

MAGAZINE • SINCE 1937

GROWER TALKS

Plant Growth Regulator Guide for Annuals

In partnership with

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Excellence in PGR Technology

2025-26

By Brian Whipker, North Carolina State University



Dear Valued Partners and Colleagues,

At Fine Americas, our deep-rooted expertise in Plant Growth Regulator (PGR) solutions has allowed us to become a trusted partner for commercial growers, helping them navigate challenges and drive long-term success. For years, we've been committed to providing growers with a proven suite of PGR products that consistently deliver reliable results—products that help you not only enhance plant performance, but maintain solid financial outcomes, as well.

Today, as part of Fine's ongoing commitment to the ornamental industry, we're excited to introduce a valuable resource in partnership with *GrowerTalks* that continues this legacy of support: our new *Annuals PGR Guide*. This updated edition underscores the transformative impact our PGRs have on successful annual production, featuring the latest research and test results that unlock new opportunities in plant production. Since our founding in 2004, we've provided growers with the tools to enhance both plant quality and profitability, empowering them to meet and exceed their goals year after year.

In this guide, we focus on three of our most trusted products that have become essential to commercial horticulture:

■ **Collate® 2L:** Fine is expanding the uses of its long-trusted ethephon product, Collate 2L. In this issue of the *Annuals PGR Guide*, the proposed new drench application use (not yet approved by the EPA) is explained, including research results from multiple years of trials. Articles detail this use with the planned application rates and timings for various species. The label amendment for Collate 2L drench uses is currently under EPA review, with the label expected one day now.

■ **Piccolo® 10 XC:** A versatile and reliable PGR that delivers consistent growth regulation across the entire greenhouse, enabling growers to maintain control and maximize efficiency.

■ **Advocate®:** A powerful PGR designed to accelerate root development in cuttings and transplants, helping plants establish more quickly and reducing overall production time.

Beyond these three products are many more in our portfolio that have been helping growers for years—addressing both immediate challenges and supporting long-term financial sustainability. And as we move forward we remain committed to expanding our range of solutions to enhance your operations and drive even greater success.

We would also like to take this opportunity to express our sincere gratitude to our esteemed university research partners. Their ongoing collaboration and valuable insights have been instrumental in the development of this guide and in advancing our shared goal of fostering horticultural excellence.

Thank you for your continued trust and partnership. We look forward to working with you as we continue to provide the products and support that help you achieve enduring growth in your business.

Damian Eldred,
President—Fine Americas



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GreenProfit Supplement Enclosed



An Update on Using Collate 2L

By Brian E. Whipker, North Carolina State University

Collate 2L is a higher-concentration (21.7%) ethephon plant growth regulator that's widely used in floriculture greenhouse production. Ethephon products have been commercially available for agricultural use since being synthesized in 1965 and being registered in 1973. Ethephon helps avoid lodging in cereal crops, enhances boll opening in cotton, and is used for increasing yield in hybrid seed production, fruit initiation and fruit ripening.

In the 1990s, Dr. Peter Konjoian initiated floriculture trials that established commercial greenhouse protocols for use of ethephon for growth control (Figure 1). Since that time, ethephon has become one of the most popular plant growth regulators used in the greenhouse. In order to get the most out of your Collate 2L applications, here are some use tips to consider.



Mode of action. Ethephon has a unique way in which it works as compared to the other anti-gibberellin plant growth regulators. When applied as a foliar spray, ethephon enters the stomata and degrades into ethylene gas and 2-hydroxy ethyl phosphonic acid. The ethylene gas acts as a growth regulator by limiting apical dominance and thus stimulating lateral branching. With the increase in axillary shoot development the plants are more compact (Figure 2). This can result in labor savings by avoiding the need to pinch a crop. Ethephon can also be used to avoid early season flowering on many greenhouse crops. Ethylene results in an abscission layer at the base of the flower or bud that results in flower drop (Figure 3). This helps keep plants vegetative. With foliar sprays, ethephon applications should be avoided six to eight weeks prior to sales of flowering plants. Ethylene can also inhibit rooting, so avoid applying it to mother stock prior to taking new cuttings.

Suitable species. Greenhouse label uses for Collate 2L 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.

Optimal foliar spray concentrations.

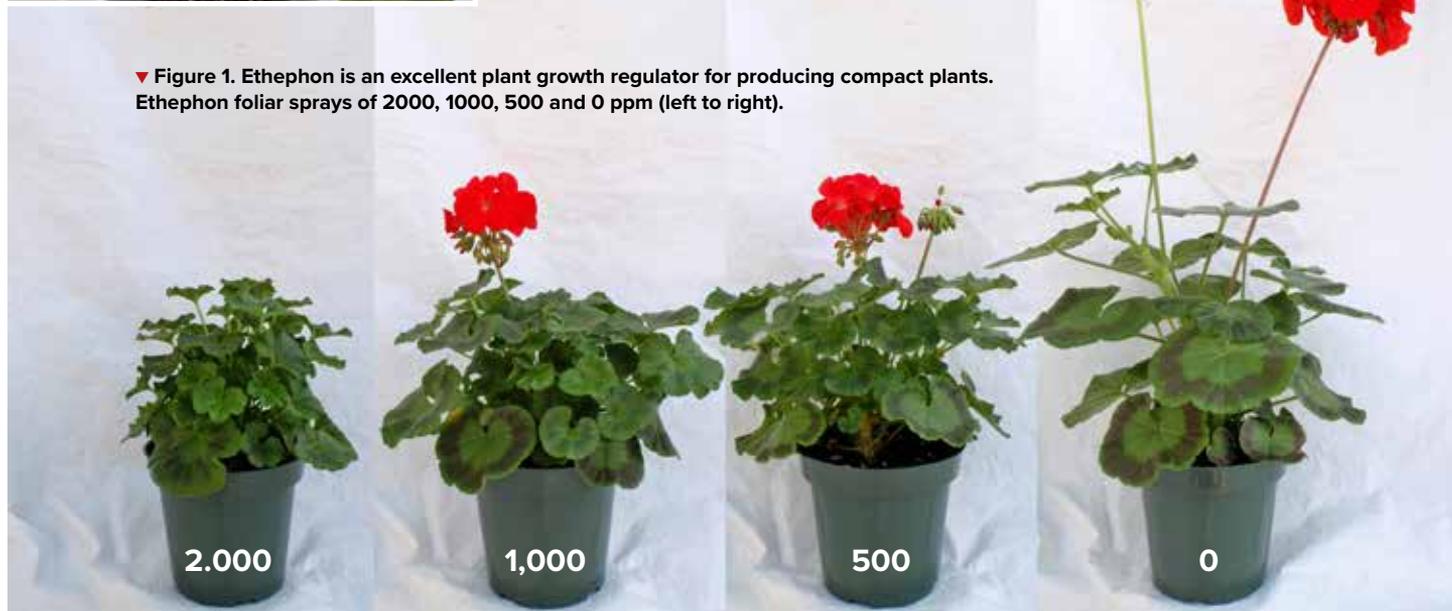
For most plants, Collate 2L spray rates are typically at 500 ppm, but can vary between 250 and 1,000 ppm depending on the plant (Figure 4). Complete spray coverage is required because Collate 2L isn't translocated within the plant. This is especially important for plants such as garden mums. Incomplete spray applications will result in uneven growth and flowering (Figure 5).

Upcoming drench recommendations.

Research starting back in 2014 has shown that drench applications are an effective way to control excessive plant growth. The application rates are lower—in the range of 50 to 250 ppm when applied early and slightly higher when applied mid-season. At this time, none of the registered ethephon products, including Collate 2L, are labeled for drench applications. This is about to change, as Fine Americas has a label update pending EPA approval for Collate 2L's use as a substrate drench. Once approved, Fine Americas will post the revised use label on their website, which

◀ Figure 2. Applications of ethephon increase lateral branching.

▼ Figure 1. Ethephon is an excellent plant growth regulator for producing compact plants. Ethephon foliar sprays of 2000, 1000, 500 and 0 ppm (left to right).



Photos by Brian Whipker.



Figure 3. Ethephon is used to prevent early season flowering of geraniums.



Figure 4. Optimal foliar spray ranges are usually between 250 and 500 ppm. Left to right: 0, 250 and 500 ppm.



Figure 5. Ethephon is not readily translocated within the plant, therefore even spray coverage is required or one-sided results can occur.



Figure 6. While ethephon is an excellent PGR, it's also a stress enhancer. Avoid applications to stressed plants or leaf loss can occur.



Figure 7. Excessive rates can result in temporary leaf phytotoxicity.

Photos by Brian Whipker.

will allow grower use of Collate 2L as a drench. This additional use will greatly expand your PGR toolbox options.

Application parameters. Collate 2L 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. This can be achieved with the use of acid additions to neutralize the alkalinity or by utilizing a water conditioner. The ideal endpoint pH for a Collate 2L 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 2L activity is linked to active plant growth. Applications made when temperatures are below 60F (15.5C) or higher than 95F (35C) 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 2L foliar spray application should be made six to eight weeks prior to the intended sales date. Late spray applications can 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 2L applications will result in enhanced plant growth. Because ethylene produced by Collate 2L 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 2L is applied to drought-stressed plants (Figure 6).

Phytotoxicity. Some cultivars have a greater sensitivity to Collate 2L. Cupping and distortion of the young expanding leaves can occur (Figure 7). In addition, over-application can also result in distortion and leaf bleaching.

Protective equipment and REI. Collate 2L is acidic when ethephon degrades into ethylene gas and 2-hydroxy ethyl phosphonic acid, 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 headgear for overhead applications. A box of baking soda should be handy to neutralize the acidity of Collate 2L in case it comes in contact with your skin.

In summary, Collate 2L is effective in controlling excessive growth of many greenhouse plants. Collate 2L 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 2L has become an essential component of the floriculture PGR toolbox. 

COLLATE[®] 2L



LOOKING FOR MORE MARKETABLE ORNAMENTALS? THAT'S PERFECTLY FINE.

Introducing Collate 2L PGR, packed with a high concentration of ethephon to boost lateral branching in top ornamentals like azaleas, chrysanthemums, geraniums, lantana, petunias, and verbena. With two pounds of ethephon per gallon, concentrated Collate 2L also manages plant height and prevents stem topple in daffodils and hyacinth. Plus, it can even extend flowering times in other varieties. All of which helps generate even more green from your greenhouse.



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Collate 2L Drenches: Highlighting Experimental Results

By Brian E. Whipker, North Carolina State University

The active ingredient in Collate 2L is ethephon. The PGR has been a primary go-to product for the greenhouse industry for the past 30 years. Historically, greenhouse growers have focused on foliar sprays as the primary way for application because it's cost effective and easy to apply.

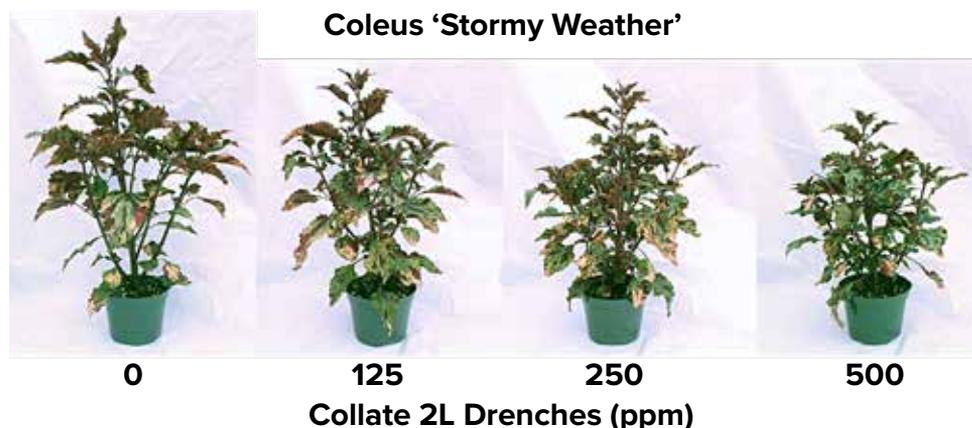
Drench PGR applications have mainly focused on the triazole-related chemicals such as paclobutrazol, uniconazole, ancymidol and flurprimidol. While chlormequat chloride has a drench label, effective doses aren't economical. Historically due to substrate tie-up, daminozide is listed as not being suitable for drenching.

Ethephon was also not listed as a possible drenching PGR, but its suitability wasn't investigated. This changed with work published by a team lead by Dr. Bill Miller at Cornell in 2012 in which they trialed drench rates of up to 500 ppm. Overall, they found that drench rates of around 100 ppm worked well on 24 bedding plant species trialed. Additional work by Virginia Tech University researchers in 2015 found that ethephon efficacy was greater at substrate pH of 4.5 than 7.0. This was due to the slower evolution of ethephon to ethylene at lower pH, which allows for greater plant effect.

Iowa State University researchers explored how the timing of ethephon applications controlled growth. Of course, control increased as rates increased from 0, 50, 100 and 200 ppm. In addition, greater growth control occurred if the applications were

made five days after transplant than on days 10, 15 or 20. Flowering delay also was more likely if higher rates were applied early. All these results provided the foundation for the use of ethephon as a drench PGR.

Missing component. The primary challenge with using ethephon as a drench is that it lacked a use label. No ethephon formulation offered on the U.S. market has a drench label. Fine Americas initiated research work five years ago



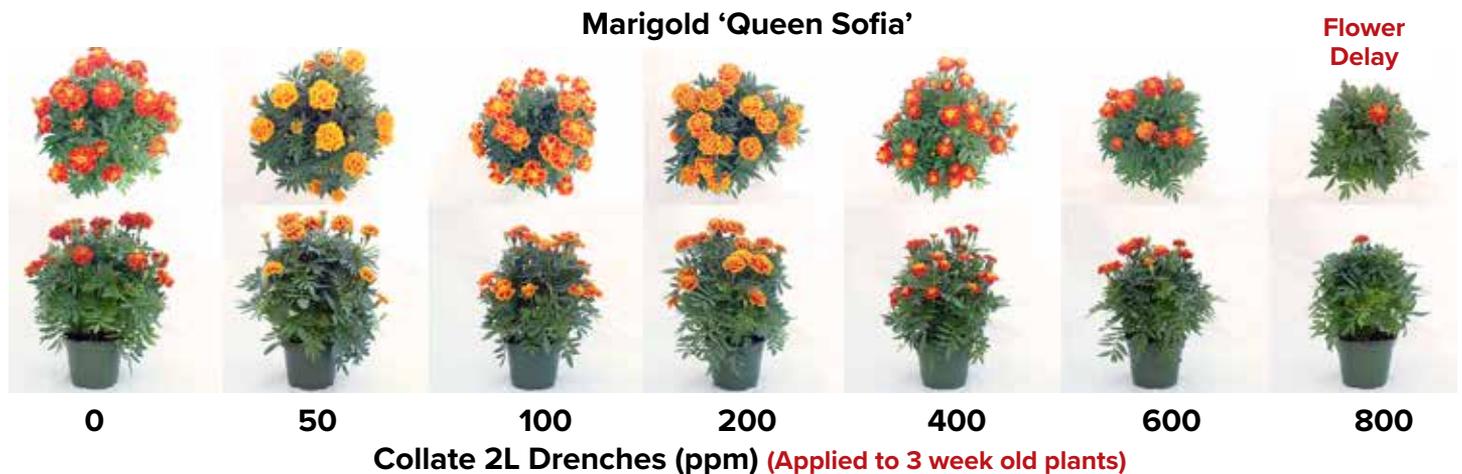
at a number of universities to develop a new drench label. The label change is currently under review at the EPA and approval is expected shortly. Once approved, Fine Americas will publish a supplemental drench use label on their website that will allow greenhouse growers to apply Collate 2L drenches.

Optimal rates. Recommended Collate 2L drench rates are affected by application timing and concentration. The

earlier a drench is made after transplant, the greater effect it will have. Thus lower rates work better (100 ppm) with early applications (five days after transplant) and rates should increase (up to 200 ppm) with later applications (14 to 21 days after transplant). The active ingredient in Collate 2L is ethephon and it's a stress enhancer. Therefore, if plant establishment is uneven or slow, it's recommended to delay a Collate 2L

application until the plant is well rooted into the pot at days 14 to 21. This will still provide growth control without the risk of plant stall and leaf yellowing.

Until Collate 2L receives EPA label approval as a drench, the rates illustrated in the photos should be considered experimental. Once approved, the use of Collate 2L drenches offer another effective tool in your PGR toolbox for greenhouse production. 



Improve Rooting with Advocate

By Brian E. Whipker, North Carolina State University

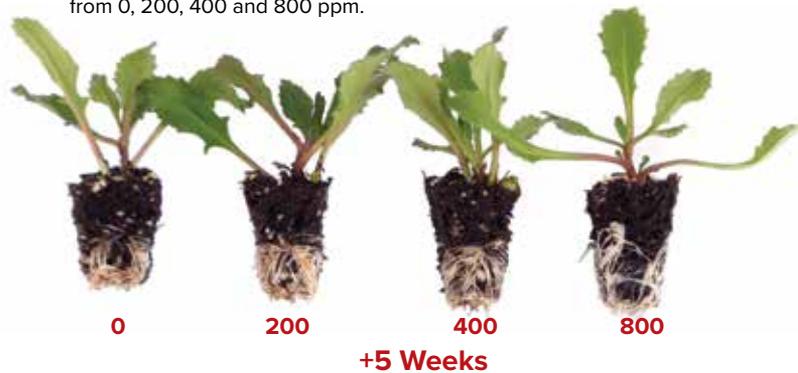
Many growers now root their own cuttings in order to reduce shipping costs and ensure timely availability of plugs. Rooting ease varies among species and cultivars. To ensure a uniform rooting and consistency of these cuttings, growers need to optimize environmental and production factors. This includes the use of rooting hormones to speed up the rooting process and ensure the cuttings are uniformly rooted. The rooting hormone indole-3-butyric acid (IBA) is one such hormone that

helps growers produce a more uniform product in less time.

IBA is available in multiple forms—from a talc powder or gel applied to the basal end of the cuttings as a dip to products for overhead spray applications. Historically, these 0.3% talc products have been commonly used, but are time-consuming to apply and pose the opportunity for disease transmission amongst cuttings.

Recently, the greenhouse industry has shifted to applying

Plug view of Scala Blue Scaevola cuttings with the application of Advocate from 0, 200, 400 and 800 ppm.



Plug view of Sweetunia Mystery Petunia cuttings with the application of Advocate from 0, 200, 400 and 800 ppm.



Plug view of Beauty Yellow Argyranthemum cuttings with the application of Advocate from 0, 200, 400 and 800 ppm.



Plug view of Broad Street Coleus cuttings with the application of Advocate from 0, 200, 400 and 800 ppm.



Plug view of Magnum Fire New Guinea Impatiens cuttings with the application of Advocate from 0, 200, 400 and 800 ppm.



Plug view of Dollar Princess Fuchsia cuttings with the application of Advocate from 0, 200, 400 and 800 ppm.



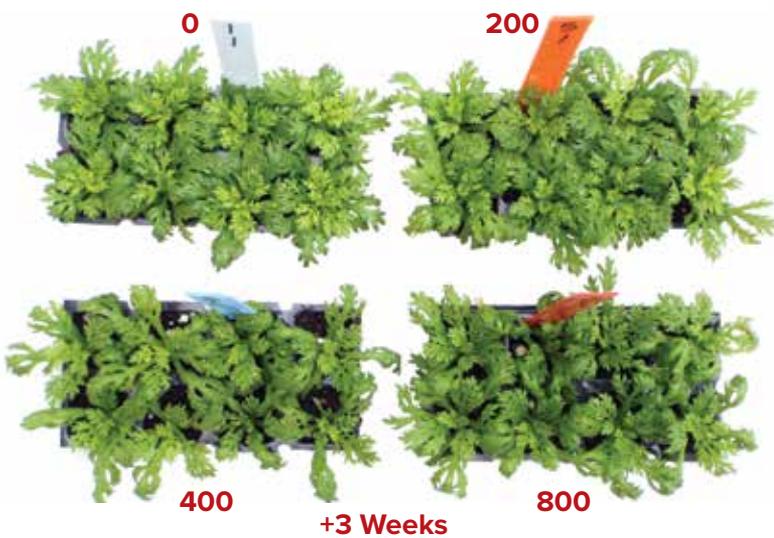
Top view of Scala Blue Scaevola cuttings with the application of Advocate from 0, 200, 400 and 800 ppm.



