e-GRO Alert

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Perennial Powerhouse: Unlock More with the New PGR Guide

The latest edition of the Plant Growth Regulator Guide for Containerized Herbaceous Perennial Plants is now available online and in print. 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.

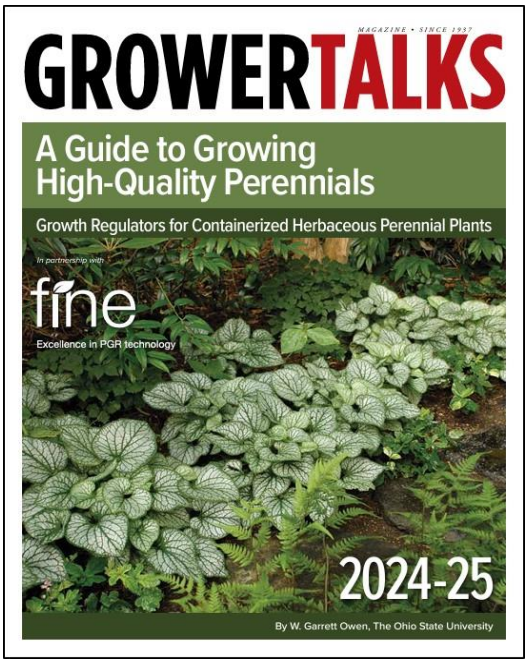

Figure 1. The 2024-25 Plant Growth Regulator Guide for Containerized Herbaceous Perennial Plants. Photo by: W. Garrett Owen.

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 2024-25 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

This article highlights ethephon, the active ingredient of Collate (21.7% ethephon) and Florel (3.9% ethephon), applied as a substrate drench. While currently only registered for

Cutting-Edge PGRs

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 ▶

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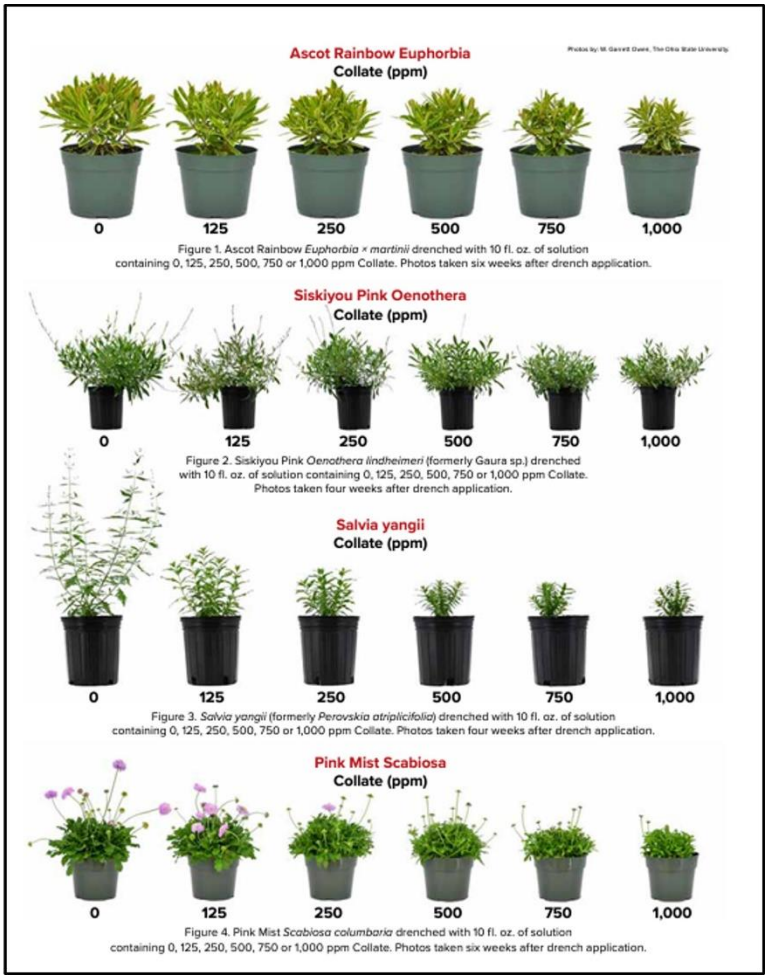

Figure 2. Article highlighting research trials of ethephon, the active ingredient of Collate (21.7% ethephon) and Florel (3.9% ethephon), applied as a substrate drench to herbaceous perennial. Photo by: W. Garrett Owen.

foliar sprays, research trials led by Dr. Joyce Latimer at Virginia Tech and Dr. Garrett Owen at The Ohio State University suggests its potential as a substrate drench for containerized herbaceous perennials. In the first trial, researchers at Virginia Tech investigated substrate pH. They found that solutions with higher Collate concentrations have a lower pH, potentially reducing efficacy if the water source is high in alkalinity. Interestingly, substrate pH within the recommended range (5.5 to 6.5) did not significantly reduce drench effectiveness. In the second trial, researchers at Virginia Tech evaluated the impact of substrate temperature on drench efficacy. They found that Collate drenches effectively controlled growth regardless of root zone temperature, ranging from 55 °F to 82 °F (13 °C to 28 °C). In the third trial, researchers at The Ohio State University evaluated the response of 20 herbaceous perennials taxa to increasing Collate drench concentrations. They found that Collate drenches effectively controlled the growth of most perennials tested (Fig. 2). Although these studies provide valuable insights into substrate pH and root zone temperature and help establish concentration recommendations, Collate drenches are not yet approved for use. Once regulatory approval for drench applications is granted, researchers recommend that growers conduct their own in-house trials.

