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Plant Growth Regulator Guide for Herbaceous Perennials Update

The latest edition of the Plant Growth Regulator Guide for Containerized Herbaceous Perennial Plants is now available. Thanks to the sponsor, Fine Americas, Inc., growers can download a free copy online and/or subscribers of GrowerTalks will receive a copy in the mail.

Herbaceous perennial growers - need a little help regulating or enhancing plant growth this cropping season? We have you covered! The [“Plant Growth Regulator Guide for Containerized Herbaceous Perennial Plants”](#) has been updated for the 2022-23 cropping season (Fig. 1). The 76-page guide, sponsored by Fine Americas, Inc. and designed by GrowerTalks, is now available [online](#) and subscribers of GrowTalks will receive a hardcopy of the guide with their monthly magazine. Herbaceous perennial growers will find updates on cutting-edge plant growth regulators (PGRs), crop reports, and resources produced by members of the e-GRO team. Highlights for each section are provided.

Cutting-edge PGRs

In this section, one product is highlighted for herbaceous perennials - Advocate. If you are unfamiliar with Advocate, it is a liquid 20% indole-3-butyric acid (IBA) which allows growers to easily dose the desired concentrate for mixing and application. The article www.e-gro.org



Figure 1. The 2022-23 PGR Guide for Containerized Herbaceous Perennial Plants. Photo by: W. Garrett Owen.

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Cutting-Edge PGRs

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 concentration 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 Dümnen Orange. Cuttings were individually inserted into 195-cell propagation trays (30-ml, individual cell vol.) filled with a pre-moistened commercial peat-based substrate (L.M. 111, Lambert Peat Moss) amended with (by vol.) 50% coarse perlite. Unrooted cuttings were placed in a propagation environment under +56% shade cloth where ambient daylight was supplemented with +74 µmol/m²·s⁻¹ delivered from 600 W high-pressure sodium lamps to create a 16-hour photoperiod and benches providing root-zone heating of 72°F (22°C). After 24 hours, unrooted cuttings of each species received foliar spray ▶

Gaura 'Siskiyou Pink'
DLI 11 ± 1.8 mol·m⁻²·d⁻¹
Air Temperature 73 ± 3.2 F
Substrate Temperature 73 ± 4.5 F
Relative Humidity 76 ± 6.2%

UTC
Advocate (ppm)
0 200 400 800 1,200

7
10
14
21

Days after spray

Application volume of 0.5 gallon per 100 ft²

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.

GROWERTALKS | 2022-23 Guide to Growing Top-Quality Perennials 3

Figure 2. Research trial highlighting foliar spray applications of Advocate, a liquid 20% indole-3-butyric acid (IBA) and rooting response of herbaceous perennial species. Photo by: W. Garrett Owen.

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 ± 1.8 mol·m⁻²·d⁻¹, 70 ± 2.2F, 73 ± 2.5F and 70 ± 3.2%, respectively.

In general, the magnitude of extension growth control and branching varied by species while enhancing rooting in response to the PGR applications. For example, increasing from 50 to 400 ppm Configure significantly reduced 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 ± 1.8 mol·m⁻²·d⁻¹
Air Temperature 70 ± 2.2 F
Substrate Temperature 73 ± 2.5 F
Relative Humidity 70 ± 3.2%

Control Advocate 200 Advocate + Configure (in ppm)
0 200 50 100 200 300 400 600 800

Photos taken 21 days after tank mix application.
Application volume of 0.5 gallon per 100 ft²

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 ± 1.8 mol·m⁻²·d⁻¹
Air Temperature 70 ± 2.2 F
Substrate Temperature 73 ± 2.5 F
Relative Humidity 70 ± 3.2%

Control Advocate 200 Advocate + Configure (in ppm)
0 200 50 100 200 300 400 600 800

Photos taken 21 days after tank mix application.
Application volume of 0.5 gallon per 100 ft²

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.

GROWERTALKS | 2022-23 Guide to Growing Top-Quality Perennials 5

Figure 3. Research trial highlighting tank mixes of Advocate, a liquid 20% indole-3-butyric acid (IBA) and Configure (benzyladenine) applied to cuttings as foliar sprays to control growth and enhance branching during propagation of herbaceous perennial species. Photo by: W. Garrett Owen.

highlights two research trials performed by the University of Kentucky Controlled-Environment Horticulture lab. The first trial highlights foliar spray applications of Advocate and rooting response of herbaceous perennial species (Fig. 2). The second trial highlights tank mixes containing Advocate + Configure (benzyladenine) and applied to cuttings as foliar sprays to control growth and enhance branching during propagation (Fig. 3). For those that are interested in Advocate foliar applications on annual bedding plants, refer to the [2021-22 Plant Growth Regulator Guide for Annuals](#) by Dr. Brian Whipker, NC State.