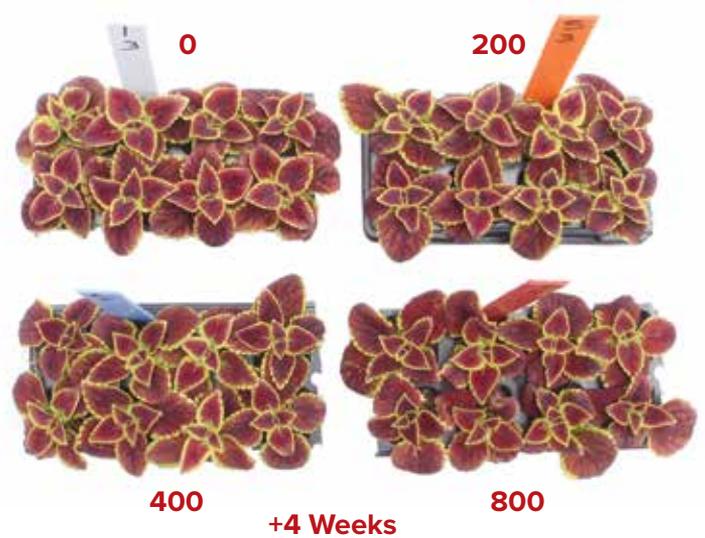
Top view of Magnum Fire New Guinea Impatiens cuttings with the application of Advocate from 0, 200, 400 and 800 ppm.



Top view of Beauty Yellow Argyranthemum cuttings with the application of Advocate from 0, 200, 400 and 800 ppm.



Top view of Broad Street Coleus cuttings with the application of Advocate from 0, 200, 400 and 800 ppm.



IBA as a foliar spray the morning after sticking. This offers a quick and cost-effective application method. Fine Americas introduced an improved liquid IBA product called Advocate. Being a liquid makes mixing easier and quicker.

At North Carolina State University, we conducted initial formulation trials over the past five years to fine-tune and evaluate optimal rates of the product. The recommended rate can vary by species and sometimes among cultivars. You should begin your initial trials for vegetative annual cuttings within the 100 to 200 ppm range for optimizing results. Too high of a rate (~>800 ppm) will cause epinasty (twisting) of the cuttings. Here are some of the highlights of how Advocate can improve rooting. 

Top view of Dollar Princess Fuchsia cuttings with the application of Advocate from 0, 200, 400 and 800 ppm.



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 2L** 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 2L and Florel are used to promote flower bud abortion and vegetative branching in crops. Collate 2L 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 2L , 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 2L, 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	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)	0.01-8.0 (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			
	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)	+
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 Floricultural Crops in Greenhouses

Brian E. Whipker, Department of Horticultural Science, North Carolina State University

This table lists labeled rates of plant growth regulators (PGRs) for greenhouse crops, as well as recommendations based on research at North Carolina State University and recommendations by suppliers. Read the label for a complete listing of precautions. The degree of control can vary depending on a number of factors, including plant type, cultivar, stage of development, fertilization program, growing temperatures and crop spacing. When using a PGR for the first time, it's good to test the rate on a few plants prior to treating the entire crop. Keep accurate records and adjust

rates for your location. Also keep in mind as a general rule, sunbelt growers should consider 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. Additional information about plant growth regulators is available at www.pgrinfo.com.

General recommendations: Plug culture and flat culture have different recommended rates. The rates in this table include recommendations for both plug (lower rates) and flat culture (higher rates). Apply ALL foliar sprays of plant growth regulators using 0.5 gal. per 100 sq. ft. of bench area.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
ABUTILON	To control plant growth	Citadel/Altercel	750 to 1,500 ppm spray	
		Dazide/B-Nine	2,500 ppm spray	Rate for use on plugs.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	5 ppm spray	Can be applied once plant fills the pot, 2 to 3 weeks after transplanting.
	To increase branching	Flore!/Collate 2L	250 to 500 ppm spray	Applied 2 weeks after transplanting. Follow with a pinch if needed.
ACHILLEA	To control plant growth	Dazide/B-Nine	2,500 ppm spray	One or 2 sprays may be needed to keep plants more compact.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	0.5 to 1 ppm drench	Apply to moderately moist substrate.
ACHMELLA OLERAEA	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	15 ppm spray	Apply 2 weeks after transplant. Repeat a week later or a week after pinch if needed.
AGASTACHE	To control plant growth	Citadel+Dazide/Altercel+B-Nine	3,000 ppm + 1,500 ppm spray	Rates for compact genetics needing slight growth control.
AGASTACHE Purple Haze (Hyssop)	Induce branching of plugs	Configure	300 ppm	Foliar spray applied ~27 days after sticking (plants moderately rooted) increased lateral branching but not basal branching. Multiple applications or higher rates decreased root surface area.
AGERATUM	To control plant growth	Abide/A-Rest	7 to 26 ppm spray	
		Dazide/B-Nine	2,500 to 5,000 ppm spray	One or 2 sprays may be needed to keep plants more compact.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	15 to 45 ppm spray	High rates of Piccolo 10 XC may delay flowering. Late applications and overdosing may cause slow growth on transplantation. This can be avoided by using multiple applications of 25% to 50% of the specified rate and monitoring plant growth.
		Citadel/Chlormequat E-Pro/ Altercel	800 to 1,500 ppm spray	
		Concise/Sumagic	2 to 30 ppm spray	Cultivar response rates vary. Use lower rates to hold plants.
		Topflor	20 to 60 ppm spray	Based on NC State University trials. Adjust rates for other locations.

Disclaimer: The information and listed table rates of plant growth regulators are current as of January 2025. 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 02962, Growth Enhancement of Floriculture Species.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
AGERATUM, Plugs	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
ALCEA ROSEA	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	30 to 50 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O/ Downsize	0.12 to 0.24 mg a.i. (1 to 2 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
ALTERNANTHERA (Joseph's coat)	To control plant growth	Abide/A-Rest	25 to 132 ppm spray	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) for a 6-in. pot (1 to 2 fl. oz./gal of drench solution: apply 4 fl. oz./6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		Citadel/Chlormequat E-Pro/ Altercel	Spray	Apply only if needed. Not recommended on some cultivars due to potential phytotoxicity.
		Dazide/B-Nine	5,000 ppm spray	
		Florel/Collate 2L	500 ppm spray	To keep plants more compact. Based on Texas A&M University trials.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	30 to 45 ppm spray	Rate for <i>Alternanthera dentata</i> .
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	4 ppm drench	To keep plants more compact. Apply to moderately moist substrate
ALYSSUM	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	40 to 60 ppm spray	
		Concise/Sumagic	5 to 25 ppm spray	
		Dazide/B-Nine	2,500 ppm spray	
ALYSSUM, Plugs	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	10 to 20 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
AMARYLLIS	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	23.66 mg a.i. (200 ppm) drench for a 6-in. pot (6.4 fl. oz./gal. of drench solution; apply 4 fl. oz./6-in. pot)	Drench volumes and mg a.i. vary with pot size.
			100 ppm bulb soak	
ANAGALLIS	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	0.5 ppm drench	To keep plants more compact. Apply to moderately moist substrate.
ANEMONE	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	2 ppm drench	Rates for Mona Lisa series. Apply about 6 weeks after transplant when the foliage has covered the pot and the first visible flower bud is showing. Rates up to 4 ppm can be used after conducting your own trial. Apply one week earlier during warm weather if needed.
ANGELONIA	To control plant growth	Citadel + Dazide/Altercel + B-Nine	1,500 to 3,000 ppm Dazide/B-Nine + 750 to 1,000 ppm Citadel/Altercel applied as a tank-mix spray	At planting, soft pinch to promote lateral shoot development.
			Citadel/Altercel	1,500 ppm spray
		Concise/Sumagic	10 to 20 ppm spray	Based on NC State University trials.
		Dazide/B-Nine	3,000 ppm spray	
		Florel/Collate 2L	Spray	Not recommended.
		Topflor	45 to 60 ppm spray	Based on NC State University trials.
ANTHURIUM	Induce lateral or basal branching	Configure	250 ppm	10 ml drench applied at the plant base. 250 ppm recommended.
			1000 ppm	Single foliar spray. 1000 ppm recommended.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
AQUILEGIA	To control plant growth	Dazide /B-Nine	3,000 to 5,000 ppm spray	
ARGYRANTHEMUM	To control plant growth	Citadel /Altercel	750 to 1,500 ppm spray	
		Citadel+Dazide /Altercel+B-Nine	750 to 1,000 ppm + 1,000 to 2000 ppm spray	Rates for compact genetics needing slight growth control.
		Concise /Sumagic	3 to 40 ppm spray	Based on NC State University trails conducted during late spring. Trial rates of 3 to 5 ppm for compact genetics.
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	5 to 10 ppm spray	Rates for compact genetics needing slight growth control.
			1 to 5 ppm drench	Rates for compact genetics needing slight growth control.
	Dazide /B-Nine	1,500 to 2,500 ppm spray		
To induce basal branching	Collate 2L /Florel	500 ppm spray	Apply one week after establishment.	
ASCLEPIAS TUBEROSA (Butterfly Weed)	To control plant growth	Piccolo/Piccolo 10 XC / Bonzi/Pac O	30 to 60 ppm spray	
	Induce lateral or basal branching	Configure	600 ppm	Not responsive to a single foliar spray.
ASTER NOVI-BELGII (Perennial)	To control plant growth	Concise /Sumagic	80 to 160 ppm spray	
		Dazide /B-Nine	1,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	160 ppm spray	Use lower rates of 5 to 10 ppm later in the season.
12 to 16 ppm drench				
ASTER, Bedding Plant (<i>Callistephus chinensis</i>)	To control plant growth	Abide /A-Rest	7 to 26 ppm spray	
		Dazide /B-Nine	2,500 to 5,000 ppm spray	
ASTER, Cut (<i>Callistephus chinensis</i>)	To promote stem elongation and break dormancy	Florgib /ProGibb T&O	50 to 100 ppm spray	Make one to three applications during the early vegetative period at 2- to 3-week intervals. Apply when plants are 2 to 6 in. tall.
ASTERISCUS MARITIMUS (Compact Gold Coin)	To control plant growth	Dazide /B-Nine	750 to 1,500 ppm spray	
		Citadel /Altercel	800 to 1,500 ppm spray	
		None	None	Plants grown with good light and optimal growing conditions generally do not need PGRs.
ASTILBE	To control plant growth	Concise /Sumagic	25 ppm drench	Apply just prior to flower stem elongation.
		Dazide /B-Nine	5,000 ppm spray	1 or 2 sprays can be used to keep plants more compact. Begin once flower stalks show color. 1 to 2 week delay in flowering possible.
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	30 ppm drench	Apply just prior to flower stem elongation.
AZALEA	To control plant growth	Abide /A-Rest	26 ppm spray	
		Concise	5 to 15 ppm spray	Apply as a uniform spray at a volume of 1.5 qt. per 100 sq. ft. of bench area approximately 4 to 6 weeks after the final pinch. Shorter-growing cultivars (Gloria, Solitaire): use 10 ppm. If a second application is required 2 to 3 weeks later, use 5 to 10 ppm. Taller-growing cultivars (Prize): use 10 ppm. If a second application is required 2 to 3 weeks later, use 10 to 15 ppm.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
AZALEA <i>continued</i>	To promote flower initiation	Dazide /B-Nine	1,500 to 2,500 ppm spray	Apply solution when new growth from final pinch is 1 to 2 in. long.
		Citadel /Chlormequat E-Pro/ Altercel	1,000 to 4,000 ppm spray	Optimum rates are generally between 1,000 and 2,000 ppm. Two to six multiple sprays may be needed. Make first application when new growth is approximately 2 in. long.
	To prevent flower bud initiation during vegetative growth	GibGro	130 to 850 ppm spray	Apply two to three sprays at 2- to 3-week intervals.
		Florgib /ProGibb T&O	100 to 750 ppm spray	Apply a first application beginning 2 to 3 weeks after pinching. Weekly applications can continue for 1 to 2 additional weeks, for a maximum of three total applications.
	For partial or full substitution of cold treatment	GibGro	265 to 1,055 ppm spray	Spray timing, concentration and number of applications vary with cultivar, as well as intended degree of cold substitution. Consult label for exact recommendations. Not labeled for California.
		Florgib /ProGibb T&O	250 to 500 ppm spray	Spray timing, concentration and number of applications vary with cultivar, as well as intended degree of cold substitution. Consult label for exact recommendations.
	To promote lateral shoot growth on vegetative plants	Off-Shoot-O	Use a 3 to 5% solution in greenhouses; use a 5 to 7% solution outdoors. Apply as a foliar spray.	Efficacy is related to relative humidity and temperature. Spray a few plants to check activity prior to treating the entire crop; effect should be visible in about 1 hr. Be certain chemical covers shoot tip. Ineffective if microscopic flower buds are present.
	To increase lateral branching	Augeo/Atrimmec	3,125 to 6,250 ppm spray	
		Florel/Collate 2L	2,500 to 5,000 ppm spray	
	To control plant growth, reduce bypass shoot elongation and promote flower bud initiation	Piccolo/Piccolo 10 XC / Bonzi/Pac O	100 to 200 ppm spray	To control plant growth and promote flower bud initiation, apply after final shaping when new growth is 1.5 to 2 in. long. To reduce bypass shoot development, apply after bud set when bypass shoots are barely visible, or about 5 to 7 weeks prior to cooling.
Piccolo/Piccolo 10 XC / Bonzi/Pac O/ Downsize		0.59 to 1.77 mg a.i. (5 to 15 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot)	Drench volumes mg a.i. vary with pot size.	
To control plant growth	Concise /Sumagic	10 to 15 ppm spray	Apply at 1.5 qt per 100 sq. ft. of bench area.	
BACOPA (SUTERA)	To control plant growth	Dazide /B-Nine	750 to 1,500 ppm spray	At planting, soft pinch to promote lateral shoot development. Initially try with lower rate.
		Piccolo	4 to 8 ppm liner root soak	Irrigation of the liners occurred within 24 hours prior to application, which results in a moderately dry substrate (the stage the plants would be watered but not wilted). Soak for a minimum of 30 to 60 seconds. Transplant after 3-hour waiting period. Rates based on Michigan State University trials.
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	1 to 2 ppm drench	
		Florel/Collate 2L	150 to 200 ppm spray	Early spray will increase branching and reduce early flowering.
	To increase lateral branching	Florel/Collate 2L	150 to 200 ppm spray	
BANKSIA ASHBYI	Flower enhancer/ Dormancy interruption/ Branching inducer	Configure	100 to 500 ppm	BA overcame winter quiescence of buds and breaks apical dominance. The effects are long lasting. Plants have many more branches. 400 ppm BA sprayed on the overwintering inflorescences hastened spring flowering by 1 to 2 months.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
BEDDING PLANTS (Not specifically listed in this table)	To control plant growth	Abide /A-Rest	6 to 66 ppm spray; use 15 ppm spray as a base rate and adjust as needed	
			0.06 to 0.12 mg a.i. drench for a 4-in. pot; apply 2 fl. oz./4-in. pot)	Drench volumes and mg a.i. vary with pot size.
		Citadel + Dazide /Altercel + B-Nine	800 to 5,000 ppm + 1,000 to 1,500 ppm Altercel applied as a tank-mix spray	Use the highest rate of Citadel that doesn't cause excessive leaf yellowing, and then adjust the Dazide/B-Nine rate up and down within the labeled range to attain the desired level of height control.
		Piccolo /Bonzi/Pac O	5 to 90 ppm spray. Use 30 ppm spray as a base rate and adjust as needed.	Conduct trials on a small number of plants, adjusting the rates as needed for desired final plant height and duration of height control. Not recommended for use on fibrous begonia or vinca.
		Piccolo /Bonzi/Pac O/ Downsize	0.118 mg a.i. drench for a 6-in. pot; apply 4 fl. oz./6-in. pot)	Drench applications are recommended only for bedding plants in 6-in. or larger containers. Not recommended for use on fibrous begonia or vinca.
		Citadel /Altercel	800 to 1,500 ppm spray	Conduct trials on a small number of plants, adjusting the rates as needed for desired final plant height and duration of height control.
		Concise /Sumagic	1 to 50 ppm spray	Conduct trials on a small number of plants, adjusting the rates as needed for desired final plant height and duration of height control. Apply spray as elongation begins (plant height about 2 to 4 in.).
			0.1 to 2 ppm drench	
	Piccolo 10 XC	15 to 30 ppm spray	General starting point for conducting trials for plants not specifically on the label. Use lowest rate in the Northern Belt Region and the upper rate in the Sunbelt Region.	
		1 ppm drench	General starting point for conducting trials for plants not specifically on the label.	
	To promote plant growth and overcome over-application of gibberellin-inhibiting PGRs	Florgib /ProGibb T&O	1 to 25 ppm spray	Conduct trials on a small number of plants initially using 1 ppm unless previous experience warrants higher use rates. Following assessment of plant response, and if desired results were not evident, reapplication or an increase in rate may be warranted. Consult the label for additional precautions.
		Fresco /Fascination	1 to 25 ppm spray	Conduct trials on a small number of plants initially using 1 ppm unless previous experience warrants higher use rates. Following assessment of plant response, and if desired results were not evident, reapplication or an increase in rate may be warranted. The most common rates for use are 3 to 5 ppm. SEE LABEL FOR ADDITIONAL PRECAUTIONS BEFORE USE.
To induce lateral or basal branching	Configure	50 to 500 ppm spray	The supplemental label allows legal use on greenhouse-grown plants not specifically listed on the original label. See label for trialing suggestions and precautions.	
BEDDING PLANT PLUGS (Not specifically listed in this table)	To control plant growth	Abide /A-Rest	3 to 35 ppm spray	
			Drench plug flats with a 0.5 to 1 ppm solution	For uniform application, use a subirrigation delivery system. Plug trays should not be excessively dry prior to the subirrigation treatment. Plants should develop one to two true leaves prior to first application.
		Dazide /B-Nine	1,500 to 2,500 ppm spray	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and duration of height control. Can be used at the beginning of the true first leaf stage through the finishing stage.
		Citadel + Dazide /Altercel + B-Nine	800 to 5,000 ppm Dazide/B-Nine + 1,000 to 1,500 ppm Citadel/Altercel applied as a tank-mix spray	Use the highest rate of Citadel/Altercel that doesn't cause excessive leaf yellowing and then adjust the Dazide/B-Nine rate up and down within the labeled range to attain desired level of height control.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
BEDDING PLANT PLUGS (Not specifically listed in this table) <i>continued</i>	To control plant growth <i>continued</i>	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	1 to 20 ppm spray. Use 5 ppm spray as a base rate and adjust as needed.	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and duration of height control. Plants should develop one to two true leaves prior to first application.
		Citadel/ Altercel	400 to 1,500 ppm spray	Conduct trials on a small number of plants. Start with lower rates and adjust the rates as needed for desired final plant height and duration of height control.
		Concise/ Sumagic	0.5 to 10 ppm spray	Conduct trials on a small number of plants, adjusting the rates as needed for desired final plant height and duration of height control. Plugs can be especially sensitive to Concise/Sumagic.
BEGONIA, Hiemalis (Elatior)	To control plant growth	Citadel/ Altercel	500 to 1,000 ppm spray	Applied 1 week after short days begin in summer or when short days begin in winter. Late applications can result in insufficient flower stalk elongation.
	To increase lateral branching	Augeo/Atrimmec	781 to 1,562 ppm spray	
BEGONIA, Seed (Wax)	To control plant growth	Abide/ A-Rest	3 to 15 ppm spray	Use lower half of rate range for plugs and upper range for finishing plants.
		Dazide/ B-Nine	2,500 to 5,000 ppm spray	
		Flore/ Collate 2L	500 ppm spray	Apply to increase lateral branching, prevent flower initiation and development, and inhibit internode elongation.
		Concise/ Sumagic	Sprays	Not registered for use. Can result in excessive control.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	Sprays	Not registered for use. Can result in excessive control.
		Topflor	Sprays	Not registered for use. Can result in excessive control.
		Citadel/ Altercel	500 ppm spray	
BEGONIA, Tuberous	To control plant growth	Citadel/ Altercel	250 to 500 ppm spray	Rate can be used on Stage 4 plugs or beginning 2 weeks after transplanting.
		Citadel/ Altercel	1,000 ppm spray	Rate for actively growing plants.
		Dazide/ B-Nine	2,500 ppm spray	Rate for actively growing plants.
BEGONIA, Vegetative	To control plant growth	Citadel/ Altercel	750 to 1,000 ppm spray	
BEGONIA, Vegetative (Dragon Wing)	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	3 to 5 ppm spray	For 4-in. pots, apply a weekly 3 ppm spray starting 2 weeks after transplanting for 3 weeks. For 6-in. pots, use 5 ppm starting 2 weeks after transplant. A second and third application may be useful.
	Induce lateral or basal branching	Configure	20 to 160 ppm	Foliar spray. Slight increase in branching but no decrease in height. Flowers emerged slightly earlier.
BELLIS	To control plant growth	Dazide/ B-Nine	2,500 ppm spray	If needed.
		Concise/ Sumagic	5 ppm spray	If needed.
BIDENS	To control plant growth	Dazide/ B-Nine	1,500 to 2,500 ppm spray	At planting, soft pinch to promote lateral shoot development.
		Concise/ Sumagic	1 to 5 ppm spray	Rates for genetics needing slight growth control.
			0.25 ppm drench	Rates for genetics needing slight growth control.
	To increase lateral branching	Flore/ Collate 2L	300 to 500 ppm spray	