Crop Report

Two new crop report articles highlight plant growth retardant use on heartleaf brunnera (*Brunnera macrophylla*) and butterfly bush (*Buddleia* sp.). The first crop report highlights


Crop Report

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 ≈125 µmol-m^{-2}-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 mol-m^{-2}-d^{-1} and 70%, respectively. Throughout

Brunnera 'Jack Frost'
Foliar Spray
Concise (ppm)

0 2.5 5.0 7.5 10.0 20.0

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.

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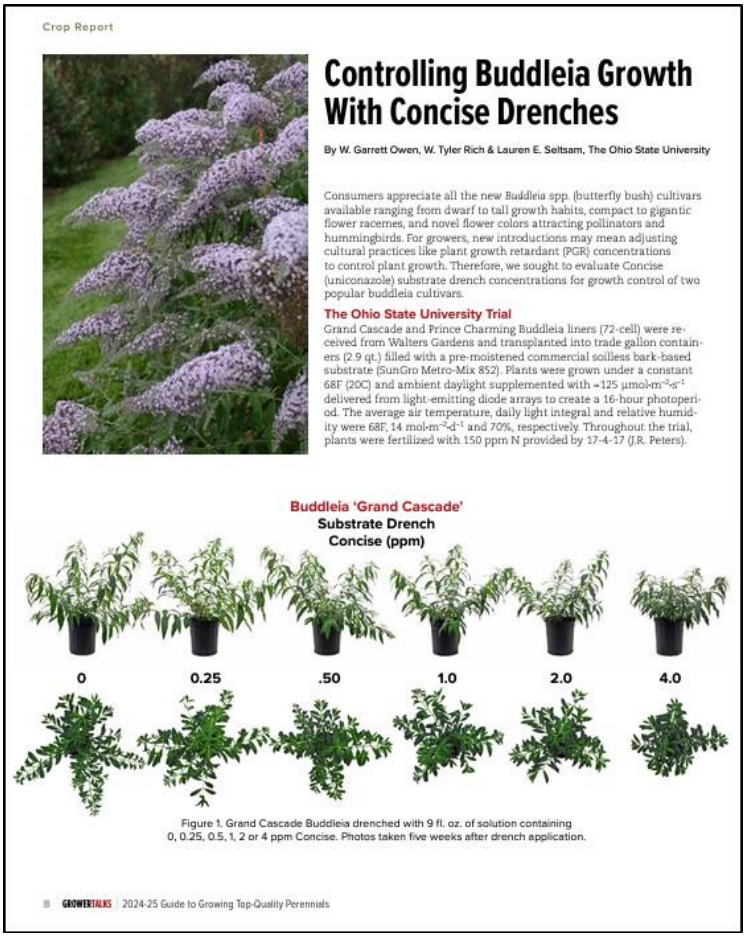
Figure 3. Research trial highlighting foliar sprays and substrate drenches of Concise (uniconazole 0.06%) to control growth of 'Jack Frost' heartleaf brunnera (*Brunnera macrophylla*). Photo by: W. Garrett Owen.


Crop Report

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 ≈125 µmol-m^{-2}-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 mol-m^{-2}-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)

0 0.25 .50 1.0 2.0 4.0

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.

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Figure 4. Crop report discussing the use of Concise (uniconazole 0.06%) substrate drenches to control growth of 'Grand Cascade' and 'Prince Charming' butterfly bush (*Buddleia* sp.). Photo by: W. Garrett Owen.

Concise (uniconazole 0.06%) foliar sprays and substrate drenches to control growth of heartleaf brunnera (Fig. 3). In general, researchers found Concise foliar sprays of 5 to 10 ppm and substrate drenches of 0.875 to 5 ppm effectively controlled growth of 'Jack Frost' heartleaf brunnera.

The second article focused on the use of Concise substrate drenches to control growth of two popular butterfly bush cultivars (Fig. 4). Researchers determined Concise substrate drenches of 1 to 4 ppm effectively controlled growth of 'Grand Cascade' and 'Prince

Charming' butterfly bush; however, growers will need to determine the desired level of control and consider market dates when selecting substrate drench concentrations of Concise. If you are a producer of heartleaf brunnera and butterfly bush, then you do not want to miss these crop reports.

Resources

In addition to the new articles, updates were made to other resources found throughout the guide. One of the most notably updates include the chlormequat chloride commercial product formerly known as Cycocel is now Altercel. Additionally, a 'Wide Assortment of Available PGRs' table was created to compare the attributes of plant growth promoters, branching agents, and root hormones (Fig. 5). Growers will also find

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

Attributes	Plant Growth Regulator			
Chemical	Benzyladenine	Gibberellins	Benzyladenine + Gibberellins	Indole-3-butyric Acid
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 type[1]				
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)	+

Figure 5. The new 'Wide Assortment of Available PGRs' table comparing the attributes of plant growth promoters, branching agents, and root hormones. Photo by: W. Garrett Owen.

new species listed in the 62-page PGR application recommendation table. Growers will also find other useful articles including Using Advocate and Advocate Tank Mixes During Perennial Propagation, Additional Benefits of PGRs, Controlling growth of *Rubeckia* Cultivars, Apply Fresco to Recover PGR-Stunted Herbaceous Perennials, Using Dazide and Concise to Control Growth of Hybrid *Echinacea*, Fresco Use Tips, and Collate Use Tips. As always, there is a dilution table that can help with all your mixing needs.

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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