Crop Report

Two new articles are provided as crop reports from the University of Kentucky and Virginia Tech. The first crop report, from the University of Kentucky, discusses the use of Concise (uniconazole) and Piccolo (paclobutrazol) substrate drenches to control growth of seven containerized *Rudbeckia* cultivars (Fig. 4). Concise substrate drenches at 1 to 4 ppm only controlled growth of 'Glowing' *Rudbeckia*, while Piccolo substrate drenches at 5 to 10 ppm were effective at controlling growth of all cultivars trialed. These recommendations will assist you in controlling growth of *Rudbeckia*.

The second article, from Virginia Tech, discusses the use of Fresco [combo product of the gibberellins GA4/7 + 6-BA (benzyladenine)] in enhancing the growth of herbaceous perennial plants previously stunted by the application of excessive PGR application (Fig. 5). Fresco foliar spray applications at 2.5 ppm were effective at restoring growth of

Crop Report

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-mixed 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-11). Plants were grown under a constant 66F (20C) and ambient daylight supplemented with +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 9% 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 50% (13 in.) and 56% (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 tested. The lack of growth control at the concentrations tested 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.

6. **COVER STORY** 2022-23 Guide to Growing Top-Quality Perennials

Figure 4. Crop report discussing the use of Concise (uniconazole) and Piccolo (paclobutrazol) substrate drenches to control growth of seven containerized Rudbeckia cultivars. Photo by: W. Garrett Owen.

Crop Report

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 2.5 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.

Fresco use tips
Never use more than the low dose of 2.5 ppm Fresco as it's restoring growth and salubility of these PGR-stunted plants. We generally recommend spray rates of 1 to 5 ppm Fresco, depending on the severity of the stunting. Begin with the lower rates and wait seven days to determine if you've achieved the desired level of growth recovery.

After seven days, if you have not seen the level of recovery desired, an additional application may be made to continue the recovery. Only apply enough Fresco to restore the growth rate to overcome the growth retardant effect. Too much Fresco will cause excessive growth/stretching of the stem and flower stalks and weaken the overall plant structure. You want to restore growth, not force it. Results vary with the crop and the degree of stunting, so always start with a small trial and adjust the rates accordingly.

If you're more comfortable with drench or subirrigation applications, be aware that Fresco is the only GA+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 on the label.

Gaura Siskiyou Pink

Started (days)	Fresco rate (ppm)	Plant height (in)	Plant width (in)
No	0	24.5 a	19.3 b
Yes	0	13.0 a	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	22.6 a	27.3 ab
p-value*		<0.01	<0.01

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

Veronica First Love

Started (days)	Fresco rate (ppm)	Plant height (in)	Plant width (in)
No	0	42.2 a	31.6 a
Yes	0	20.9 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 1. Height and width of Gaura Siskiyou Pink plants started 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, 10 or 15 ppm.

Table 2. Veronica First Love plants started with a 60-ppm foliar application of Concise. Growth measured at 15 days after a spray application of Fresco at 0, 2.5, 5, 10 or 15 ppm.

6. **COVER STORY** 2022-23 Guide to Growing Top-Quality Perennials

Figure 5. Crop report discussing the use of Fresco [combo product of the gibberellins GA4/7 + 6-BA (benzyladenine)] in enhancing the growth of herbaceous perennial plants previously stunted by an excessive PGR application. Photo by: W. Garrett Owen.

PGR-stunted perennials. For severely stunted plants, general recommended spray concentration range between 1 and 5 ppm Fresco. Growers should conduct trials and adjust the spray concentrations.

Resources

In addition to the new articles, updates were made to other resources found throughout the guide including the 'Wide Assortment of Available PGRs' and 'Dilution Table'. Growers will also find new species listed in the 61-page PGR application recommendation table. Finally, growers will find additional helpful information in the guide such as an article on the [PGR Mix Master](#) which can assist you in mastering all your PGR mixing needs. Other articles include: PGRs on Herbaceous Perennials, Additional Benefits of PGRs, Improving Branching of Gaura with Configure or a Configure + Dazide (daminozide) Tank Mix, Evening Out Results with Piccolo 10XC, Using Dazide and Concise to Control Growth of Hybrid Echinacea, Enhancing Growth of Sempervivum with Configure, Fresco Use Tips, and Collate (Ethephon) Use Tips.

Overall, the Plant Growth Regulator Guide for Containerized Herbaceous Perennial Plants is to provide an updated resource of PGR information for herbaceous perennial growers.

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