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
BLETILLA STRIATA (Hardy Orchid)	Increase the sprouting of pseudobulbs	Configure	50 and 100 ppm	Soak pseudobulbs in solution for 30 min – 1 hr. 50 ppm increased growth rate but only under low temperatures. 100 ppm inhibited sprouting.
BORONIA HETEROPHYLLA (Red Boronia)	Induce lateral or basal branching	Configure	100 ppm foliar spray every 3 days for 18 days on mature plants in mid-fall; or 10 to 150 ppm foliar spray every 2 days for 4 to 8 days on rooted cuttings in mid-fall	100 ppm on mature plants vastly increased branching over pinching. Transient phytotoxicity noted. 50 ppm, 4 applications increased branching over pinching in rooted cuttings. Higher rates and more applications caused phytotoxicity and reduced flowering.
BORONIA METASTIGMA (Brown Boronia)	Induce lateral branching and additional cuttings	Configure	100 ppm	Foliar spray 3 times, 1 week apart – 2 months prior to taking cuttings. BA increased branching but subsequent cuttings rooted very poorly compared to control.
BOSTON FERN (<i>Nephrolepis exaltata</i>)	Induce lateral branching	Configure	50 to 150 ppm	Single foliar spray 4 weeks after planting. BA controlled frond length but did not stimulate more fronds.
BOUGAINVILLEA	To control plant growth	Abide/A-Rest	50 ppm drench	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	25 to 100 ppm drench	
	To increase lateral branching	Augeo/Atrimmec	400 to 1,600 ppm spray	Cultivar response rates vary. Conduct your own trials to determine suitability and appropriate timing.
			1,600 ppm drench	Cultivar response rates vary. Conduct your own trials to determine suitability and appropriate timing.
BRACHYSCOME	To control plant growth	Florel/Collate 2L	500 to 1,000 ppm spray	To keep plants more compact. Based on Texas A&M University trials.
		Dazide/B-Nine	2,500 to 5,000 ppm spray	
BRACTEANTHA, BRACTEATA	To control plant growth	Dazide/B-Nine	2,500 ppm spray	
		Piccolo/Bonzi/Pac O	20 to 30 ppm spray	
			1 ppm drench	
	Concise/Sumagic	10 to 20 ppm spray		
	To increase lateral branching	Florel/Collate 2L	300 to 500 ppm	
BROMELIAD (<i>Fosterella penduliflora</i>)	To promote flower initiation	Florel/Collate 2L	2,471 ppm spray	Cultivar response rates vary. Conduct your own trials to determine suitability and appropriate timing.
	Branching agent/ Enhance cutting numbers	Configure	200 to 800 ppm	Foliar spray on 9 month old plants 4 times at two week intervals. BA 800 ppm increased lateral shoot production by 50% and is better than pinching. New shoots were shorter and not as thick.
BROWALLIA	To control plant growth	Dazide/B-Nine	2,500 to 5,000 ppm spray	
BULB CROPS (Not specifically listed in this table)	To control plant growth	Abide/A-Rest	25 to 50 ppm spray	
			0.25 mg a.i. (2 ppm) drench for a 6-in. pot; apply 4 fl. oz./ 6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	100 ppm spray	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and duration of height control.
			1,183 mg a.i. (10 ppm) drench for a 6-in. pot; apply 4 fl. oz./ 6-in. pot)	Drench volumes and mg a.i. vary with pot size.
			20 ppm bulb soak	Soak for 15 min. Conduct trials on a small number of bulbs, adjusting the rate and soaking period (up to 1 hour) as needed for desired final plant height.

Color Code:	White = Label Rates
	Pink = University Research Trials
	Gold = Supplier/Grower Trials

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
BULB CROPS (Not specifically listed in this table) <i>continued</i>	To control plant growth <i>continued</i>	Concise /Sumagic	2.5 to 20 ppm spray	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and length of height control.
			1 to 3 ppm drench	Drench volumes and mg a.i. vary with pot size. Application should be made when newly emerged shoots are 1 to 2 in. tall.
			1 to 10 ppm bulb soak	Soak for 1 to 5 min. Conduct trials on a small number of bulbs, adjusting the rate and soaking period as needed for desired final plant height.
	To promote plant growth and overcome over-application of gibberellin-inhibiting PGRs.	Fresco	1 to 25 ppm spray	Conduct trials on a small number of plants initially using 1 ppm, unless previous experience warrants higher use rates. Following assessment of plant response, and if desired results were not evident, reapplication or an increase in rate may be warranted. The most common rates for use are 3 to 5 ppm. SEE LABEL FOR ADDITIONAL PRECAUTIONS BEFORE USE.
CALADIUM	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Piccolo /Bonzi/Pac O/ Downsize	100 to 200 ppm spray (3.2 to 6.4 fl oz/gal)	Make first spray application when plants are 2 to 4 in. tall.
			0.24 to 1.77 mg a.i. (5 to 15 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot)	Make first application when plants are 1 to 2 in. tall. Drench volumes and mg a.i. vary with pot size.
		Piccolo /Bonzi/Pac O	60 ppm tuber soak	Soak tubers for 30 min. prior to planting.
		Piccolo 10 XC	100 to 200 ppm spray	Spray applications of Piccolo 10 XC are the least desirable method for controlling bulb plant height and must be applied sequentially to maximize uniformity of the crop. Begin spray applications when plants reach a height of 2 to 4 in.
			2 to 16 ppm drench	Drench volume varies with pot size. Begin drench applications when plants reach a height of 1 to 2 in.
	Topflor	0.5 to 2 mg a.i. drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations. Use lower rates for less vigorous cultivars.	
Branching agent and de-eying agent	Configure	250 to 4000 ppm	Pre-plant bulb soak for 1hour. Shoot emergence delayed, shorter plants, and fewer shoots than non-de-eyed controls.	
CALCEOLARIA	To control plant growth	Citadel /Altercel	400 to 800 ppm spray	Used to control internode length. Apply 400 ppm when flower buds are 1-in. in diameter. Repeat 2 weeks later if needed.
		Dazide /B-Nine	1,000 to 1,500 ppm spray	Used to control internode length.
CALENDULA	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	Can be used when the visible flower bud is pea sized. Rates of 3,500 ppm be used 4 to 5 weeks after germination (when 3 to 4 mature leaves formed).
			2,500 to 5,000 ppm spray	Plugs: Use 2,500 ppm with Stage 1 and 5,000 ppm with Stages 2 or 3.
		Concise /Sumagic	1 ppm spray	Plugs: Use at Stages 2 or 3.
		Piccolo / Piccolo 10 XC /Bonzi/Pac O	4 ppm spray	Plugs: Use at Stages 2 or 3.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
CALIBRACHOA	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	At planting, soft pinch to promote lateral shoot development. Multiple applications may be required.
		Citadel + Dazide /Altercel + B-Nine	2,500 ppm Dazide + 500 to 1,500 ppm Citadel applied as a tank-mix spray	
		Concise /Sumagic	10 to 25 ppm spray	Try lower rate initially. Apply 2 weeks after transplanting.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	3 to 50 ppm spray	Use rates of 3 to 5 ppm for compact genetics needing slight growth control.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O/Downsize	3 to 8 ppm drench	Rates for compact genetics needing slight growth control. Begin with 1 to 2 ppm to determine suitable rates.
		Flore!/ Collate 2L	300 to 500 ppm spray	Early spray will increase branching and reduce early flowering.
	Induce lateral or basal branching	Configure	5 to 10 ppm spray	150 to 300 ppm
CALLA LILY <i>(Zantedeschia aethiopica)</i>	To control plant growth	Piccolo/Piccolo 10 XC /Bonzi/Pac O/Downsize	0.59 to 1.77 mg a.i. (5 to 15 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Make first application when plants are 1 to 2 in. tall. Drench volumes and mg a.i. vary with pot size.
		Piccolo /Bonzi/Pac O	20 ppm rhizome/tuber soak	Soak the rhizomes/tubers for 15 min. prior to planting.
		Concise /Sumagic	1 to 2 mg a.i. drench (8.45 to 16.9 ppm); apply 4 fl. oz./6-in. pot)	Optimal rate based on NC State University trials. Adjust rate for plant vigor. Drench volumes and mg a.i. vary with pot size.
		Topflor	1 to 2.25 mg a.i. drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations.
	To promote flowering	Florgib /ProGibb T&O	500 ppm rhizome/tuber soak	Soak the rhizomes or tubers for 10 min. prior to planting. See label for details.
Flower enhancer	Configure	250 to 350 ppm	Pre-plant rhizome dip for 20 minutes. BA 350 ppm increased total flowers produced. BA caused some flower abnormalities. Increasing flower production in one year reduces future production from the rhizome.	
CAMPANULA	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	Use at visible bud.
		Topflor	10 to 30 ppm spray	Use at visible bud.
CANNA LILY	To control plant growth	Topflor	50 to 80 ppm spray	
CASTOR BEAN (<i>Ricinus communis</i>)	Flower enhancer	Configure	50 to 75 ppm	Applied to buds 0 to 8 days after formation. BA 75 ppm at 4 to 8 days after bud formation causes the normally monocious flowers to become perfect.
CELOSIA	To control plant growth	Abide /A-Rest	7 to 26 ppm spray	
		Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	15 to 45 ppm spray	
		Citadel /Chlormequat E-Pro/Altercel	800 to 1,500 ppm spray	
		Concise /Sumagic	10 to 20 ppm spray	
		Topflor	10 to 40 ppm spray	Based on NC State University trials. Adjust rates for other locations.
CELOSIA, Plugs	To control plant growth	Piccolo/Piccolo 10 XC /Bonzi/Pac O	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
CENTAUREA	To control plant growth	Abide /A-Rest	10 to 15 ppm spray	
		Dazide /B-Nine	2,500 to 5,000 ppm spray	
CENTRADENIA HYBRID	To control plant growth	None	None	Plants grown with good light and optimal growing conditions generally do not need PGRs.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
CHAMAECEREUS SILVESTRI (Succulent, Peanut Cactus)	Induce lateral branching	Configure	100 to 200 ppm	Single foliar spray. 200 ppm increased branching.
CHAMAECEREUS SILVESTRII F. VARIEGATA (Peanut Cactus)	Increase offset production	Configure	1000 to 5000 ppm	Application method not listed. 5000 ppm increased offset (tuberclcs) of sufficient size.
CHRISTMAS CACTUS (<i>Schlumbergera spp.</i>)	To increase branching under vegetative conditions	Configure	100 ppm spray	After planting when new vegetative growth begins, uniformly apply 1 to 2 quarts of finished spray solution to 100 sq. ft. of area.
	To increase the number of flower buds under reproductive conditions	Configure	100 to 200 ppm spray	Apply as a uniform foliar spray after the start of short days following leveling, or when flower buds become visible. See the label for specific guidelines based on lighted or natural-season growth plants.
	Flower enhancer	Configure	10 to 100 ppm	High temperatures and foliar sprays applied at beginning of short day or 10 to 20 days later. BA inhibits flower production if applied at beginning of short day. At temperatures above 20C it is best applied 10 to 20 days after start of short day.
	100 to 1000 ppm		Foliar sprays during long days as well as 5 to 10 days after start of short days. Under long days, 100 to 200 ppm was ideal for increasing phylloclade branching. From 5 to 10 days after start of short days, BA caused more flowers per phylloclade and flowering occurred 10 days sooner. BA also induced flowering on immature plants under short days when short days alone did not.	
CHRYSANTHEMUM, Cut	To reduce "neck" stretching	Dazide /B-Nine	2,500 ppm spray	Spray upper foliage 5 weeks after start of short-day treatment.
	To elongate peduncles of pompom-type mums	Florgib /ProGibb T&O	25 to 60 ppm spray	Use a single application 4 to 5 weeks after initiation of short days. Direct spray solution towards the flower buds. See label for precautions.
CHRYSANTHEMUM, Perennial	To control plant growth	Piccolo/Piccolo 10 XC /Bonzi/Pac O	50 to 200 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O/Downsize	0.12 to 0.48 mg a.i. (1 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
CHRYSANTHEMUM, Potted	To control plant growth	Abide /A-Rest	25 to 50 ppm spray	
			0.25 to 0.5 mg a.i. drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Apply when plants are 2 to 6 in. in height (about 2 weeks after pinch). Drench rates and application volumes vary with pot size.
		Dazide /B-Nine	1,000 ppm preplant foliar dip	Rooted cuttings can be dipped in solution to thoroughly wet leaves and stems and then potted. Allow foliage to dry before watering in. For unrooted cuttings, dip stems in solution, remove to flat, cover to prevent dehydration and hold overnight under cool conditions. Stick the next day.
			2,500 to 5,000 ppm spray	Spray when new growth from pinch is 1 to 2 in. long. Some varieties may require another application 3 weeks later.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	50 to 200 ppm spray	Applications should begin when axillary shoots are 2 to 3 in. long. Sprays can be applied earlier to vigorous cultivars if additional control is desired. Sequential applications of lower rates generally provide more uniformly shaped plants than single-spray applications. Uniform application of both sprays and drenches is critical for uniform crop development.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
CHRYSANTHEMUM, Potted <i>continued</i>	To control plant growth <i>continued</i>	Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	0.118 to 0.473 mg a.i. (1 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size. Begin when the axillary shoots are to 2 to 3 in. long. Uniform application is required.
		Concise	5 to 10 ppm dip treatment on cuttings	Apply when the lateral shoots are 1.5 to 2.0 in. tall (about 7 to 14 days after pinching). Test for cultivar sensitivity. Multiple applications of the lower label rate may elicit a more satisfactory response and/or increasing the spray volume from 2 qts/100 sq. ft. to 3 qts/100 sq. ft. For Florida only: use a foliar spray concentration between 5 to 10 ppm (1.3 to 2.56 fl. oz./gal). For medium to tall cultivars, increase the spray volume to 3 qts/100 sq. ft.
			2.5 to 10 ppm spray	Apply as a dip treatment on unrooted cuttings followed by a foliar spray in the low rate range. On rooted cuttings, use a solution of 2.5 ppm or less, followed by a foliar spray in the low rate range.
		Concise/Sumagic	2.5 to 10 ppm spray	
		Topflor	7.5 to 25 ppm spray	Based on NC State University trials. Adjust rates for other locations. Use lower rates for less vigorous cultivars.
	Induce lateral branching	Configure	200 to 400 ppm	Single foliar spray 2 weeks before pinch, at pinch, or 2 weeks after pinch. 400 ppm applied at pinch increased branching and was better than spraying 2 weeks before or after pinch. No delay in flowering. Plants shorter.
CHRYSANTHEMUM, Garden	To control plant growth	Concise	5 to 10 ppm dip treatment on cuttings	Apply when the lateral shoots are 1.5 to 2.0 in. tall (about 7 to 14 days after pinching). Test for cultivar sensitivity. Multiple applications of the lower label rate may elicit a more satisfactory response and/or increasing the spray volume from 2 qts/100 sq. ft. to 3 qts/100 sq. ft. For Florida only: use a foliar spray concentration between 5 to 10 ppm. For medium to tall cultivars, increase the spray volume to 3 qts/100 sq. ft.
			Concise/Sumagic	2.5 to 10 ppm spray
		Dazide/B-Nine	1,000 to 5,000 ppm foliar spray	Normal starting point is 2,500 ppm. Multiple applications may be needed. Trial rates for cultivar response. Do not apply after bud set to avoid flower delay and/or discoloration.
		Piccolo/Piccolo 10 XC/Bonzi/Pac O	30 to 50 ppm spray	Trial rates for cultivar response. Do not apply after bud set to avoid flower delay and/or discoloration.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O/Downsize	0.5 to 2 ppm drench	Trial rates for cultivar response. Start trials at the lower rate range. Multiple applications may be needed if using low concentration drenches for the entire season growth control program. In grower trials late season drenches have been reported to help maintain plant finish size and avoid stretching. In addition, flowering delay has not been reported with late season applications at lower rates.
	To increase lateral branching	FloreI/ Collate 2L	500 ppm spray	FloreI and Collate 2L applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.
	Flower enhancer	Configure	0.1 to 10 ppm	Three foliar sprays (planting day, at 5 open leaves or 10 open leaves) in the early summer on field grown plants. 0.1 to 1.0 ppm resulted in slightly earlier flowering (up to 3.9 days) and stem lengths were unchanged. 10 ppm delayed flowering, stem lengths were shorter, leaves were larger and there was slight phytotoxicity.
CHRYSOCEPHALUM APICULATUM	To control plant growth	Dazide/B-Nine	2,500 ppm spray	Plants pinched and grown with good light and optimal growing conditions generally do not need PGRs.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
CLARKIA (Godetia)	To control plant growth	Concise /Sumagic	15 to 25 ppm drench	Trial rates for cultivar response. Rates based on older cultivars.
		Dazide /B-Nine	3,000 ppm foliar spray	Trial rates for cultivar response. Rates based on older cultivars.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	20 to 30 ppm drench	Trial rates for cultivar response. Rates based on older cultivars.
CLEMATIS	To control plant growth	Abide /A-Rest	25 to 132 ppm spray	Drench volumes and mg a.i. vary with pot size.
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
CLEOME	To control plant growth	Abide /A-Rest	7 to 26 ppm spray	
		Citadel /Chlormequat E-Pro/Altercel	800 to 1,500 ppm spray	
		Dazide /B-Nine	4,000 to 5,000 ppm spray	Multiple applications may be required. Make them at 7- to 10-day intervals.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	20 to 30 ppm spray	Multiple applications may be required. Make them at 7- to 10-day intervals.
CLERODENDRUM	To control plant growth	Abide /A-Rest	50 ppm spray	
			0.9 mg a.i. drench	
	To increase lateral branching	Piccolo/Piccolo 10 XC /Bonzi/Pac O	100 ppm drench	
			0.5 mg a.i. drench	
COLEUS PLUGS, Seed	To control plant growth	Piccolo/Piccolo 10 XC /Bonzi/Pac O	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
COLEUS, Seed	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	15 to 30 ppm spray	
		Citadel /Chlormequat E-Pro/Altercel	400 to 3,000 ppm spray	
		Concise /Sumagic	10 to 20 ppm spray	
		Topflor	20 to 40 ppm spray	Based on NC State University trials. Adjust rates for other locations.
COLEUS, Vegetative	To control plant growth	Citadel + Dazide /Altercel + B-Nine	2,500 to 4,000 ppm Dazide + 1,000 to 1,500 ppm Citadel applied as a tank-mix spray	See General Recommendations. Scheduling the crop to avoid excessive stretch is the most effective means of controlling growth.
			Piccolo/Piccolo 10 XC /Bonzi/Pac O	5 to 30 ppm spray
			1 to 2 ppm drench	
		Citadel /Chlormequat E-Pro/Altercel	800 to 1,500 ppm spray	
		Concise /Sumagic	5 to 20 ppm spray	Use rates of 5 to 10 ppm for compact genetics needing slight growth control.
	Collate 2L /Florel	500 ppm spray		
	Induce lateral or basal branching	Configure	400 to 1200 ppm	Foliar spray. 800 ppm BA increased branching and height of pinched and unpinched coleus.
	100 to 3200 ppm		Single foliar spray applied 2 weeks after potting. BA controlled plant growth in one of 2 cultivars tested.	
COLUMBINE	To control plant growth	Abide /A-Rest	65 to 132 ppm spray	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
CONEFLOWER (<i>Echinacea</i> spp.)	To control plant growth	Concise /Sumagic	30 to 40 ppm spray	
	To increase branching	Configure	300 to 900 ppm spray	Apply after plant establishment and resumption of growth (i.e., approximately 2 weeks after potting). Apply in a uniform spray volume of 2 qts/100 sq. ft. of area. Application timing and rate may vary with cultivar.
CONSOLIDA (<i>Larkspur</i>)	To control plant growth	Abide /A-Rest	35 to 132 ppm spray	Drench volumes and mg a.i. vary with pot size.
			0.25 to 0.5 mg a.i. drench for a 6-in. pot (1 to 2 fl. oz./gal of drench solution; apply 4 fl. oz./6-in. pot)	
		Concise /Sumagic	5 ppm drench	
		Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	30 to 60 ppm spray	
CONSOLIDA, Cut (<i>Larkspur</i>)	To promote growth and stem elongation	Florgib /ProGibb T&O	50 to 100 ppm spray	Apply when plants are 4- to 8-in. tall. Apply at 2- to 3-week intervals. See label for precautions.
CORDYLIN	Induce lateral or basal branching	Configure	250 ppm	8 foliar sprays applied weekly. 250 ppm recommended.
COREOPSIS	To control plant growth	Concise /Sumagic	2 to 4 ppm spray	Rates for compact genetics needing slight growth control.
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	3 to 100 ppm spray	Use rates of 3 to 6 ppm for compact genetics needing slight growth control.
		Piccolo/Piccolo 10 XC / Bonzi/Pac O/Downsize	0.59 to 1.18 mg a.i. (5 to 10 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Rates for vigorous genetics needing moderate growth control.
		Topflor	2 to 4 ppm spray	Rates for compact genetics needing slight growth control.
	Induce lateral or basal branching on plugs	Configure	300 to 500 ppm	Rates of 300 to 500 ppm improved branching of the cultivars 'American Dreams', 'Moonbeam', 'Zagreb', and 'Rum Punch'.
COREOPSIS GRANDIFLORA (<i>Tickseed</i>)	Induce lateral branching	Configure	50 to 1600 ppm	No effect
COREOPSIS VERTICILLATA	Induce lateral branching	Configure	250 to 2000 ppm	Single foliar spray or crown drench. 500 ppm increased branching and also delayed flowering. Higher rates caused phytotoxicity.
CORNFLOWER (<i>Centaurea</i>)	To control plant growth	Abide /A-Rest	7 to 26 ppm spray	
		Dazide /B-Nine	2,500 to 5,000 ppm spray	
COSMOS	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	
CROSSANDRA	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	Apply after pinch when new growth is 2-in. long.
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	50 ppm spray	Apply 2 weeks after pinch.
CUPHEA	To control plant growth	Dazide /B-Nine	1,500 to 2,500 ppm spray	PGRs not required on compact cultivars.
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	1 to 5 ppm spray	Initially, test on a few plants to determine rate for optimum control. Cuphea is sensitive to excessive rates.
		Piccolo/Piccolo 10 XC / Bonzi/Pac O/Downsize	0.25 to 2 ppm drench	Use rates of 0.25 to 0.5 ppm for compact genetics needing slight growth control. Use 2 ppm for vigorous cultivars grown in the south.

