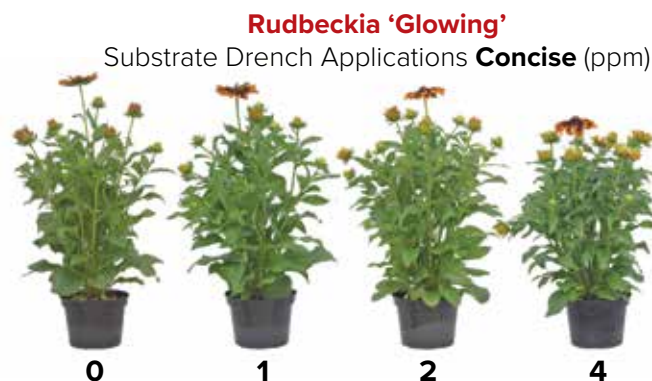


Figure 1. Glowing Rudbeckia drenched with 0, 1, 2 or 4 ppm Concise.

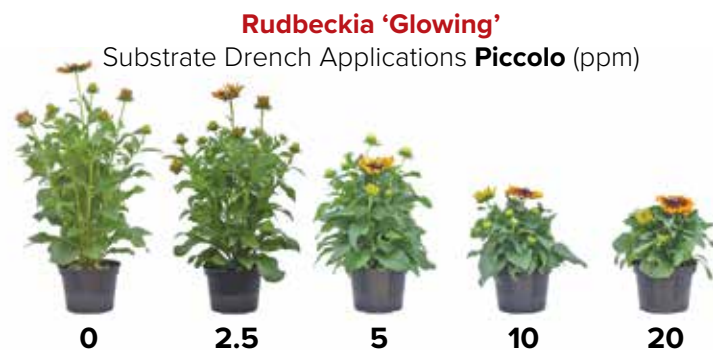


Figure 2. Glowing Rudbeckia drenched with 0, 2.5, 5, 10 or 20 ppm Piccolo.



Figure 3. Happy Rudbeckia drenched with 0, 2.5, 5, 10 or 20 ppm Piccolo.

Photos by W. Garrett Owen.

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 GA4/7 + 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 GA4+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. 



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.

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.

Using Dazide and Concise to Control Growth of Hybrid Echinacea

By Mara C. Grossman, Holly L. Scoggins & Joyce G. Latimer, Virginia Tech

Growers and consumers appreciate all of the exciting new flower colors and forms of hybrid echinacea cultivars, however, in production, some hybrids can grow to be overly tall.

In our previous research, we've used different PGRs to control the height of echinacea cultivars. We found that Echinacea Harvest Moon was more compact after spray or drench treatment with Concise (uniconazole) or Piccolo 10 XC (paclobutrazol) or spray applications of Dazide (daminozide). However, while Echinacea Marmalade was shorter in response to spray applications of Dazide, flowering in finished plants was diminished.

In this study, we wanted to determine the effectiveness of a mixed growth regulator approach using Dazide during liner development and Concise after liner transplant in order to meet the goal of compact liners and finished plants without negative effects on flowering.

Materials & methods

As part of a 20-cultivar evaluation, Echinacea Julia tissue culture plantlets were transplanted into a peat and pine bark substrate and acclimated to greenhouse conditions under a 16-hour photoperiod. To enhance branching, a 300 ppm Config (benzyladenine) spray was applied to all liners at 40 and 57 days after transplant. Plants were divided into two groups, one control group not treated with growth retardants and one group that received two foliar applications of 2,500 ppm Dazide at six and eight weeks after transplant. Liner growth was assessed at 10 weeks after transplant after which liners were planted into quart containers.

Four weeks after planting, foliar applications of 15 ppm Concise were applied to plants in the growth retardant treatment. The study ended when plants were in flower at nine weeks after planting (19 weeks after initial tissue culture transplant).

Liner results

Liners were ready for planting to quart containers at 10 weeks after transplant of tissue culture plantlets. At this time, liners treated with Dazide were significantly shorter than those without (3.3 in. for Dazide vs. 4.2 in. for untreated plants). Plant width, number of branches and rooting weren't affected by Dazide applications.