Color Code:	White = Label Rates
	Pink = University Research Trials
	Gold = Supplier/Grower Trials

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
CYCLAMEN PERSICUM	Flower enhancer and promote early flowering	Configure	50 to 100 ppm	Foliar spray applications. Flowering was advanced, especially at low temperatures. Flower malformations at high temperatures and when BA was applied with high levels of nitrogen. A foliar spray of 50 to 100 ppm applied after early October (cooler temperatures) is recommended.
DAFFODIL	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	2.37 to 4.73 mg a.i. (20 to 40 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	See CALADIUM.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	80 ppm bulb soak	Soak bulbs for 1 hr. prior to planting. Ten minute soaks of 400 ppm provided excellent results in NC State University trials.
		Florel/Collate 2L	2,000 ppm spray	Controls plant height and stem topple. Apply when shoots are 3 to 4 in. tall. See label for cultivar differences in rates.
DAHLIA, Bedding Plant	To control plant growth	Abide/A-Rest	7 to 26 ppm spray	
		Dazide/B-Nine	2,500 to 5,000 ppm spray	
		Citadel + Dazide/Altercel + B-Nine	2,500 to 4,000 ppm Dazide + 1,000 to 1,500 ppm Citadel applied as a tank-mix spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	15 to 45 ppm spray	
		Citadel/Chlormequat E-Pro/ Altercel	800 to 1,500 ppm spray	
		Concise/Sumagic	10 to 20 ppm spray	
DAHLIA PLUGS, Bedding Plant	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
DAHLIA, Tuberous	To control plant growth	Abide/A-Rest	0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	1.18 to 4.73 mg a.i. (10 to 40 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	Greater than 40 ppm tuber soak	Soak tubers for 20 min. prior to planting.
		Concise/Sumagic	0.25 to 0.5 mg a.i. drench (2.1 to 4.2 ppm); apply 4 fl. oz./6-in. pot	Optimal rate based on NC State University trials. Adjust rate for plant vigor. Drench volumes and mg a.i. vary with pot size.
		Topflor	0.25 to 2 mg a.i. (2.1 to 16.9 ppm) drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations. Use lower rates for less vigorous cultivars.
	Induce lateral or basal branching	Configure	20 to 40 ppm	3 foliar sprays made one week apart in summer. Lateral branching increased.
DELPHINIUM	To control plant growth	Abide/A-Rest	35 to 132 ppm spray	
			0.25 to 0.5 mg a.i. drench for a 6-in. pot (1 to 2 fl. oz./gal of drench solution; apply 4 fl. oz./6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		Concise/Sumagic	5 ppm drench	
		Dazide/B-Nine	2,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	30 to 60 ppm spray	
DELPHINIUM, Cut	To promote plant growth and stem elongation	Florgib/ProGibb T&O	50 to 100 ppm spray	Apply when plants are 4 to 8 in. tall. More than one application is possible at 2- to 3-week intervals. See label for precautions.

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DIANTHUS, Bedding Plant	To control plant growth	Abide /A-Rest	7 to 26 ppm spray	
		Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	5 to 60 ppm spray	Cultivar response rates vary. Conduct your own trials to determine suitability and appropriate timing. Some series recommend the use of 5 to 8 ppm sprays.
		Citadel /Chlormequat E-Pro/Altercel	800 to 1,500 ppm spray	
		Concise /Sumagic	3 to 5 ppm spray	
DIANTHUS CARYOPHYLLUS (Carnation)	Induce basal branching and cutting number	Configure	25 to 800 ppm	Single foliar spray onto stock plants. 400 ppm increased the cutting number by 35% without inhibiting subsequent rooting.
DIANTHUS PLUGS, Bedding plant	To control plant growth	Piccolo/Piccolo 10 XC /Bonzi/Pac O	10 to 20 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
DIANTHUS, Cut	To promote plant growth and stem elongation	Florgib /ProGibb T&O	50 to 100 ppm spray	Apply when plants are 4 to 8 in. tall. More than one application is possible at 2- to 3-week intervals. See label for precautions.
	Induce lateral or basal branching	Configure	100 ppm	Single foliar spray at various times. BA increased branching but the timing of the spray was very important. Plants sprayed at the 5 open leaf stage of development branched the most.
DIANTHUS, Pot	To control plant growth	Concise /Sumagic	15 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	15 ppm spray	
DIASCIA Hybrid	To control plant growth	Dazide /B-Nine	1,250 to 5,000 ppm	At planting, soft pinch to promote lateral shoot development. Use higher rates on vigorous cultivars.
		Concise /Sumagic	5 to 15 ppm spray	Use lower rates to ensure taller flower spikes.
		Florel/ Collate 2L	200 to 500 ppm spray	Use 2 weeks after pinch.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	30 ppm spray 1 to 2 ppm drench	
DIASCIA, Seed	To control plant growth	Abide /A-Rest	20 ppm spray	Start application 7 to 10 days after transplant. Repeat 7 days later.
		Concise /Sumagic	5 to 10 ppm spray	To hold plants under warm conditions. Use caution, plants very responsive.
		Dazide /B-Nine	3,000 to 5,000 ppm spray	Start application 7 to 10 days after transplant.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	10 to 20 ppm spray	To hold plants under warm conditions. Use caution, plants very responsive.
DICENTRA SPECTABILIS (Bleeding Heart)	To control plant growth	Abide /A-Rest	65 to 132 ppm spray 0.25 to 0.5 mg a.i. drench for a 6-in. pot; apply 4 fl. oz./6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		Dazide /B-Nine	2,500 to 5,000 ppm spray	Apply as new sprouts emerge from the pot. Repeat if needed due to non-uniform emergence.
		Citadel+Dazide /Altercel+B-Nine	1,000 ppm + 5,000 ppm spray	Also increases branching and improves silver color.
DICHONDRA ARGENTEA	To control plant growth	Dazide /B-Nine	5,000 ppm spray	Also increases branching and improves silver color. Apply 2 weeks after transplanting.
		Configure	500 to 2000 ppm 750 ppm	Single foliar spray 500 to 1000 ppm was the optimal. 2000 ppm caused phytotoxicity. Apply foliar sprays on 3 consecutive days.

Color Code:	White = Label Rates
	Pink = University Research Trials
	Gold = Supplier/Grower Trials

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
DIGITALIS	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	80 to 160 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	0.24 to 0.48 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
DORITAENOPSIS (Orchid)	Flower enhancer	Configure	100 to 400 ppm	3 Foliar sprays on days 0, 7, 14 from the time they were moved into a floral inductive environment, or a single spray from -1 to +6 weeks after moving to an inductive environment. 200 to 400 ppm sprayed 3 times resulted in 3 to 9 days earlier flowering and produced 3 to 8 additional flowers per plant than the untreated plants. Spraying 1 week after the transfer to inductive conditions increased flowering the most.
DOROTHEANTHUS BELLIDIFORMIS	To control plant growth	None	None	Plants pinched and grown with good light and optimal growing conditions generally do not need PGRs.
DRACAENA	To control plant growth	Abide/A-Rest	25 to 132 ppm spray	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
DUSTY MILLER (Senecio cineraria)	To control plant growth	Dazide/B-Nine	2,500 to 5,000 ppm spray	
		Concise/Sumagic	30 ppm spray	
	Induce lateral or basal branching	Configure	50 to 400 ppm	Foliar spray or drench applied at 2 weeks after potting (WAP), 2+3 WAP or 2+3+4 WAP. BA decreased the size of the plants.
EASTER LILY (See Lily, Easter)				
ECHEVERIA spp	To induce offsets and induce flower development	Configure	100 to 400 ppm spray	Based on NC State University trials when applied 2 weeks after potting. A slight increase in offsets occurred along with the induction of flowering.
ECHINACEA HYBRIDS Fragrant Angel, Merlot, Tiki Torch (Hybrid Coneflower)	Induce lateral or basal branching	Configure	600 ppm	Single foliar application increased basal branching. This rate was our screening rate. Lower rates may be effective.
ECHINACEA PURPUREA	Induce lateral or basal branching on plugs	Configure	300 ppm	Single foliar application increased basal branching on plugs.
ECHINACEA PURPUREA Doubledecker, Magnus, Ruby Star, White Swan (Purple Coneflower)	Induce lateral or basal branching	Configure	300 ppm	Single foliar spray increased basal branching. No significant effect on plant height.
EGGPLANT	To control plant growth	Sumagic	2 to 10 ppm spray	See label for application suggestions and precautions. Make initial foliar applications when 2 to 4 true leaves are present. Apply uniformly as a foliar spray using 2 qt/100 sq. ft. Sequential applications at lower recommended rates will generally provide more growth control than a single high rate application. First-time users should apply the lowest recommended rate in order to determine optimal rate for individual cultivars under local environmental conditions. If additional growth control is required, a sequential spray application at the lowest recommended rate should be made 7 to 14 days after the initial application. If multiple applications are made to the transplants, the total amount of Sumagic applied may not exceed that from a single application of a 10 ppm spray. The final application may not occur later than 14 days after the 2 to 4 true leaf stage.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
EPIPREMNUM AUREUM (<i>syn Rhipidophora aurea</i>) (Golden Pothos)	Induce lateral or basal branching	Configure	50 to 200 ppm	Foliar spray 3 times every two weeks starting 2 weeks after potting. 200 ppm increased branching.
ERYSIMUM	To control plant growth	None	None	Plants grown with good light and optimal growing conditions generally do not need PGRs.
EUPATORIUM	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	>240 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	0.96 to 1.18 mg a.i. (8 to 10 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
EUPHORBIA DULCIS Chameleon (Purple spurge)	Induce lateral or basal branching	Configure	600 ppm	Single foliar spray increased lateral branching but not basal branching. Lower rates may be effective.
EUPHORBIA HYPERICIFOLIA HYBRID	To control plant growth	Dazide/B-Nine	2,500 ppm spray	Plant growth slow early on. Apply PGRs if control is needed.
		Citadel+Dazide/Altercel+B-Nine	750 ppm + 2,500 ppm spray	
		Flore/ Collate 2L	Spray	Not recommended.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	0.5 to 2 ppm drench	Can be applied 3 to 4 weeks before finish, using the lower rate in the North and higher rate in the South.
EVOLVULUS	To control plant growth	None	None	Plants grown with good light and optimal growing conditions generally do not need PGRs.
EXACUM (Persian Violet)	To control plant growth	Dazide/B-Nine	2,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	75 ppm spray	
			0.25 to 0.75 mg a.i. drench for a 6-in. pot	
		Topflor	25 to 50 ppm spray	Based on NC State University trials. Adjust rates for other locations.
	0.01 to 0.03 mg a.i. (0.08 to 0.25 ppm) drench for a 6-in. pot		Based on NC State University trials. Adjust rates for other locations. Exacum is very responsive to Topflor drenches, so start trials with lower rates.	
Induce lateral or basal branching	Configure	50 to 400 ppm	Foliar spray applied twice at weekly interval. No effect on growth. Phytotoxicity at all rates. Severely delayed flowering. Applications to exacum is NOT recommended.	
FATSHEDERA	To control plant growth	Abide/A-Rest	65 to 132 ppm spray	
			0.25 to 0.5 mg a.i. drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
FELICIA	To control plant growth	Citadel+Dazide/Altercel+B-Nine	1,000 to 1,500 ppm + 2,500 to 4,000 ppm spray	Pinch plant as needed to improve shape.
		Citadel/Altercel	1,500 ppm spray	Applied to pinched plants.
FLOWERING/ FOLIAGE PLANTS, Herbaceous Species (Not specifically listed in this table)	To control plant growth	Abide/A-Rest	20 to 50 ppm spray	Recommended starting rate for an Abide/A-Rest spray on a new herbaceous flowering or foliage species is 33 ppm (16 fl. oz./gal).
			0.125 to 0.25 mg a.i. (1 to 2 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	30 ppm spray	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and length of height control.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	0.118 mg a.i. (1 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size. Conduct trials on a small number of plants.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS	
FLOWERING/ FOLIAGE PLANTS, Herbaceous Species (Not specifically listed in this table) <i>continued</i>	To control plant growth <i>continued</i>	Citadel /Altercel	800 to 3,000 ppm spray	Optimum rate depends on species, desired amount of height control and environmental conditions. The suggested initial rate for small-scale trials is 1,250 ppm. Example: herbaceous species known to respond to Altercel are—Achimenes, Aster, Astilbe, Begonia (hiemalis), Begonia (tuberous), Calceolaria, Carnation, Chrysanthemum, Columbine, Easter lily, <i>Gynura aurantiaca</i> , Ivy, Kalanchoe, <i>Lilium spp.</i> , Morning glory, Pachystachys, <i>Pilea spp.</i> , Pentas, <i>Salvia spp.</i> , Schefflera, <i>Sedum spp.</i> and Sunflower.	
			2,000 to 4,000 ppm drench	Drench volumes vary with pot size. See label for recommended volumes. Herbaceous species known to respond to Altercel are listed above.	
		Concise /Sumagic	5 to 40 ppm spray	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and length of height control.	
			0.1 to 1 ppm drench	Drench volumes and mg a.i. vary with pot size.	
	To promote plant growth and overcome over-applications of gibberellin-inhibiting PGRs	Florgib /ProGibb T&O	1 to 25 ppm spray	Conduct trials on a small number of plants initially using 1 ppm, unless previous experience warrants higher use rates. Following assessment of plant response, and if desired results are not evident, reapplication or an increase in rates may be warranted. Consult the label for additional precautions.	
		Fresco /Fascination	1 to 25 ppm spray	Conduct trials on a small number of plants initially using 1 ppm, unless previous experience warrants higher use rates. Following assessment of plant response, and if desired results were not evident, reapplication or an increase in rate may be warranted. The most common rates for use are 3 to 5 ppm. SEE LABEL FOR ADDITIONAL PRECAUTIONS BEFORE USE.	
	To induce lateral or basal branching	Configure	50 to 500 ppm spray	The supplemental label allows legal use on greenhouse grown plants not specifically listed on the original label. See label for trialing suggestions and precautions.	
	FLOWERING/ FOLIAGE PLANTS, Woody Species (Not specifically listed in this table)	To control plant growth	Abide /A-Rest	50 ppm spray	
				0.25 mg a.i. (2 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
			Dazide /B-Nine	2,500 to 7,500 ppm spray	Two or more applications may be necessary if new growth begins to stretch or for enhanced coloration.
Piccolo/Piccolo 10 XC /Bonzi/Pac O			50 ppm spray	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and length of height control.	
Piccolo/Piccolo 10 XC /Bonzi/Pac O/Downsize			0.237 mg a.i. drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.	
Citadel /Altercel			800 to 3,000 ppm spray	Optimum rate depends on species, desired amount of height control and environmental conditions. The suggested initial rate for small-scale trials is 1,250 ppm. Example: woody species known to respond to Citadel are—Barleria cristata, Bougainvillea, Camellia, Gardenia, Fuchsia, Hollies, Hydrangea, Lantana, Pseuderanthemum lactifolia, Rhododendron and Roses (potted).	
			2,000 to 4,000 ppm drench	Drench volumes vary with pot size. See label for recommended volumes. Woody species known to respond to Citadel are listed above.	
Concise /Sumagic			20 to 50 ppm spray	Conduct trials on a small number of plants, adjusting the rate as needed for desired final plant height and length of height control.	
	0.5 to 2 ppm drench	Drench volumes and mg a.i. vary with pot size.			

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
FREESIA	To control plant growth	Abide/A-Rest	100 to 200 ppm corm soak	Soak corms in the solution for 1 hour before planting. Cultivar response varies, so conduct your own trials.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	0.22 to 0.48 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	To increase lateral branching.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	50 to 200 ppm corm soak	Soak corms in the solution for 1 hour before planting. Cultivar response varies, so conduct your own trials.
FUCHSIA	To control plant growth	Abide/A-Rest	25 to 75 ppm spray	May also increase flowering.
		Dazide/B-Nine	1,250 to 2,500 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	5 to 10 ppm spray	Make applications prior to visible bud to avoid delay.
		Concise/Sumagic	2 to 5 ppm spray	Make applications prior to visible bud to avoid delay.
	To increase lateral branching	Augeo/Atrimmec	781 to 2,343 ppm spray	
		Flore/ Collate 2L	500 ppm spray	Flore and Collate 2L applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.
	To promote stem elongation for topiary	Florgib/ProGibb T&O	200 to 400 ppm spray	For use on upright growing cultivars used for topiary. Weekly sprays can be used, maximum 3 applications.
GAILLARDIA ARISTA Dazzler (Common gaillardia)	Induce lateral or basal branching	Configure	600 ppm	A single foliar spray caused excessive branching. Use much lower rates for this crop.
GAILLARDIA X GRANDIFLORA Gallo Yellow, Orange Lemon	Induce lateral or basal branching on plugs	Configure	300 ppm	Single foliar spray increased lateral branching.
GARDENIA	To control plant growth	Abide/A-Rest	50 ppm spray	
			0.25 mg a.i. (2 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
		Dazide/B-Nine	5,000 ppm spray	Spray when plants are at two-thirds final market size.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	12 ppm drench	Flower delay possible. Apply prior to floral initiation (short days) or 6 weeks after pinching.
	Topflor	100 to 200 ppm spray	Apply prior to floral initiation (short days) or 6 weeks after pinching.	
To increase lateral branching	Augeo/Atrimmec	2,343 to 4,687 ppm spray		
GAURA GAURA Siskiyou Pink	To control plant growth	Dazide/B-Nine	3,000 to 4,000 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	30 to 50 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	3.54 mg a.i. (30 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
		Concise/Sumagic	10 to 30 ppm spray	
	Induce branching on plugs	Configure	300 ppm	Single or multiple foliar sprays applied ~27 days after sticking (plants moderately rooted) increased lateral and basal branching with no adverse effects on rooting.
	Induce lateral or basal branching/enhance flower numbers	Configure	600 ppm	A single foliar spray resulted in increased lateral and basal branching. Increased number of flower stalks. This was our screening rate. Lower rates may be effective.

Color Code:	White = Label Rates
	Pink = University Research Trials
	Gold = Supplier/Grower Trials

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
GAZANIA	To control plant growth	Citadel /Chlormequat E-Pro/Altercel	1,500 ppm spray	Make applications prior to visible bud to avoid delay.
		Dazide /B-Nine	2,500 ppm spray	Make applications prior to visible bud to avoid delay.
GERANIUM (<i>Pelargonum x hortorum</i>)	To control plant growth	Abide /A-Rest	26 to 66 ppm spray	See AGERATUM.
		Piccolo /Bonzi/Pac O	5 to 30 ppm spray	Apply to zonal geraniums when new growth is 1.5 to 2 in. long. Apply to seed geraniums approximately 2 to 4 weeks after transplanting.
		Concise	3 to 8 ppm spray	Use lower rates for less vigorous plants and higher rates for more vigorous growing plants. Flower delay on some cultivars can occur when using rates >6 ppm.
		Citadel /Chlormequat E-Pro/Altercel	800 to 1,500 ppm spray	Make first application 2 to 4 weeks after planting plugs or rooted cuttings (after stems have started elongating). Multiple applications may be needed.
		Piccolo 10 XC	10 to 30 ppm spray	See Piccolo remarks for GERANIUM. Early applications may require lower rates to avoid overdosing. Piccolo 10 XC will reduce late stretch when applied as the flower stems begins to elongate.
		Concise /Sumagic	3 to 6 ppm spray for cutting geraniums and 2 to 4 ppm spray for seed geraniums	
		Topflor	15 to 25 ppm spray	Apply to zonal geraniums when new growth is 1.5 to 2 in. long.
	To promote earlier flowering in seed geraniums	Citadel /Chlormequat E-Pro/Altercel	1,500 ppm spray	Make two applications at 35 and 42 days after seeding. Treated plants should flower earlier and be more compact and more well-branched than untreated plants.
		Florgib /ProGibb	5 to 15 ppm spray (0.02 to 0.06 fl. oz./gal)	Make a single foliar application when first flower bud set is noted. Spray the entire plant until runoff. See label for precautions.
	To increase flower number and size in cutting geranium	Florgib /ProGibb T&O	1 to 5 ppm spray	Make a single foliar application when first flower bud set is noted. Spray the entire plant until runoff. See label for precautions.
Induce lateral or basal branching	Florel / Collate 2L	300 to 500 ppm spray	Labeled for zonal and ivy geraniums. Use the lower concentration for ivy geraniums. Florel and Collate 2L will also provide some growth retardant effect and delay flowering. Read the label for restrictions on timing of applications.	
		Configure	1000 ppm	Single foliar sprays applied 2 weeks before, during, or 2 weeks after a soft pinch. BA applied at pinch increased branching of geranium. BA applied at pinch delayed flowering 2 to 5 days.
	50 to 200 ppm		Rates of 50 to 200 ppm improved branching of the cultivars 'Melody', 'Candy Lavender', and 'Patriot Bright Red'. Some cultivars may be sensitive to Configure , and small trials should be conducted to evaluate the potential for phytotoxicity.	
GERANIUM, IVY (<i>Pelargonum x peltatum</i>)	To control plant growth	Citadel /Chlormequat E-Pro/Altercel	750 to 1,500 ppm spray	
	To increase branching	Augeo/Atrimmec	1,562 ppm spray	Labeled for ivy geraniums only.
		Florel / Collate 2L	200 to 300 ppm spray	
	Induce lateral or basal branching	Configure	50 to 200 ppm	Rates of 50 to 200 ppm improved branching of the cultivars 'Caliente Rose', 'Caliente Lavender, and 'Caliente Dark Red. Some cultivars may be sensitive to Configure , and small trials should be conducted to evaluate the potential for phytotoxicity.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
GERANIUM, REGAL <i>(Pelargonum grandiflorum)</i>	To control plant growth	Citadel /Chlormequat E-Pro/Altercel	1,500 to 3,000 ppm spray	Multiple applications may be needed. Trial rates for cultivar response. Do not apply after bud set to avoid flower delay and/or discoloration.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	5 to 10 ppm spray	Multiple applications may be needed. Trial rates for cultivar response. Do not apply after bud set/flower coloration to avoid flower delay and/or discoloration.
	Induce lateral or basal branching	Configure	150 ppm	Single foliar increased lateral branching and reduced plant height
GERANIUM, Seed	To promote earlier flowering	Citadel	1,500 ppm spray	See label. Make two spray applications at 35 and 42 days after seeding. Plants flower quicker, are compact and have increased lateral breaks.
	To control plant growth	Concise	2 to 4 ppm spray	Apply when plant height is approximately 4 in. tall.
GERBERA DAISY (<i>Gerbera jamesonii</i>)	To control plant growth	Abide /A-Rest	25 to 132 ppm spray	Do not apply when flower stems are visible.
			0.25 to 0.5 mg a.i. drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size. Do not apply when flower stems are visible.
		Dazide /B-Nine	1,200 to 5,000 ppm spray	Do not apply when flower stems are visible. Apply lower rate at 10 to 14 interval if needed.
	Branching agent/Enhance cutting numbers	Configure	100 to 400 ppm	Plants defoliated and sprayed twice 6 weeks apart to induce new shoots. 2 sprays of 200 ppm BA promoted more sprouting shoots harvested for cuttings. Large cultivar differences.
	Flower enhancer	Configure	25 or 50 ppm	Single foliar spray. No effect on height, branching, flower number or timing, or fasciation.
GLADIOLUS	To control plant growth	Abide /A-Rest	1.5 mg drench per 0.5 gal. pot	For container-grown plants.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	2.5 to 5.0 mg drench per 0.5 gal. pot	For container-grown plants.
	Increase corm and cormel yield	Configure	25 ppm	Corm or cormel preplant soak for 24 to 30 hours just after harvesting in April. BA decreased time to sprouting from 90 days to 10 days and increased the number of corms and slightly increased the number of cormels produced one year later.
			25 to 100 ppm	Pre-plant bulb soak for 24 hours. 25 ppm BA decreased the number days to sprouting by 10 days as well as increasing sprouting percentage. BA increased corm diameter and weight and cormel number and weight.
GLOXINIA (<i>Sinningia speciosa</i>)	To control peduncle length	Dazide /B-Nine	1,250 ppm spray	PGRs may not be required on compact cultivars. Make first application when the leaves reach the side of the pot. A repeat application can be made 7 to 10 days later if needed. Flower streaking can develop if PGR applied when the buds show color. Phytotoxicity may occur at rates >1,250 ppm.
			30 ppm spray	Can be applied when buds grow above the foliage.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	4 to 8 ppm drenches	For elongation control late in the season (10 weeks after transplant).
GOMPHRENA	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Citadel /Chlormequat E-Pro/Altercel	800 to 1,500 ppm spray	
GOODENIA	To control plant growth	None	None	Plants grown with good light and optimal growing conditions generally do not need PGRs.
GRAPE IVY	To increase lateral branching	Augeo/Atrimmec	781 to 1,562 ppm spray	
GROUNDCHERRY	To control plant growth	Concise /Sumagic	2 to 10 ppm spray	See precautions listed with EGGPLANT.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
GYPSOPHILA	To accelerate plant growth, increase stem and flower number and increase flower uniformity	Florgib /ProGibb T&O	150 to 500 ppm spray	Make 3 to 4 foliar applications after 4 weeks of new growth has occurred after pinching. Use 2-week intervals between sprays. See label for precautions.
HEDERA CANARIENSIS (Algerian Ivy)	Induce lateral or basal branching	Configure	50 to 200 ppm	Foliar spray 3 times every two weeks starting 2 weeks after potting. 200 ppm increased branching
HELENIUM AMARUM	To control plant growth	Dazide /B-Nine	5,000 ppm spray	Apply after plant established (2 weeks after transplant).
HELENIUM (Sneezeweed)	Induce lateral/ Flowering enhancer	Configure	20 to 40 ppm	Foliar sprays 3 times, one week apart in summer. Increased lateral branching but did not affect height. Delayed flowering but increased flower number.
HELENIUM AUTUMNALE Coppelia (Sneezeweed)	Induce lateral or basal branching	Configure	600 ppm	Not responsive to a single foliar spray at this screening rate. Multiple sprays may be effective.
HELICHRYSUM PETIOLARE/ H. ITALICUM (Licorice plant)	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	1 ppm drench	Plants grown with good light and optimal growing conditions generally do not need PGRs.
	To increase lateral branching	Florel/Collate 2L	300 to 500 ppm spray	Make first application after 2 weeks. Repeat in 2 weeks if needed (with larger pots).
HELICONIA	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	15 to 30 ppm spray	Apply when axillary shoots are 4 to 6-in. high after removal of primary shoot (2 to 3 months after planting). Cultivar variation possible, so conduct your own trials to determine optimal rates.
			0.375 mg a.i. drench / 6-in. pot	Apply when axillary shoots are 4 to 6-in. high after removal of primary shoot (2 to 3 months after planting). Cultivar variation possible, so conduct your own trials to determine optimal rates.
HELIOTROPIUM ARBORESCENS	To control plant growth	Citadel /Chlormequat E-Pro/ Altercel	500 ppm spray	Rate for compact genetics needing slight growth control.
		Citadel+Dazide /Altercel+B-Nine	750 to 1,000 ppm + 1,500 to 3,000 ppm spray	Rate for compact genetics needing slight growth control.
HELLEBORUS X HYBRIDUS (Lenten Rose)	Induce lateral or basal branching	Configure	50 to 800 ppm	Foliar spray or drench applied every 2 weeks for 12 weeks during the summer. Some increase in branching. No phytotoxicity but leaves were feathered.
HEMEROCALLIS (Daylily)	Induce lateral or basal branching	Configure	2500 or 5000 ppm	Foliar spray for 1, 2, 3, 4, or 5 consecutive weeks. BA increased offset formation. Higher rates and more applications were generally optimal.
			1250, 2500, 3750 ppm	Foliar sprays applied twice in the summer. BA at 2500 ppm increased divisions by 20%.
HEMEROCALLIS Strutters Ball (Daylily)	Induce lateral or basal branching	Configure	600 ppm	Not responsive to a single foliar spray. Multiple applications may improve response.
HEUCHERA Raspberry Ice, Silver Lode (Coral bells)	Induce lateral or basal branching	Configure	600 ppm	A single foliar spray increased basal branching. Lower rates may be effective.
HIBISCUS MOSCHEUTOS	To control plant growth	Citadel /Altercel	1000 ppm foliar spray	Multiple applications may be required.
		Concise /Sumagic	15 ppm foliar spray	

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
HIBISCUS ROSA-SINENSIS	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Piccolo / Piccolo 10 XC / Bonzi/Pac O	5 to 150 ppm spray	Application should be made when laterals are 1 to 4 in. long. Single applications control lateral growth for 3 to 6 weeks.
		Concise	10 ppm spray	Apply within 7 days after pruning. Make additional applications as necessary to obtain desired results. Florida only: Use a foliar spray concentration between 5 to 10 ppm and apply a uniform spray volume of 3 qts/100 sq. ft.
		Citadel /Altercel	200 to 600 ppm spray	Multiple applications starting prior to first pinch are recommended. See label for additional precautions. Avoid applications after flower buds are visible.
		Concise /Sumagic	0.025 to 0.2 mg a.i. drench per pot	
HOLLY	To control plant growth	Abide /A-Rest	50 ppm spray	
			0.25 mg a.i. (2 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
HOLLYHOCK	To control plant growth	Piccolo /Bonzi/Pac O	30 to 50 ppm spray	
		Concise /Sumagic	5 to 40 ppm spray	
HOSTA	To promote lateral growth on finished plants	Configure	1,000 to 3,000 ppm spray	Apply in a uniform spray volume. Application is most effective when plants are fully established prior to application (i.e. at least 3 to 4 weeks after potting), when there is evidence of surface root development but before flower initiation.
	To increase production of offsets for propagation	Configure	1,000 to 3,000 ppm spray	Apply in a uniform spray volume to fully established, actively growing stock plants. Repeat the application at 30-day intervals during the growing season. Offsets may be harvested at any time. Treatment effects may vary by Hosta cultivar and may respond differently to a given rate. Multiple applications at 30-day intervals using lower rates may be more effective than a single application at a higher rate. Conduct trials on a small number of plants under actual use conditions to establish the proper use rates and timings.
	Induce lateral or basal branching	Configure	1250 to 3750 ppm	Single foliar sprays in summer onto plants with 0, 1, 2, or 3 pre-existing offsets. The optimal rate was 3750 ppm onto plants with 0 initial offsets.
			3000 ppm	1 to 4 foliar sprays at 30 day intervals. 4 applications yielded the highest number of offsets.
			1250 to 3750 ppm	Single foliar spray. Optimal rate varied by cultivar. 10 cultivars trialed. BA improves offset number on all cultivars. No phytotoxicity was observed.
3000 ppm			Foliar spray, crown spray, crown + foliar spray, crown drench, root immersion, or crown + root immersion. Foliar sprays were the least effective. Crown and crown + root immersions were the most effective.	
HYACINTH	To reduce stem topple	Flore / Collate 2L	1,000 ppm spray	To reduce stem topple at time of full flower, apply foliar spray before florets have opened.
	To control plant growth	Piccolo /Bonzi/Pac O	100 ppm bulb soak	Ten minute soaks provided excellent results in NC State University trials. Cultivar response varied.
		Concise /Sumagic	20 to 40 ppm bulb soak	Two to ten minute preplant soaks provided excellent results in NC State University trials. Cultivar response varied.
		Topflor	0.5 to 1 mg a.i. (4.2 to 8.45 ppm) drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations.
			10 to 25 ppm bulb soak	Two to ten minute preplant soaks provided excellent results in NC State University trials. Cultivar response varied.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
HYACINTH, GRAPE (<i>Muscari armeniacum</i> M. <i>comosum</i>)	Propagation/ Increase bulblet production	Configure	1000 to 5000 ppm	BA mixed with lanolin paste and applied to basal plate of 6 to 7 cm bulbs. All rates increased bulblet formation 30x over controls in <i>M. armeniacum</i> and 3x over controls in <i>M. comosum</i> .
HYBRID LILY (See Lily, Hybrid)				
HYDRANGEA	To control plant growth	Abide/A-Rest	50 ppm spray	Drench volumes and mg a.i. vary with pot size.
			0.25 mg a.i. (2 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
		Dazide/B-Nine	1,250 to 7,500 ppm spray	Use lower rate in spring when 4 to 5 pairs of leaves are visible and new growth is starting to unfold, but not later than 4 weeks after initiation of forcing. Use higher rate for summer when regrowth after pinching is 1 to 2 in. long.
		Topflor	100 to 200 ppm spray	
HYLOCEREUS	Induce lateral or basal branching	Configure	25 to 100 ppm	24-hour soak of cuttings (apical tip only). 100 ppm caused more lateral shoots to break, providing more shoots for propagation.
HYPOCALYMMMA ANGUSTIFOLIA (White myrtle)	Induce lateral or basal branching	Configure	100 ppm	Foliar spray 3 times, 1 week apart – 2 months prior to taking cuttings. BA increased branching but subsequent cuttings rooted very poorly compared to control.
HYPOESTES	To control plant growth	Chlormequat E-Pro	800 to 1,500 ppm spray	Initially apply after second set of leaves have developed. If needed, reapply 2 weeks later.
		Citadel/Altercel	400 to 1,500 ppm spray	Initially apply after second set of leaves have developed. If needed, reapply 2 weeks later.
		Dazide/B-Nine	1,000 ppm spray	Initially apply after second set of leaves have developed. If needed, reapply 2 weeks later.
IMPATIENS, Seed	To control plant growth	Abide/A-Rest	10 to 44 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	10 to 45 ppm spray	
		Concise/Sumagic	5 to 10 ppm spray	
		Topflor	20 to 60 ppm spray	Based on NC State University trials. Adjust rates for other locations.
	To increase branching	Florel/Collate 2L	100 to 300 ppm spray	Use if better branching needed.
IMPATIENS PLUGS, Seed	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	0.5 to 10 ppm spray (0.015 to 0.32 fl. oz./gal)	Timing of application should normally begin at the 1 to 2 true leaf stage.
IMPATIENS, Vegetative	To control plant growth	Piccolo/Bonzi/Pac O	2 to 15 ppm spray	Cultivars' response to PGRs varies, so test a few plants to determine rate for optimum control.
			0.5 to 1 ppm drench	Drench volumes and mg a.i. vary with pot size. See label for recommended volumes.
		Florel/Collate 2L	100 to 300 ppm spray	Will improve branching.
IMPATIENS, Seashell-type	To control plant growth	Piccolo/Bonzi/Pac O	5 to 8 ppm spray	Apply when plants have reached 75% of finished height. Don't apply to plants under stress. Recommendations based on Michigan trials.
IOCHROMA	To control plant growth	Dazide/B-Nine	5,000 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	2 ppm spray	