Finished plant results

Finished plants treated with growth retardants were shorter than those without (17.6 in. compared to 22.2 in. for untreated plants). Plant width, days to flower and number of flower stalks weren't affected by growth retardant applications. Although the number of branches was greater in plants without height control treatment (13 branches compared to 10 branches in those treated with growth retardants), all plants were well branched and fully filled the containers.

Conclusions

Echinacea Julia plants were significantly more compact following growth retardant applications, both as liners and as finished plants. Rooting and flowering weren't affected by PGR treatment.

We followed this PGR protocol on other echinacea hybrid cultivars as well, most with good success. The key to obtaining good height control with PGRs in echinacea is proper timing of the applications. In the liner stage, we applied growth retardants when liners were well rooted and stems were just beginning to elongate. After planting to quart pots, we applied Concise as a foliar spray after flower stalks developed, but prior to their elongation. Although Julia only required one application of Concise, some cultivars required additional applications as flower stems elongated. ①



Echinacea Julia liners at 10 weeks after transplant of tissue culture plantlets, untreated on the left or treated twice with 2,500 ppm Dazide on the right.



Echinacea Julia finished plants at 9 weeks after planting liners, untreated on the left or treated with Dazide and Concise on the right.

Piccolo 10 XC



For precise control of your
ornamentals, use Piccolo 10 XC.
For not-so precise control, don't.

As a grower, uncertainty is not your friend. Enter Piccolo 10 XC. With its crystal clear, water-soluble formula, this paclobutrazol formulation never settles out or requires additional agitation after mixing. That means your plants get consistent rate across the greenhouse, so they grow to the exact height you want. That's what we call clear, certain success.

fine

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 A₄+A₇ [GA₄+7] and 1.8% benzyladenine [6-BA]. This combination provides stimulation of intermodal elongation with the GA₄+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 Florigib 4L. It contains gibberellin A₃ 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 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 GA₄+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.

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

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.
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.



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

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. Ⓢ

Collate Use Tips

By Brian E. Whipker, North Carolina State University

In greenhouse floriculture production, Florel has been the go-to ethephon formulation for years. It's available as a 3.9% active ingredient solution. Fine Americas introduced Collate in 2013, which is a higher-concentration (21.7%) product. Greenhouse label uses for Collate include inducing flowering of ornamental bromeliads; avoidance of stem topple of potted hyacinths; height control of potted daffodils; and flower inhibition, increase in axillary shoot development and height control in a variety of ornamental crops. In order to get the most out of your Collate applications, below are some use tips to consider.

Application parameters. Collate breaks down and becomes inactive with water pH conditions greater than 6.1. While all of the registered ethephon products contain acidifiers, in areas with high levels of alkalinity, the alkalinity will need to be neutralized BEFORE mixing the solution. The ideal endpoint pH for a Collate solution is ~4.5 to 5.0. Be careful to avoid getting the solution pH too low, though—leaf phytotoxicity can occur with ethephon applications when the pH is below 3.

Temperatures. In addition, Collate activity is linked to active plant growth. Applications made when temperatures are below 60F (15.5C) or higher than 80F (27C) will be less effective. Therefore, during times when temperatures are excessive, make applications either early in the morning or late at night.

Timing. When used to promote axillary branching, the plants should be well-rooted in the container. Typically, rooting to the side of the pot will occur within two weeks. Applications made before plugs or plants are well-rooted can result in retarded root development and stunted growth.

When used for prevention of early flowering, it should be noted that the last Collate foliar spray application should be made six to eight weeks prior to the intended sales date. Late spray applications will result in flower delay.

Suitable application windows should also be noted with stock plants. Ethylene can inhibit rooting, so applications shouldn't be made within seven days of harvesting cuttings.

Avoid applications to stressed plants. When used correctly, Collate applications will result in enhanced plant growth. Because ethylene produced by Collate is a stress enhancer, it's important to have the plants actively growing and not under suboptimal conditions (heat, drought, environmental or disease stress). Lower leaf yellowing typically occurs when Collate is applied to drought-stressed plants.