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
IPOMOEA (<i>Ipomoea batatas</i> ; Ornamental Sweet Potato)	To control plant growth	Concise /Sumagic	10 to 25 ppm spray	Not needed if optimal scheduling is used. If needed, apply when plants have reached 75% of finished growth. Recommendations based on NC State University trials.
		Dazide /B-Nine	2,500 ppm spray	Apply as needed.
		Florel/ Collate 2L	500 to 1,000 ppm spray	Will improve branching and control growth.
			Piccolo/Piccolo 10 XC / Bonzi/Pac O	8 ppm drench
	Induce lateral or basal branching	Configure	12.5 to 1600 ppm	Two foliar sprays applied 30 days apart during winter production. No effect with rates used.
IRESINE HYBRID (Blood Leaf)	To control plant growth	Citadel+Dazide /Altercel+B-Nine	1,000 to 1,500 ppm + 2,500 to 4,000 ppm spray	
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	5 to 10 ppm spray	
			Piccolo/Piccolo 10XC /Bonzi/ Pac O/Downsize	1 to 3 ppm drench
	Induce lateral or basal branching	Configure	50 to 800 ppm	Single foliar spray applied 2 weeks after potting. No effect on growth. Some phytotoxicity at the highest rates.
IRIS GERMANICA (Tall bearded Iris)	Induce lateral/ Flowering enhancer	Configure	100 to 200 ppm	Single foliar spray. 100 ppm slightly increased lateral branching on one cultivar. This resulted in more bloom stalks the following year.
JACOBINIA (Pink)	To control plant growth	Piccolo/Piccolo 10 XC / Bonzi/Pac O	5 to 10 ppm spray	
		Piccolo/Piccolo 10 XC / Bonzi/Pac O/Downsize	0.06 to 0.12 mg a.i. (0.5 to 1 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
JERUSALEM CHERRY (<i>Solanum pseudocapsicum</i>)	To control plant growth	Citadel /Chloromequat E-Pro	800 to 1,500 ppm spray	
		Citadel /Altercel	400 to 1,500 ppm spray	
	To promote stem elongation for topiary	Florgib /ProGibb T&O	250 ppm spray	For plants grown in 6-in. pots and with 4- to 6-in. of growth, apply 2 foliar sprays 10 days apart to promote stem elongation for topiary plants. Stake plants to support stem.
JOVIBARBA HIRTA (Hens and Chicks)	Induce lateral or basal branching	Configure	50 to 1600 ppm	Single foliar spray. 1600 ppm increased offsetting the most.
KALANCHOE	To control plant growth	Abide /A-Rest	50 ppm spray	Apply when axillary growth begins and repeat 20 to 30 days after short days begin. Trial to determine optimal rates and timing for your location.
		Dazide /B-Nine	2,500 to 5,000 ppm spray	Rates and timing vary with the season and cultivar. Applications typically begin 2 weeks after pinching. Apply sprays every 7 days in the summer, 10 to 15 days in the spring and fall, and 14 to 21 days in the winter. Trial to determine optimal rates and timing for your location.
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	2 to 4 ppm spray	Trial to determine optimal rates and timing for your location.
	To increase lateral branching	Augeo/Atrimmec	1,042 to 2,343 ppm spray	
	To control peduncle length	Dazide /B-Nine	1,200 to 5,000 ppm spray	Phytotoxicity possible if B-Nine/Dazide accumulates in cupped areas of certain cupped-leaved varieties.
	Induce lateral branching/ Pinching replacement	Configure	10 to 50 ppm	Single foliar spray. 50 ppm increased branching above that of hand pinching.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
LACHENALIA sp.	To control plant growth	Concise /Sumagic	20 ppm corm soaks	Rates based on trials at Cornell University.
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	100 to 200 ppm spray	Rates based on trials at Cornell University.
			1 to 2 mg a.i./pot drench	Rates based on trials at Cornell University.
LAMIUM	To control plant growth	Concise /Sumagic	5 ppm spray	
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	30 ppm spray	
			1 ppm drench	
	To increase lateral branching	Collate 2L /Florel	500 ppm spray	Improves branching and produces compact growth.
LANTANA	To control plant growth	Citadel + Dazide /Altercel + B-Nine	2,500 to 5,000 ppm Dazide + 1,000 to 1,500 ppm Citadel applied as a tank-mix spray	Cultivar response varies.
		Piccolo /Bonzi/Pac O	20 to 40 ppm spray	
		Concise /Sumagic	10 to 20 ppm spray	
	To increase lateral branching	Augeo/Atrimmec	781 to 1,562 ppm spray	
		Florel/ Collate 2L	500 ppm spray	Florel and Collate 2L applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.
	Induce lateral or basal branching	Configure	800 to 1200 ppm	Weekly foliar sprays for 3 weeks. BA increased branching.
LAVANDULA X INTERMEDIA Provence (Lavandin)	Induce branching on plugs	Configure	300 ppm	Two foliar sprays applied, first at ~34 days after sticking (plants moderately rooted) and again 2 weeks later; increased lateral and basal branching but reduced root surface area and root volume of plugs.; no reduction in establishment of plants. Apply after plugs are well rooted.
LAURENTIA AXILLARIS	To control plant growth	Abide /A-Rest	2 to 4 ppm spray	
		Dazide /B-Nine	2,500 ppm spray	
		Piccolo/Piccolo 10 XC / Bonzi/Pac O	1 to 2 ppm drench	
LEUCANTHEMUM X SUPERBUM Alaska, Becky (Shasta Daisy)	Induce basal branching/enhance flower number	Configure	600 ppm	A single foliar spray increased basal branching on both cultivars but effect was short term on 'Alaska'. Multiple applications may improve branching. This treatment doubled the number of flowers on 'Alaska'.
LEUCANTHEMUM X SUPERBUM Snowcap (Shasta daisy)	Induce branching on plugs	Configure	300 ppm	Single or multiple foliar sprays applied ~27 days after sticking (plants moderately rooted) increased basal branching but reduced root surface area and root volume. Apply after plugs are well rooted.
LEUCOSPERMUM (Pincushion)	Flower enhancer	Configure	50 to 300 ppm	Foliar spray (50 to 300 ppm) applied once or 200 ppm applied 1 to 4 times in late summer to fall. 200 ppm applied once in late summer increased the number of florets and increased flower stem diameter.
LIATRIS	To control plant growth	Abide /A-Rest	25 to 132 ppm spray	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot)	Drench volumes and mg a.i. vary with pot size.
		Dazide /B-Nine	2,500 to 5,000 ppm spray	
LILIUM X FORMOLONGI (Lily)	Propagation/Seed Germination	Configure	100 ppm	24 pre-plant seed soak. 100 ppm increased germination by 20%, and reduced germination time by 3 days.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
LILY, Easter	To control plant growth	Abide/A-Rest	30 to 132 ppm spray. Use 50 ppm spray as a base rate and adjust as needed.	Apply when newly developing shoots are 2 to 3 in. long; a second application when shoots average 6 in. long may be needed.
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Single drench should be applied when shoots average 3 to 5 in. long. Drench volumes and mg a.i. vary with pot size.
		Concise	3 to 15 ppm spray	Apply when shoots average 3 in. tall. It is best to make only one foliar application per crop.
			0.03 to 0.06 mg a.i. (0.23 to 0.5 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Apply when shoots average 3 in. tall. Use lower rates on cultivars such as Nellie White and higher rates for Ace. For Florida only: use a solution concentration of between 0.05 to 0.12 mg a.i. (0.4 to 1.0 ppm) drench for a 6-in. pot (0.11 to 0.26 fl. oz./gal of drench solution, apply 4 fl. oz./6-in. pot).
	Concise/Sumagic	3 to 15 ppm spray	Apply when shoots average 3 in. tall.	
		0.03 to 0.06 mg a.i. (0.25 to 0.5 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.	
To prevent leaf yellowing	Fresco/Fascination	5 to 10 ppm spray	Apply early season (7 to 10 days PRIOR to visible bud stage) and mid-season (7 to 10 days AFTER visible bud stage). Apply spray only to lower leaves to minimize stem elongation. See label.	
To prevent leaf yellowing and prolong flowering	Fresco/Fascination	100 ppm spray	Apply late season (when first bud reaches at least 3 in. in length) and no more than 14 days prior to placement in a cooler or shipping. Apply to foliar and flower buds. See label.	
LILY, Hybrid	To control plant growth	Piccolo/Piccolo 10 XC/Bonzi/Pac O	200 to 500 ppm spray	See CALADIUM.
		Piccolo/Bonzi/Pac O	5 to 30 ppm bulb soak	Soak bulbs in the solution for 15 min. prior to planting.
		Piccolo/Piccolo 10 XC/Bonzi/Pac O/Downsize	0.25 to 0.5 mg a.i. (4 to 30 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Single drench should be applied when shoots average 3 to 5 in. long. Drench volumes and mg a.i. vary with pot size and cultivar.
		Concise	2.5 to 20 ppm spray	Conduct a trial to determine optimal rates for each cultivar and adjust the rate as needed. Spray when shoots average 3 in. tall. If a second application is needed or a split application is made, it should be applied when the shoots average 6 in. tall. Usually two applications of foliar sprays at a lower rate are more effective than one application at a higher rate. Avoid applications after visible bud stage.
			1 to 3 ppm drench	Drench volume varies with pot size. Applications should be made when newly emerged shoots are 1 to 2 in. tall.
			1 to 10 ppm bulb soak	Treatment soak time should range from 1 to 5 minutes. Soak time will vary depending on bulb size, cultivar, and final desired height. Lower rates may require longer soak times (5 to 10 minutes) than higher rates (1 minute).
		Concise/Sumagic	3 to 15 ppm spray	Apply when shoots average 3 in. tall.
	0.03 to 0.06 mg a.i. (0.25 to 0.5 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot		Drench volumes and mg a.i. vary with pot size.	
	Topflor	0.25 to 0.5 mg a.i. (2.1 to 4.2 ppm) drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations and plant response.	
	To prevent leaf yellowing	Fresco/Fascination	5 to 10 ppm spray	Apply early season (7 to 10 days PRIOR to visible bud stage) and mid-season (7 to 10 days AFTER visible bud stage). Apply spray only to lower leaves to minimize stem elongation. See label.
	To prevent leaf yellowing and prolong flowering	Fresco/Fascination	100 ppm spray	Apply late season (when first bud reaches at least 3 in. in length) and no more than 14 days prior to placement in a cooler or shipping. Apply to foliar and flower buds. See label.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
LILY, Oriental	To control plant growth	Piccolo /Bonzi/Pac O	100 to 200 ppm bulb soak	Ten minute preplant soaks provided excellent results in NC State University trials. Cultivar response varied.
		Concise	2.5 to 10 ppm spray	See Concise label comments for Hybrid lilies.
			1 to 10 ppm bulb soak	See Concise label comments for Hybrid lilies.
		Concise /Sumagic	1 to 10 ppm bulb soak	See Concise label comments for Hybrid lilies. Ten minute preplant soaks of 5 ppm provided excellent results in NC State University trials. Cultivar response varied.
		Piccolo 10 XC	200 to 500 ppm spray	Begin spray applications when plants reach a height of 2 to 4 inches.
			4 to 30 ppm drench	Drench volume varies with pot size. Begin drench applications when plants reach a height of 1 to 2 inches.
	Topflor	0.5 mg a.i. drench (4.2 ppm); apply 4 fl. oz./6-in. pot	Optimal rate based on NC State University trials. Adjust rate for plant vigor. Drench volumes and mg a.i. vary with pot size.	
25 ppm bulb soak		Ten minute preplant soaks provided excellent results in NC State University trials. Cultivar response varied.		
	To prevent leaf yellowing	Fresco /Fascination	100 ppm spray	Apply early season (7 to 10 days PRIOR or AFTER visible bud stage). Apply spray only to lower leaves to minimize stem elongation. See label.
	To prevent leaf yellowing and prolong flowering	Fresco /Fascination	100 ppm spray	Apply late season (no more than 14 days prior to placement in a cooler or shipping). Apply to foliar and flower buds. See label.
LINARIA HYBRIDA (Baby snapdragon)	To control plant growth	Dazide + Citadel /B-Nine + Altercel	2,500 ppm Dazide/B-Nine + 300 to 500 ppm Citadel/Altercel applied as a tank-mix spray	Controlled plant growth, but didn't strengthen stems, as well as paclobutrazol sprays.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	10 to 30 ppm spray	Use 10 ppm 1 week after transplant. Make a second application of 20 to 30 ppm once the secondary shoots are 2-in. long. Stenghtened stems and improved flower coloration.
LINER DIPS	To control plant growth	Piccolo	0.5 to 8 ppm preplant liner dip	See label: for detailed recommendations for chemical application techniques, adjusting rates for northern or southern locations, and the specific rates for achieving the desired level of activity.
LIPSTICK VINE	To increase lateral branching	Augeo/Atrimmec	521 to 1,042 ppm spray	
LISIANTHUS (Eustoma)	To control plant growth	Abide /A-Rest	0.5 mg a.i. drench	Cultivar response varies.
		Concise /Sumagic	5 to 10 ppm spray	Cultivar response varies.
		Dazide /B-Nine	2,500 to 5,000 ppm spray	Cultivar response varies.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	4 to 16 ppm drench	Cultivar response varies.
LOBELIA	To control plant growth	Dazide /B-Nine	1,500 to 2,500 ppm spray	
		Concise /Sumagic	1 to 10 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	4 ppm spray	
			1 ppm drench	Can be used 3 to 5 weeks before sale to control stretch.
LOBELIA CARDINALIS (Cardinal flower)	Induce basal branching	Configure	600 ppm	A single foliar spray increased basal branching. Lower rates may be effective.
LOBELIA X SPECIOSA Fan Deep Rose (Hybrid Lobelia)	Induce basal or lateral branching	Configure	600 ppm	A single foliar spray increased number of shoots not branches. Moderate response. This rate was our screening rate. Multiple applications may be more effective.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
LOBULARIA	To control plant growth	Piccolo	4 to 8 ppm liner root soak	See BACOPA. Rate based on North Carolina State University trials with Snow Princess.
			75 to 100 ppm spray	Sprays less effective than preplant liner soaks or substrate drenches. Rate based on North Carolina State University trials with Snow Princess.
			2 to 4 ppm drench	Drench volume varies with pot size. Rate based on North Carolina State University trials with Snow Princess.
		Concise	0.5 to 1 ppm liner root soak	See BACOPA. Rate based on North Carolina State University trials with Snow Princess.
			20 to 25 ppm spray	Sprays less effective than preplant liner soaks or substrate drenches. Rate based on North Carolina State University trials with Snow Princess.
			1 to 2 ppm drench	Drench volume varies with pot size. Rate based on North Carolina State University trials with Snow Princess.
Topflor	10 ppm spray			
LOPHOSPERMUM (LOFUS)	To control plant growth and improve branching	Collate 2L/Florel	250 to 500 ppm spray	Cultural requirements vary with the cultivar grown. Many cultivars only require high light, optimal growing conditions and regular pinching to control growth. Use a PGR if needed. Multiple applications may be needed in warmer climates. Avoid applications within 8 weeks of sale to ensure flowering is not delayed.
LUPINE (<i>Lupinus angustifolius</i>)	Enhance seed set	Configure	450 ppm	Painted onto flowers daily until senescence with a paint brush. BA increased the number of seed pods set, but reduced the number of seeds per pod. Overall seed production increased 11%.
LYCHNIS X ARKWRIGHTII Vesuvius (Arkwright's Campion)	Induce basal or lateral branching	Configure	600 ppm	A single foliar spray increased lateral branching. Lower rates may be effective.
MAMMILLARIA ELONGATA (Succulent)	Induce lateral branching	Configure	100 to 200 ppm	Single foliar spray. 200 ppm increased branching (linearly with rate).
MANDEVILLA SANDERI (Dipladenia)	To control plant growth	None	None	Cultural requirements vary with the cultivar grown. Many cultivars only require high light, optimal growing conditions, and regular pinching to control growth.
		Dazide/B-Nine	2,500 to 3,500 ppm spray	Use a PGR if needed. Multiple applications may be needed in warmer climates.
		Dazide/B-Nine + Citadel/Altercel	1,000 to 1,500 ppm Dazide/B-Nine + 750 ppm Citadel/Altercel spray	Use a PGR if needed. Multiple applications may be needed in warmer climates.
MARIGOLD	To control plant growth	Abide/A-Rest	13 to 33 ppm spray	
		Dazide/B-Nine	2,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	15 to 60 ppm spray	See remarks for AGERATUM. Use 15 to 30 ppm for French type and 30 to 60 ppm for African type (apply at an early stage of plant growth for African type with good stem coverage, especially for vigorous varieties).
		Citadel/Chlormequat E-Pro/ Altercel	800 to 1,500 ppm spray	
		Concise/Sumagic	10 to 20 ppm spray	
		Topflor	20 to 60 ppm spray	Based on NC State University trials. Adjust rates for other locations.
MARIGOLD, Plugs	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	5 to 20 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage. Use 5 to 10 ppm for French types and 10 to 20 ppm for African types.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
MATTHIOLA, Bedding Plant (Stock)	To control plant growth	Dazide + Citadel /B-Nine + Altercel	800 to 5,000 ppm Dazide/B-Nine + 1,000 to 1,500 ppm Citadel/Altercel applied as a tank-mix spray	
MATTHIOLA, Cut (Stock)	To promote growth and stem elongation	Florgib /ProGibb T&O	50 to 100 ppm spray	Apply when plants are 4 to 8 in. tall. Apply at 2- to 3- week intervals. See label for precautions.
MELAMPODIUM	To control plant growth	Dazide /B-Nine	2,500 ppm spray	Use when plants reach 75% of marketable size to tone.
MIMULUS	To control plant growth	Dazide /B-Nine	2,500 ppm spray	Use if needed. Delay in flowering possible with multiple applications.
MONARDA	To control plant growth	Piccolo/Piccolo 10 XC /Bonzi/Pac O	60 to 160 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O/Downsize	>0.48 mg a.i. (>4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
		Concise /Sumagic	15 to 30 ppm spray	
MONSTERA	To control plant growth	Abide /A-Rest	25 to 132 ppm spray	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
MONTBRETIA	To control plant growth	Piccolo /Bonzi/Pac O	20 to 30 ppm corm soak	Soak corms in the solution for 15 min. prior to planting.
NARSISSUS	To control plant growth	Florel/ Collate 2L	500 to 2,000 ppm spray	For types requiring a vernalization period (<i>Narcissus hybrids</i>), apply when new leaves reach 3 to 4 in. of height. For paperwhite narcissus (<i>Narcissus tazetta</i>), apply 2,000 ppm when the new leaves are 3- to 4-in. tall. Cultivar response varies, so conduct your own trial to determine suitable concentrations. Results based on Cornell University trials.
NASTURTIUM	To control plant growth	Citadel /Altercel	800 to 1,500 ppm spray	Use only on non-food plants.
NEMESIA	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	Use on compact varieties to tone and hold crop.
		Piccolo /Bonzi/Pac O	10 to 20 ppm spray	Based on NC State University trials.
		Collate 2L /Florel	250 to 500 ppm spray	Make final application 4 to 6 weeks before sale.
		Concise /Sumagic	3 to 30 ppm spray	In NC State University trials, 5 ppm worked well on Vanilla Sachet.
		Topflor	2.5 to 5 ppm spray	Recommendation based on NC State University trials with Vanilla Sachet.
NEPHTHYTIS, Green and Green Gold	To control plant growth	Abide /A-Rest	25 to 132 ppm spray	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
NEW GUINEA IMPATIENS	To control plant growth	Piccolo/Piccolo 10 XC /Bonzi/Pac O	0.25 to 15 ppm spray	Apply 2 to 4 weeks after transplanting. Cultivars' response to PGRs varies greatly. Test a few plants to determine rate for optimal control.
		Piccolo /Bonzi/Pac O	0.25 to 2 ppm drench	Drench volumes vary with pot size. See label for recommendations. Cultivars response to PGRs varies greatly. Test a few plants to determine rate for optimal control.
		Florel/ Collate 2L	100 to 300 ppm spray	To increase lateral branching and reduce premature flowering, don't apply within 8 weeks of desired flower date.
		Topflor	5 to 15 ppm spray	Apply 2 to 4 weeks after transplanting. Cultivars' response to PGRs varies greatly. Test a few plants to determine rate for optimal control.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
NEW GUINEA IMPATIENS, Plugs	To control plant growth	Piccolo 10 XC	0.25 to 5 ppm spray	See Piccolo remarks for AGERATUM, Plugs.
NICOTIANA	To control plant growth	Dazide/B-Nine	2,500 to 5,000 ppm spray	Higher initial rates can be used after the plant becomes established. Use lower rate with multiple applications at 3-week interval.
NOLANA PARADOXA	To control plant growth	FloreI/ Collate 2L	500 ppm spray	To keep plants more compact. Based on Texas A&M University trials.
OENOTHERA	To control plant growth	Concise/Sumagic	5 to 10 ppm spray	Apply if needed.
ORNAMENTAL CABBAGE and KALE (Non-food)	To control plant growth	Dazide/B-Nine	2,500 to 5,000 ppm spray	Use the higher rates for more vigorous types/cultivars. Multiple applications may be needed. Recommendation based on North Carolina conditions.
		Concise/Sumagic	2.5 to 8 ppm spray	Use higher rates for more vigorous cultivars. Cultivar response can vary. Recommendation based on North Carolina conditions.
ORNAMENTAL PEPPERS (Capsicum) (Non-food)	To control plant growth	Piccolo/Bonzi/Pac O	20 ppm foliar spray	Recommendation based on North Carolina conditions for a moderately vigorous cultivar.
		Concise/Sumagic	5 to 15 ppm spray	
ORNAMENTAL VEGETABLES (Non-food)	To control plant growth	Dazide/B-Nine	2,500 to 5,000 ppm spray	Use the higher rates for more vigorous types/cultivars like kale Red Bor. Multiple applications may be needed. Recommendation based on North Carolina conditions.
		Concise/Sumagic	10 to 25 ppm spray	Use higher rates for more vigorous cultivars. Recommendation based on North Carolina conditions.
ORNITHOGALUM	To increase stem length	Florgib/ProGibb T&O	100 ppm dip	Soak the bulbs for 20 minutes prior to potting.
OSTEOSPERMUM	To control plant growth	Citadel/Altercel	750 to 1,500 ppm spray	Two applications may be required. Two applications of 1,500 ppm (with the first applied at the start and the second at the end of the vernalization period) provided excellent results in NC State University trials.
			1,500 to 3,000 ppm drench	Drench volumes vary with pot size. See label for recommended volumes.
		Concise/Sumagic	8 ppm spray	Recommendation based on European trials on a cultivar with prostrate growth. Rates less than 24 ppm were not effective in NC State University trials.
			0.25 to 2 ppm drench; apply 3 fl. oz./5-in pot	One application of 1 to 2 ppm (at the start of vernalization) or two applications of 1 ppm (at the start of vernalization) and 0.5 ppm (at the end of the vernalization period) provided excellent results in NC State University trials for 4.5-in. production.
		Dazide/B-Nine	2,500 to 4,000 ppm spray	Can be applied 3 or 4 times (weekly) after pinch.
		Dazide + Citadel/B-Nine + Altercel	1,500 to 3,000 ppm Dazide/B-Nine + 1,000 to 1,500 ppm Citadel/Altercel applied as a tank-mix spray	Multiple sprays required. Stop applications after visible bud to avoid flower delay and smaller flowers. Not effective in NC State University trials.
		Piccolo	4 to 8 ppm liner root soak	See BACOPA. Rate based on Michigan State University trials.
		Piccolo/Bonzi/Pac O	27 to 54 ppm drench (8 to 16 mg a.i.) during production	Drench volumes vary with pot size. See label for recommended volumes. (based on NC State University trials)
			2 to 3 ppm drench (0.236 to 0.35 mg a.i.) for holding plants	
Piccolo/Piccolo 10 XC/Bonzi/Pac O	15 to 30 ppm spray			

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
OSTEOSPERMUM <i>continued</i>	To control plant growth <i>continued</i>	Topflor	20 to 60 ppm spray	One application of 1 to 2 ppm (at the start of vernalization) or two applications of 1 ppm (at the start of vernalization) and 0.5 ppm (at the end of the vernalization period) provided excellent results in NC State University trials for 4.5-in. production.
			1 to 2 ppm drench; apply 3 fl. oz./5-in pot	
OSTEOSPERMUM Astra Yellow, Voltage Yellow	Induce lateral or basal branching	Configure	150 to 200 ppm	Single foliar spray increased lateral branching and reduced plant height
OTACANTHUS	To control plant growth	Dazide /B-Nine	2,500 ppm spray	Make first application when new growth appears after pinching. A second application may be used if a second pinch is planned.
OTOMERIA	To control plant growth	Dazide /B-Nine	1,700 ppm spray	Apply 1 to 3 times if needed to tone the plant.
OXALLIS	To control plant growth	Abide /A-Rest	33 ppm spray	To limit petiole stretch.
		Concise /Sumagic	0.1 mg a.i. / 4.5-in. pot drench	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	1 to 4 ppm sprays	Rates for <i>O. regnellii</i> .
			1 to 10 ppm preplant dip	Dip for 5 minutes. Rates for <i>O. regnellii</i> .
PANSY (<i>Viola x wittrockiana</i>)	To control plant growth	Abide /A-Rest	3 to 15 ppm spray	See AGERATUM.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	5 to 15 ppm spray	Apply when plants are 2 in. in diameter. Use higher rates for higher temperatures and more vigorous cultivars. Late applications may delay flowering.
		Concise /Sumagic	1 to 6 ppm spray	Apply when plants are 3 to 4 in. tall. Use higher rates for higher temperatures and more vigorous cultivars. Late applications may delay flowering.
		Topflor	2.5 to 7.5 ppm spray	Based on NC State University trials. Adjust rates for other locations. Pansies are very responsive to Topflor, so start trials with lower rates.
	Induce lateral or basal branching	Configure	50 to 800 ppm	Single foliar spray. Limited plant height control and small increase in branching. There were cultivar differences with violas being more tolerant than pansies. Flowering was delayed. Phytotoxicity occurred above 100 ppm.
PANSY PLUGS	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	1 to 5 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage. Pansies are sensitive as plugs, so determine optimal rates.
PENNISETUM GLAUCUM	To control plant growth	Collate 2L /Florel	500 ppm spray	Apply first application 4 weeks after sowing or 1 week after transplant. If needed, a second application can be made 10 to 14 days later. Promotes side shoot production more than providing height control.
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	6 to 8 ppm drench	For direct-sown seed, apply paclobutrazol 4 weeks after sowing. A second application possible 10 days later, if needed.
			3 to 5 ppm drench	For plugs, apply 1 week after transplant.
PENNISETUM SETACEUM 'Rubrum'	To control plant growth	Concise /Sumagic	5 ppm spray	First application can be made 21 days after transplanting. Repeat if needed 14 days later.
PENSTEMON DIGITALIS Husker Red (Smooth White Penstemon)	Induce basal branching	Configure	600 ppm	A single foliar spray induced a small increase in number of laterals but increased pot fill. Slight delay in plant development resulted in reduced plant height.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
PENSTEMON HARTWEGII	To control plant growth	Citadel+Dazide /Altercel+B-Nine	1,000 ppm + 2,500 ppm spray	Rates for moderately vigorous cultivars. Up to 2 sprays may be needed.
		Concise /Sumagic	5 to 10 ppm spray	Rates for moderately vigorous cultivars. Up to 2 sprays may be needed.
		Dazide /B-Nine	2,500 ppm spray	Rates for moderately vigorous cultivars. Up to 2 sprays may be needed.
		Florel/ Collate 2L	Spray	Not recommended because of flower delay.
PENTAS	To control plant growth	Abide /A-Rest	2 to 4 ppm spray	
		Citadel /Altercel	1,000 to 1,500 ppm spray	
		Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	2 to 3 ppm spray	
PEONY (Paeonia)	Induce lateral branching	Configure	100 to 1600 ppm	5 minute pre-plant bulb soaks in the fall. BA caused buds to sprout earlier and closer together. Without BA, bud emergence occurred over a longer period of time. With BA, bud emergence was more synchronized and overall, the bud emergence dates per plant were about 20 days earlier.
PEPEROMIA	Induce lateral or basal branching	Configure	250 to 1000 ppm	Single foliar spray applied at planting. 500 ppm recommended. 1000 ppm BA resulted in more than double the number of lateral branches and a reduction in plant height and internode length. No phytotoxicity noted. Custom solution of BA used, not commercial mix. Effects lasted about 12 weeks.
PEPINO	To control plant growth	Sumagic	2 to 10 ppm spray	See precautions listed with EGGPLANT.
PEPPER	To control plant growth	Sumagic	2 to 10 ppm spray	See precautions listed with EGGPLANT.
PERENNIALS (Not specifically listed in this table)	To induce lateral or basal branching	Configure	50 to 500 ppm spray	The supplemental label allows legal use on greenhouse grown plants not specifically listed on the original label. See label for trialing suggestions and precautions.
PERICALLIS (Cineraria)	To control plant growth	Dazide /B-Nine	2,000 ppm spray	Apply every 14 days, if needed.
PERILLA	To control plant growth	Concise /Sumagic	3 to 5 ppm spray	Apply if needed.
		Dazide /B-Nine	2,000 to 4,000 ppm spray	Apply 1 to 3 times as needed.
		Dazide + Citadel /B-Nine + Altercel	2,500 to 4,000 ppm Dazide + 1,000 to 1,500 ppm Citadel applied as a tank-mix spray	
		Piccolo /Bonzi/Pac O	10 to 20 ppm spray	
PETUNIA, Seed	To control plant growth	Abide /A-Rest	10 to 26 ppm spray	See AGERATUM.
		Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	15 to 45 ppm spray	
		Concise /Sumagic	25 to 50 ppm spray	
		Topflor	20 to 60 ppm spray	Based on NC State University trials. Adjust rates for other locations.
PETUNIA PLUGS, Seed	To control plant growth	Piccolo/Piccolo 10 XC /Bonzi/Pac O	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
PETUNIA, Vegetative	To control plant growth	Abide /A-Rest	10 to 26 ppm spray	Multiple applications may be required.
		Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Dazide /B-Nine + Bonzi/ Piccolo /Pac O	2,500 ppm spray + 40 ppm Bonzi/ Piccolo /Pac O applied as a tank-mix spray	Recommendation based on NC State University trials.
		Dazide /B-Nine + Topflor	2,500 ppm spray + 15 to 30 ppm Topflor applied as a tank-mix spray	Recommendation based on NC State University trials.
		Piccolo /Bonzi/Pac O	5 to 45 ppm spray	An application at 2 to 4 ppm can be made 1 to 2 weeks after transplanting, followed by a 20 to 30 ppm spray 2 to 3 weeks later. Cultivars' responses to PGRs vary. Test a few plants to determine rate for optimal control. Finished plants can be maintained and have prolonged shelf life when 5 to 10 ppm sprays are applied on full-grown, mature plants. Recommendations based on Michigan conditions.
		Concise /Sumagic	20 to 50 ppm spray	20 ppm worked well in NC State University trials.
		Piccolo	12 ppm liner root soak	See BACOPA. Rate based on Michigan State University trials with petunia multiflora prostrate Wave Purple.
		Topflor	15 to 60 ppm spray	Recommendation based on NC State University trials.
	To increase lateral branching	Florel / Collate 2L	300 to 500 ppm spray	
	Induce lateral or basal branching	Configure	20 to 160 ppm	Foliar spray 1 to 2 times. 80 ppm applied twice was optimal at increasing branching, improving shape, increasing flowering. Transient phytotoxicity noted at 160 ppm.
PHALAEOPSIS Orchids	To increase flower number and earlier flowering	Configure	200 to 400 ppm spray	Apply Configure 1 week after the start of forcing (cooling). Cultivar response varies. Some cultivars are sensitive to Configure and distorted flower stalks may form, so conduct your own trials to determine suitability. Recommendation based on Michigan State University trials.
	To control inflorescence length	Concise /Sumagic	100 to 200 ppm spray	Apply when the flower spike length is 1 in. (3 cm).
		Piccolo / Piccolo 10 XC /Bonzi/Pac O	250 ppm spray	Apply when the flower spike length is 1 in. (3 cm).
PHILODENDRON	To control plant growth/vine control	Abide /A-Rest	25 to 132 ppm spray	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
		Citadel /Altercel	3,000 ppm spray	
		Dazide /B-Nine	2,500 to 7,500 ppm spray	
PHLOX DRUMMONDII	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	
PHLOX MACULATA, (Hybrid)	To control plant growth	Concise /Sumagic	5 to 10 ppm spray	
		Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Topflor	10 to 15 ppm spray	
PHLOX PANICULATA David (Garden Phlox)	Induce lateral or basal branching	Configure	600 ppm	Not responsive to a single foliar spray. Multiple applications may be effective.
PHLOX PANICULATA Franz Schubert (Garden Phlox)	Induce lateral or basal branching	Configure	600 ppm	A single foliar spray increased the number of shoots. No effect on height.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
PILEA	To control plant growth	Abide/A-Rest	25 to 132 ppm spray	Drench volumes and mg a.i. vary with pot size.
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
PLATYCODON	To control plant growth	Abide/A-Rest	100 ppm spray	PGRs usually not required.
		Dazide/B-Nine	1,500 to 5,000 ppm spray	PGRs usually not required. High rates have been reported to cause edge burn.
	Induce lateral or basal branching	Configure	300 ppm	Single foliar spray resulted in significant phytotoxicity.
PLECTRANTHUS	To control plant growth	Dazide + Citadel/B-Nine + Altercel	1,500 to 2,500 ppm Dazide + 750 to 1,000 ppm Citadel applied as a tank-mix spray	Cultivars' responses to PGRs vary. Test a few plants to determine rate for optimal control. See label.
		Piccolo/Bonzi/Pac O	5 to 20 ppm spray	Cultivars' responses to PGRs vary.
PLUMBAGO AURICULATA	To control plant growth	Collate 2L/Florel	1,000 ppm spray	Pinching plants help improve the overall form. In addition, to further enhance secondary shoots, apply PGR 1 week before pinch.
POINSETTIA	To control plant growth	Abide/A-Rest	0.06 to 0.25 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volume and mg a.i. vary with pot size. Start with lower rates.
		Dazide/B-Nine	2,000 to 3,000 ppm spray	Not effective in NC State University studies.
		Dazide + Citadel/B-Nine + Altercel	800 to 2,500 ppm Dazide + 1,000 to 1,500 ppm Citadel applied as a tank-mix spray	Use the higher rates of this tank-mix spray on stock plants and for finishing crops in very warm regions. Outside of very warm areas, use the lower rates. Late applications can delay flowering and reduce bract size.
		Piccolo/Bonzi/Pac O	10 to 30 ppm spray	Use higher rates of 15 to 45 ppm in southern Florida. Applications to slower-growing cultivars in cool climates should begin when axillary shoots are 2 to 3 in. long. For vigorous growing cultivars in warm climates, applications should begin when axillary shoots are 1.5 to 3 in. long. See label for other precautions.
		Piccolo/Bonzi/Pac O/Downsize	0.237 to 0.473 mg a.i. (0.25 to 3 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drenches generally have less of an effect on bract size than sprays. Drench volume and mg a.i. vary with pot size. Start with lower rates.
		Concise/Sumagic	2.5 to 10 ppm spray	Apply when the lateral shoots are 1.5 to 2.5 in. tall (about 10 to 14 days after pinching). Test for cultivar sensitivity. Multiple applications of the lower label rate may elicit short days. For Florida only: use a foliar spray concentration between 10 to 15 ppm (2.5 to 3.8 fl. oz./gal) and do not apply after October 25.
		Citadel/Chlormequat E-Pro/Altercel	800 to 1,500 ppm spray	For natural season crops in N.C., don't apply Citadel after mid-October to November 1. Late applications can reduce bract size and delay flowering.
			3,000 to 4,000 ppm drench	Drench volume varies with pot size. Consult the label for recommended volumes.
		Topflor	2.5 to 80 ppm spray	Use lower rates for less vigorous cultivars. SEE LABEL FOR ADDITIONAL RATE RECOMMENDATIONS.
	0.03 to 0.5 mg a.i. (0.25 to 4.2 ppm) drench for a 6-in. pot			
To promote plant growth	Fascination	3 ppm spray	Use an early-season application during vegetative growth prior to the start of short days and flower initiation if promoting vegetative growth. SEE LABEL FOR ADDITIONAL PRECAUTIONS BEFORE USE.	
	Fresco/Fascination	3 to 10 ppm spray	Use a late-season application to promote bract expansion. SEE LABEL FOR ADDITIONAL PRECAUTIONS BEFORE USE.	

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
POINSETTIA <i>continued</i>	Growth enhancer/ Rooting enhancer	Configure	1250 ppm	Single drench when IBA treated cuttings were stuck in the mist bed. Increased the number of roots per cutting and the root fresh weight.
	Branching agent/ Enhance cutting numbers	Configure	62.5 to 500 ppm	Foliar spray 2 times at 20 day intervals. BA 125 ppm worked optimally at maximizing the number of cuttings produced on stock plants. Rooting percentage was not affected by this rate. 500 ppm BA delayed rooting in the cuttings.
POINSETTIA, Tree	To control plant growth	Concise	2 to 3 ppm drench for a 6-in. pot	For use in Florida only: Apply when the lateral shoots are 1.5 to 2.5 in. tall (about 10 to 14 days after pinching). Test for cultivar sensitivity. Do not apply after October 25.
PORPHYROCOMA POHLIANA (Brazilian Fireworks)	To improve foliage color and for earlier flowering	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	3 to 5 ppm spray	Height control generally not needed and rates above 5 ppm can cause leaf puckering.
PORTULACA GRANDIFLORA (Moss rose)	Induce lateral or basal branching	Configure	62.5 to 250 ppm	Single foliar spray. 250 ppm BA reduced shoot length by 25%, increased branching by 143%, and caused a more prostrate habit.
PORTULACA OLERACEA (Moss rose)	To control plant growth	Abide/A-Rest	7 to 26 ppm spray	
		Concise/Sumagic	15 to 30 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	5 ppm drench	Apply 7 days after transplant. May replace the need to pinch.
		Topflor	30 ppm spray	Apply 7 days after transplant. Repeat 2 weeks later, if needed.
	To increase lateral branching	Citadel/Altercel	5,000 ppm spray	Apply 5 to 6 days after pinching to improve branching of cuttings.
		Collate 2L/Florel	300 to 500 ppm spray	Recommendations based on Michigan conditions. Defoliation can occur with rates greater than 300 ppm.
Induce lateral or basal branching	Configure	50 to 400 ppm	Single foliar spray. BA increases branching of one of two cultivars tested.	
POTHOS	To control plant growth	Abide/A-Rest	25 to 132 ppm spray	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
		Dazide/B-Nine	2,500 to 7,500 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O	4 to 6 mg a.i. drench for an 8-in. pot; apply 10 fl. oz./8-in. pot	
PRIMULA ACAULIS	To control plant growth	Dazide/B-Nine	1,000 to 2,500 ppm spray	PGRs usually not required.
PRIMULA OBCONICA	To control plant growth	Dazide/B-Nine	5,000 ppm spray	PGRs usually not required.
PURPLE CONEFLOWER	To control plant growth	Concise/Sumagic	30 to 40 ppm spray	
PURPLE PASSION	To control plant growth	Abide/A-Rest	26 to 132 ppm spray	
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
RANUNCULUS	To control peduncle length	Dazide/B-Nine	2,500 to 5,000 ppm spray	Make first application after 4 weeks. Repeat at lower rate every 2 weeks if needed. 3 to 4 applications may be needed. Conduct trials to determine optimal concentrations and timing.
REBUTIA VIOLACIFLORA (Cactus)	Flower enhancer	Configure	10 to 100 ppm	Applied 1 to 3 times. 100 ppm sprayed 3 times induces more flower buds but many of these buds aborted. Rhipsalidopsis gaertneri

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
ROSE, Bush	Induce lateral or basal branching	Configure	100 ppm	Foliar spray 2 to 3 times. Slight increase in branching and increase in the length of the side branches. Subsequent flowering was increased too. Effect was better than pinching.
ROSE, Pot	To control plant growth	Concise /Sumagic	0.1 to 0.2 mg a.i./pot drenches	Usually only a single application is made.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	16 to 25 ppm sprays	Begin applications after the final pinch. Make the first one in 14 to 21 days. Repeat weekly if needed. Discontinue applications after visible bud.
	Senescence inhibitor	Configure	45 to 180 ppm	Single foliar spray followed by simulated shipping. At 180 ppm inhibit flower senescence and leaf abscission in simulated shipping and was nearly equal to silver thiosulfate (STS).
RUDBECKIA HIRTA (syn. R. bicolor) (Blackeyed susan)	Induce lateral or basal branching	Configure	50 to 1600 ppm	Single foliar spray applied 2 weeks after potting. Height controlled. 1600 ppm caused phytotoxicity.
RUDBECKIA Goldstrum	Induce lateral or basal branching on plugs	Configure	300 ppm	Single foliar spray increased basal branching with significant early phytotoxicity.
SALVIA, Annual (Salvia splendens; Scarlet sage)	To control plant growth	Abide /A-Rest	10 to 26 ppm spray	
		Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	20 to 60 ppm spray	
		Citadel /Chlormequat E-Pro/Altercel	800 to 1,500 ppm spray	
		Concise /Sumagic	5 to 10 ppm spray	
			Topflor	20 to 80 ppm spray
	Induce lateral or basal branching	Configure	50 to 800 ppm	Single foliar spray applied 2 weeks after potting. Growth index decreased with increasing rates.
SALVIA PLUGS, Annual	To control plant growth	Piccolo/Piccolo 10 XC /Bonzi/Pac O	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
SALVIA FARINACEA (Mealy sage)	To control plant growth	Citadel+Dazide /Altercel+B-Nine	1,000 ppm + 2,500 ppm spray	Apply if growth control is needed.
		Florel/ Collate 2L	Spray	Not recommended because of flower delay.
	Induce lateral or basal branching	Configure	250 ppm	Single foliar spray. Controlled height and increased branching on par with Florel sprayed at 500 ppm.
SALVIA GUARANITICA	To control plant growth	Citadel+Dazide /Altercel+B-Nine	1,000 to 1,500 ppm + 2,000 to 3,500 ppm spray	
SALVIA HYBRID	To control plant growth	Dazide /B-Nine	1,500 to 2,500 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O/Downsize	0.5 to 1 ppm drench	
SALVIA LONGISPICATA x FARINACEA	To control plant growth	Dazide /B-Nine	2,500 to 3,000 ppm spray	
SALVIA NEMOROSA May Night (Meadow sage)	Induce lateral or basal branching	Configure	50 to 800 ppm	Single foliar spray applied 2 weeks after potting. Branching increased and flowering delayed with increasing rates. 400 ppm was optimal.
	Induce branching on plugs	Configure	300 ppm	Single or multiple foliar sprays applied ~34 days after sticking (plants moderately rooted) increased basal branching but reduced root surface area and root volume moderately. Apply after plugs are well rooted.
SALVIA PATENS	To control plant growth	Citadel+Dazide /Altercel+B-Nine	1,000 ppm + 2,500 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O/Downsize	1 ppm drench	Trial rate before use.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
SALVIA, Perennial	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	40 to 60 ppm spray	
SALVIA, Vegetative	To control plant growth	Dazide/B-Nine	1,000 to 2,000 ppm spray	Multiple applications may be needed to tone crop.
		Dazide + Citadel/B-Nine + Altercel	2,000 to 3,500 ppm Dazide + 1,000 to 1,500 ppm Citadel applied as a tank-mix spray	
SANVITALIA	To control plant growth	Dazide/B-Nine	1,200 to 5,000 ppm spray	Use to tone plants. Cultivars' response to PGRs varies. Test a few plants to determine rate for optimal control.
SCABIOSA CAUCASICA (Pincushion flower)	Induce lateral or basal branching	Configure	50 to 800 ppm	Single foliar spray applied 2 weeks after potting. No effect.
SCAEVOLA AEMULA	To control plant growth	Concise/Sumagic	30 ppm spray	Based on NC State University trials, 30 ppm worked well. Adjust rates to other locations; test on a few plants to determine rate for optimal control.
			0.125 ppm drench (0.011 mg a.i.) for a 5-in. pot; apply 3 fl. oz./5-in. pot	Drench volumes vary with pot size. See label for recommended volumes. Scaevola is very responsive to Concise/Sumagic drenches. Test on a few plants to determine rate for optimal control. Recommendations based on NC State University trials.
		Dazide/B-Nine	2,500 ppm spray	
		Piccolo/Bonzi/Pac O	20 to 40 ppm spray	
			1 to 3 ppm drench (0.12 to 0.35 mg a.i.)	Drench volumes vary with pot size. See label for recommended volumes. Cultivars' response to PGRs varies. Start with lowest rate in your trials. Scaevolans are very responsive to paclobutrazol.
		Topflor	45 to 60 ppm spray	Recommendations based on NC State University trials.
			0.79 to 2.25 ppm drench (0.075 to 0.2 mg a.i.)	Drench volumes will vary with pot size. See label for recommended volumes. Scaevola is very responsive to Topflor. Test the lower rates on a few plants. Recommendations based on NC State University trials.
			2 to 4 ppm liner dip	Scaevola is very responsive to Topflor. Test the lower rates on a few plants. Recommendations based on NC State University trials.
	To increase lateral branching	Flore/Collate 2L	300 to 500 ppm spray	Apply early, typically 2 to 3 weeks after pinching. Late applications can delay flowering.
SCHEFFLERA	To control plant growth	Abide/A-Rest	25 to 132 ppm spray	Drench volumes and mg a.i. may vary with pot size.
			0.25 to 0.5 mg a.i. (2 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
	Dazide/B-Nine	2,500 to 7,500 ppm spray		
	To increase lateral branching	Augeo/Atrimmec	3,125 ppm spray	Labeled for Schefflera arboricola only.
SCHIZANTHUS	To control plant growth	Abide/A-Rest	1 to 2 ppm spray	
		Dazide/B-Nine	1,500 to 3,000 ppm spray	
SCOPARIA	To control plant growth	Dazide/B-Nine	1,000 to 2,500 ppm spray	Use to tone plants if needed.
SCUTELLARIA JAVANICA (Skullcap)	To control plant growth	Dazide + Citadel/B-Nine + Altercel	2,500 ppm Dazide/B-Nine + 1,000 ppm Citadel/Altercel tank mix spray	Begin applications 2 to 3 weeks after transplanting. Repeat as needed every 2 weeks.
SEMPERVIVUM spp.	To induce offsets	Configure	100 to 400 ppm spray	Based on NC State University trials when applied 2 weeks after potting. For retail sales, 400 ppm produced the most offsets. For stock plant production, 100 to 200 ppm provided a balance between an increase in offset number and a larger offset size.