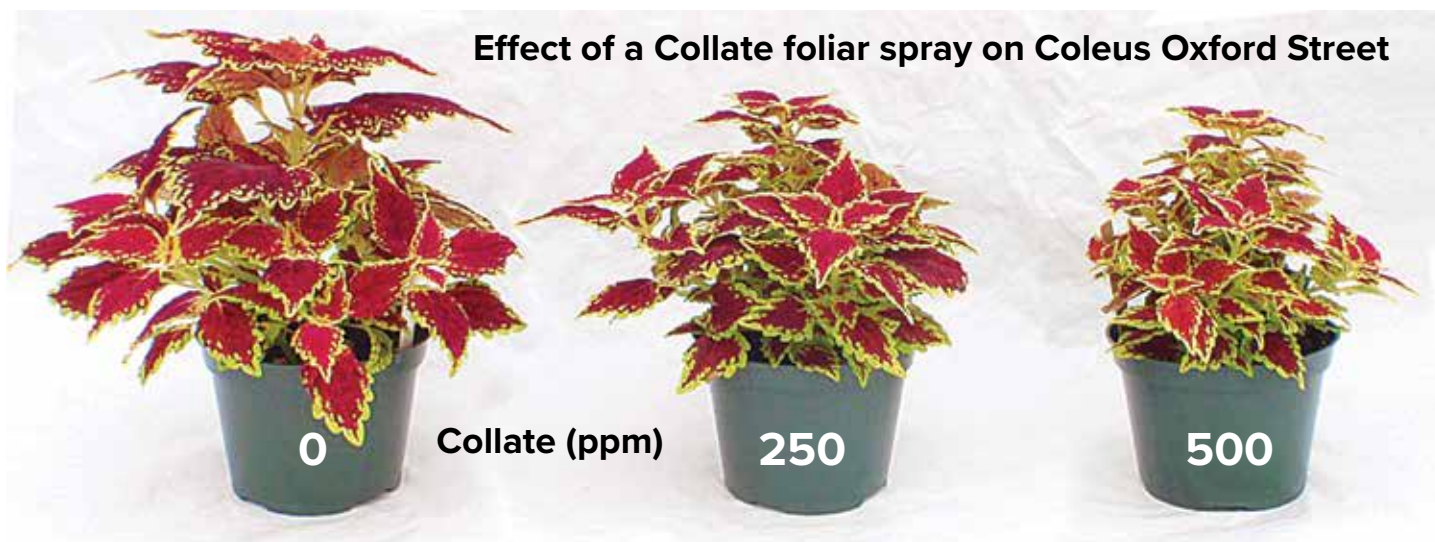
Optimal concentrations. For most plants, Collate spray rates are typically at 500 ppm. Complete spray coverage is required because Collate isn't translocated within the plant. This is especially important for plants such as garden mums. Incomplete spray applications will result in uneven growth and flowering. Research has shown that drench and pre-plant liner soak application rates are lower—in the range of 50 to 250 ppm. At this time, none of the registered ethephon products, including Collate, are labeled for drench applications.

Phytotoxicity. Some cultivars have a greater sensitivity to Collate. Cupping and distortion of the young expanding leaves can occur. In addition, over-application can also result in distortion and leaf bleaching.

Protective equipment and REI.

Collate is acidic, and because of this, it's a minor eye and skin irritant. That's the reason it has a longer REI of 48 hours. In addition, it should be noted that eye protection is required, along with protective gloves, coveralls, apron, shoes and head-gear for overhead applications. A box of baking soda should be handy to neutralize the acidity of Collate in case it comes in contact with your skin.

In summary, Collate is effective in controlling excessive growth of many greenhouse plants. Collate is an excellent and cost-effective option for improving plant structure, preventing early flowering and controlling excessive plant growth. It's easy to see why Collate has become an essential component of the floriculture PGR toolbox. 🌱



Dilution Table

Formulated product per gallon of solution

PPM AI	Abide/ A-Rest (milliliters)	Dazide/ B-Nine (grams)	Citadel/ Altercel (milliliters)	Collate (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.

Sprencches are a way of supplying a greater dose of chemical as a foliar spray. Most sprencches 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. 



When our scientists developed our portfolio of PGRs, they didn't just go by the book. They added pages to it.

As an industry leader, we know all about PGRs. Like the importance of having a comprehensive line that addresses a greenhouse full of needs. From stimulating root growth to regulating plant height, our full roster of PGRs was formulated by those who aren't comfortable with the status quo. We are experts who are always searching for ways to improve our products. For new ways to use them. For new applications. For ways to further expand our labels. And for ways to help you grow.

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