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
SEMPERVIVUM CANTABRICUM X MONTANUM VAR STRIACUM (Hens and Chicks)	Offset enhancer	Configure	50 to 400 ppm	Single foliar spray. Rates between 200 and 400 ppm was optimal for increasing offsets. Rates up to 400 ppm did not affect subsequent rooting of offsets. Cultivars varied in the number of offsets produced.
SHASTA DAISY	To control plant growth	Concise /Sumagic	15 to 30 ppm spray	
SHRIMP PLANT	To control plant growth	Abide /A-Rest	25 to 50 ppm spray	Apply after plants established.
		Dazide /B-Nine	1,000 ppm	Apply after plants established.
	To increase lateral branching	Augeo/Atrimmec	781 to 1,562 ppm spray	
SNAPDRAGON, Seed (ANTIRRHINUM)	To control plant growth	Abide /A-Rest	10 to 26 ppm spray	
		Concise /Sumagic	25 to 50 ppm spray	
		Dazide + Citadel /B-Nine + Altercel	800 to 1,000 ppm Dazide/B-Nine + 800 to 1,000 ppm Citadel/Altercel applied as a tank-mix spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	30 to 90 ppm spray	Apply at an early stage of plant growth with good stem coverage, especially for vigorous varieties.
SNAPDRAGON PLUGS, Seed (ANTIRRHINUM)	To control plant growth	Piccolo/Piccolo 10 XC /Bonzi/Pac O	10 to 20 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
SNAPDRAGON, Vegetative (ANTIRRHINUM)	To control plant growth	Piccolo /Bonzi/Pac O	30 to 60 ppm spray	
		Concise /Sumagic	20 to 45 ppm spray	
	To control plant growth and peduncle stretch	Dazide /B-Nine	1,500 ppm spray	Use during periods of high temperatures.
SPATHIPHYLLUM (Peace lily)	To induce flowering	GibGro	265 ppm spray	Apply one full-coverage spray during non-seasonal bloom period (June through January). Some cultivars exhibit distorted blooms, increased petiole length and narrow leaves.
	To accelerate bloom and increase flower number	Florgib /ProGibb T&O	150 to 250 ppm spray	Use a single application approximately 9 to 12 weeks prior to expected sale date. Spray to the point of runoff and thoroughly wet all growing points.
	Induce lateral or basal branching	Configure	250 to 1000 ppm	Single foliar spray or 10 ml substrate drench. Drench rates of 500 ppm recommended. Drenches at 1000 ppm resulted in the greatest number of lateral shoots and reduced overall height. All drench rates were better than any foliar rate.
STATICE, Cut (Limonium)	To promote plant growth and stem elongation	Florgib /ProGibb T&O	50 to 100 ppm spray	Apply when plants are 4 to 8 in. tall. Other applications can be made at 2- to 3-week intervals. See label.
	For earlier flowering and increased flowering	Florgib /ProGibb T&O	400 to 500 ppm spray	Give each plant 0.33 fl. oz. (10 ml) of solution. Use when plants are 10 in. or more in diameter (approximately 90 to 100 days after sowing). See label.
STEPHANOTIS, Pot	To tone plant growth	Dazide + Citadel /B-Nine + Altercel	100 ppm + 100 ppm spray	Controls vine elongation and shortens days until flowering.
STOKESIA (Stokesia laevis; Silver Moon Stoke's Aster)	To control plant growth	Piccolo/Piccolo 10 XC /Bonzi/Pac O	40 to 80 ppm spray	
	Induce basal branching	Configure	600 ppm	Not responsive to a single foliar spray. Higher rates or multiple applications may be effective.

Color Code:	White = Label Rates
	Pink = University Research Trials
	Gold = Supplier/Grower Trials

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
STREPTOCARPUS	To control plant growth	Abide /A-Rest	10 to 50 ppm spray	Rate based on Louisiana State University trial.
		Dazide /B-Nine	1,500 to 2,500 ppm spray	Supplier rate recommendation.
		Topflor	5 to 20 ppm spray	
	To delay premature bloom and promote additional plant growth	Collate 2L	250 to 1000 ppm spray	Optimal rates varied significantly by cultivar. Conduct your own trials to determine optimal rates for each Streptocarpus series and specific cultivar. Results based on Iowa State University trial.
STROBILANTHES DYERIANUS (Persian Shield)	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	30 ppm spray	
SUNFLOWER (<i>Helianthus annuus</i>)	To control plant growth	Citadel /Chlormequat E-Pro/Altercel	800 to 1,500 ppm spray	
		Piccolo /Bonzi/Pac O	2 to 4 mg a.i. drench; apply 4 fl. oz./6-in. pot	Optimal rate based on NC State University trials. Adjust rate for plant vigor. Drench volumes and mg a.i. vary with pot size.
		Concise /Sumagic	16 to 32 ppm sprays	Optimal rate based on NC State University trials. Adjust rate for plant vigor.
		Topflor	30 to 50 ppm spray	
	Enhance seed set	Configure	1 to 2 mg a.i. (8.45 to 16.9 ppm) drench for a 6-in. pot	150 to 250 ppm
SYNGONIUM PODOPHYLLUM (Arrowhead vine)	Induce lateral or basal branching	Configure	250 to 2000 ppm	Single foliar spray onto rooted cuttings at the 3 or 5 leaf stage. BA at the 3 to 5 leaf stage resulted in earlier development of lateral shoots and shorter bushier plants.
TALINUM PANICULATUM	To control plant growth	Dazide /B-Nine	2,500 to 3,500 ppm spray	For toning the crop. Apply once after transplanting.
TECOMA STANS	To control plant growth	Dazide + Citadel /B-Nine + Altercel	2,500 ppm Dazide/B-Nine + 1,000 ppm Citadel/Altercel tank mix spray	Begin applications 2 to 3 weeks after transplanting. Repeat as needed every 2 weeks.
TECOMA STANS (Texas star)	Induce lateral or basal branching	Configure	125 to 500 ppm	4 foliar sprays at 2 week intervals following a hard pinch. BA increased the number of cuttings but reduced rooting percentage.
THANKSGIVING CACTUS (<i>Rhipsalidopsis gaertneri</i>)	Branching agent/Flower enhancer	Configure	10 to 200 ppm	Single foliar spray 3 or 6 months after planting. 200 ppm on older plants increases branching and improves appearance.
	Flower enhancer	Configure	100 to 800 ppm	Single foliar spray applied 5 to 10 days after start of short days. BA hastens time to flower and increases number of flowers. BA 100 to 200 ppm was optimal.
THANKSGIVING CACTUS (<i>Schlumbergera truncata</i>)	Phylloclade enhancer/Flower enhancer	Configure	100 ppm	Single foliar spray 2 weeks after start of short days or during long days. Applications at 2 weeks after beginning of short day increased number of flower buds by 40%. Applications during long day increased phylloclade numbers by 150%.
	To control stem elongation/plant growth	Dazide + Citadel /B-Nine + Altercel	2,500 ppm Dazide/B-Nine + 1,000 ppm Citadel/Altercel tank mix spray	Apply to cuttings in propagation.
TIBOUCHINA	To control plant growth	Dazide /B-Nine	2,500 ppm spray	

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
TILLANDSIA BUTZII T. aeranthos T. cacticola (Succulent/Bromeliad)	Induce lateral or basal branching	Configure	1 to 50 ppm	Applied 2 to 3 times per week for 2 to 10 weeks as a foliar spray, or cuttings dipped 1 to 3 times for 1 to 24 hours. 25 to 50 ppm sprays and 1 hour dips greatly increased offsets.
TOMATILLO	To control plant growth	Sumagic	2 to 10 ppm spray	See precautions listed with EGGPLANT.
TOMATO	To control plant growth	Sumagic	2 to 10 ppm spray	See precautions listed with EGGPLANT.
TORENIA FOURNIERI	To control plant growth	Concise /Sumagic	5 to 15 ppm spray	Apply if growth control is needed.
		Dazide /B-Nine	1,500 to 2,500 ppm spray	Apply if growth control is needed.
TORENIA spp.	To control plant growth	Dazide /B-Nine	1,500 ppm spray	Apply if growth control is needed
		Florel/ Collate 2L	Avoid use	Florel and Collate 2L significantly delay flowering.
TROPICAL PLANTS (Not specifically listed in this table)	To induce lateral or basal branching	Configure	50 to 500 ppm spray	The supplemental label allows legal use on greenhouse-grown plants not specifically listed on the original label. See label for trialing suggestions and precautions.
TULIP	To control plant growth	Abide /A-Rest	0.125 to 0.5 mg a.i. (1 to 4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size.
		Piccolo/Piccolo 10 XC /Bonzi/Pac O/Downsize	0.591 to 4.732 mg a.i. (5 to 40 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	Drench volumes and mg a.i. vary with pot size. Apply drenches 1 to 5 days after forcing begins.
		Piccolo /Bonzi/Pac O	2 to 5 ppm bulb soak	Soak bulbs for 1 hr. prior to planting. Ten-minute soaks of 50 ppm (1.6 oz./gal.) provided excellent results in NC State University trials. Cultivar response varied.
		Concise /Sumagic	10 ppm bulb soak	Ten minute preplant soaks provided excellent results in NC State University trials. Cultivar response varied.
		Topflor	0.5 to 1 mg a.i. (4.2 to 8.45 ppm) drench for a 6-in. pot	Based on NC State University trials. Adjust rates for other locations.
	80 to 100 ppm spray			
	Senescence inhibitor	Configure	1 to 100 ppm	Applied via injecting bulbs or buds with 0.5 ml or 100 ppm solution, single foliar spray, or single soil drench. BA reduced bud blasting with 10 ppm being better than 1 ppm and the same as 100 ppm. BA reduced the time to flowering, increased the flower size, reduced the bulblet size, and hastened the exhaustion of the mother bulb.
VERBENA, Annual	To control plant growth	Dazide /B-Nine	2,500 to 5,000 ppm spray	
		Piccolo/Piccolo 10 XC /Bonzi/Pac O	15 to 30 ppm spray	
		Citadel /Chlormequat E-Pro/Altercel	800 to 1,500 ppm spray	Begin applications 7 days after pinching. Repeat as needed every 2 weeks.
		Concise /Sumagic	15 to 30 ppm spray	
	To increase lateral branching	Augeo/Atrimmec	521 to 1,042 ppm spray	
	Florel/ Collate 2L	500 ppm spray	Florel and Collate 2L applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.	
VERBENA CANADENSIS (Clump verbena)	Induce lateral or basal branching	Configure	250 to 1000 ppm	Single foliar sprays immediately after pinching. 1000 ppm controlled shoot elongation by 19%

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
VERBENA PLUGS, Annual	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
VERBENA, Perennial	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	120 to 160 ppm spray	
		Piccolo/Piccolo 10 XC/ Bonzi/Pac O/Downsize	>0.36 mg a.i. (>3 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
VERBENA, Vegetative	To control plant growth	Dazide + Citadel/B-Nine + Altercel	2,000 to 3,500 ppm Dazide/B-Nine + 750 to 1,000 ppm Citadel/Altercel applied as a tank-mix spray	See General Recommendations.
		Piccolo	8 to 12 ppm liner root soak	See BACOPA. Rate based on Michigan State University trials.
		Citadel/Chlormequat E-Pro/ Altercel	1,500 to 2,000 ppm spray	
		Concise/Sumagic	5 to 10 ppm spray	Apply as needed.
		Dazide/B-Nine	1,500 to 2,500 ppm spray	Do not apply within 2 weeks of a Florel or Collate 2L application.
		Florel/Collate 2L	250 to 300 ppm spray	Make last application 8 weeks before sale.
	Induce lateral or basal branching	Configure	150 to 300 ppm	Single foliar increased lateral branching.
VERBENA X HYBRIDA	Induce lateral or basal branching	Configure	30 to 300 ppm	Single foliar spray onto new cuttings. 30 ppm BA applied at cutting improved rooting after 12 days and improved branching after 24 days.
VERONICA	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Pac O	20 to 40 ppm spray	
		Concise/Sumagic	20 to 40 ppm spray	
VERONICA LONGIFOLIA Icicle (Speedwell)	Induce lateral or basal branching	Configure	600 ppm	A single foliar spray induced a short term increase in number of shoots and lateral branches. Multiple applications may improve response.
VINCA (Catharanthus)	To control plant growth	Abide/A-Rest	5 to 18 ppm spray	
		Dazide/B-Nine	2,500 to 5,000 ppm spray	
		Citadel/Chlormequat E-Pro/ Altercel	800 to 1,500 ppm spray	
		Concise/Sumagic	1 to 3 ppm spray	Apply after plants reach a height of 4 in.
		Topflor	2.5 to 7.5 ppm spray	Based on NC State University trials. Adjust rates for other locations. Vinca is very responsive to Topflor, so start trials with lower rates.
	Induce lateral branching	Configure	50 to 800 ppm	Foliar spray or drench applied at 2 weeks after potting (WAP), 2+3 WAP, or 2+3+4 WAP. BA increased branching.
VINCA VINE (Vinca spp.)	To increase lateral branching	Florel/Collate 2L	500 ppm spray	Florel and Collate 2L applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.
	Induce lateral or basal branching	Configure	600 ppm	No response to a single foliar spray. Higher rates or multiple applications may improve response.
VIOLA	To control plant growth	Concise/Sumagic	1 to 5 ppm spray	
WANDERING JEW	To control plant growth	Abide/A-Rest	26 to 132 ppm spray	

Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
WOODY LANDSCAPE PLANT (Not specifically listed in this table)	To control plant growth	Abide/A-Rest	50 ppm spray	Drench volumes and mg a.i. vary with pot size.
			0.25 mg a.i. (2 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
		Piccolo/Piccolo 10 XC/Bonzi/Pac O	100 ppm spray	See BEDDING PLANTS.
		Piccolo/Piccolo 10 XC/Bonzi/Pac O/Downsize	0.47 mg a.i. (4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
		Concise/Sumagic	10 to 50 ppm spray	
1 to 2 ppm drench				
ZINNIA	To control plant growth	Abide/A-Rest	7 to 26 ppm spray	
		Citadel/Chlormequat E-Pro/Altercel	800 to 1,500 ppm spray	
		Concise/Sumagic	5 to 25 ppm spray	
		Dazide/B-Nine	2,500 to 5,000 ppm spray	Multiple applications may be required. Use higher rates for summer crops.
		Piccolo/Piccolo 10 XC/Bonzi/Pac O	15 to 45 ppm spray	
	Flower enhancer	Configure	100 to 200 ppm	Single foliar spray. 100 ppm reduced time from bud emergence to flowering by 7 days.
	Senescence inhibitor	Configure	90 to 225 ppm	Single foliar spray, followed by simulated shipping. No effect on senescence.
ZINNIA <i>Zinnia elegans</i>	Induce lateral or basal branching	Configure	20 to 800 ppm	1, 2, or 3 foliar sprays applied 1 week apart starting 1 week after potting seedlings. BA increased branching, decreased internode length.
ZINNIA PLUGS	To control plant growth	Piccolo/Piccolo 10 XC/Bonzi/Pac O	4 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.



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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/Sumagic). Chemicals that have a different mode of action—such as Augeo, Configure, Florel, Collate 2L, Fascination or Fresco—don't have these added attributes so this article doesn't apply to them.

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

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,

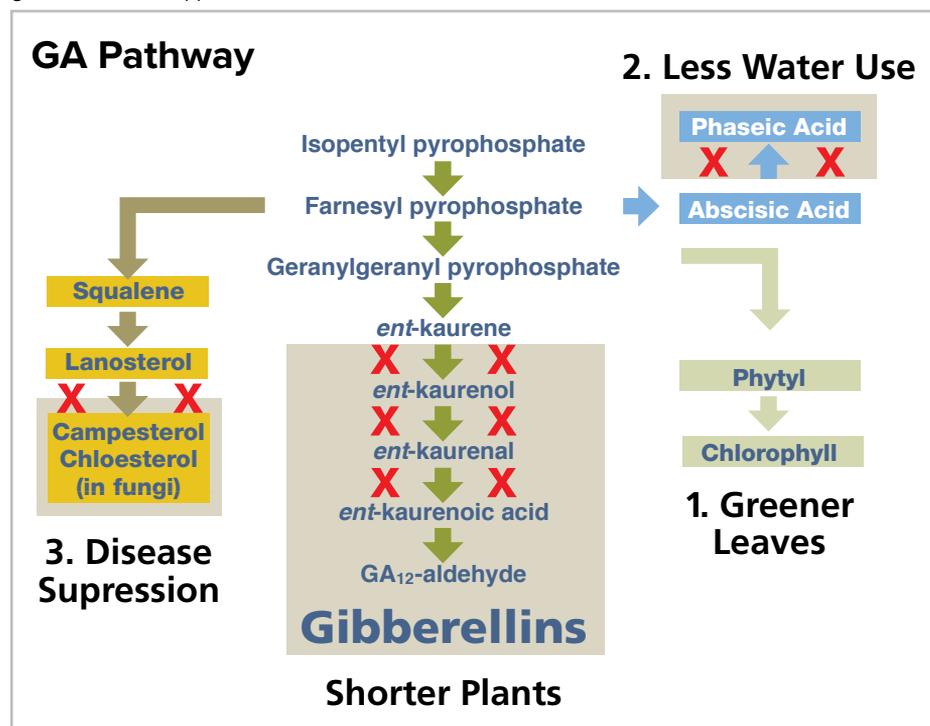
applying a PGR—which blocks the GA pathway—results in some secondary effects. In this case, an up-regulation, or increase, in the amount of chlorophyll produced by the plant (Figure 1).

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

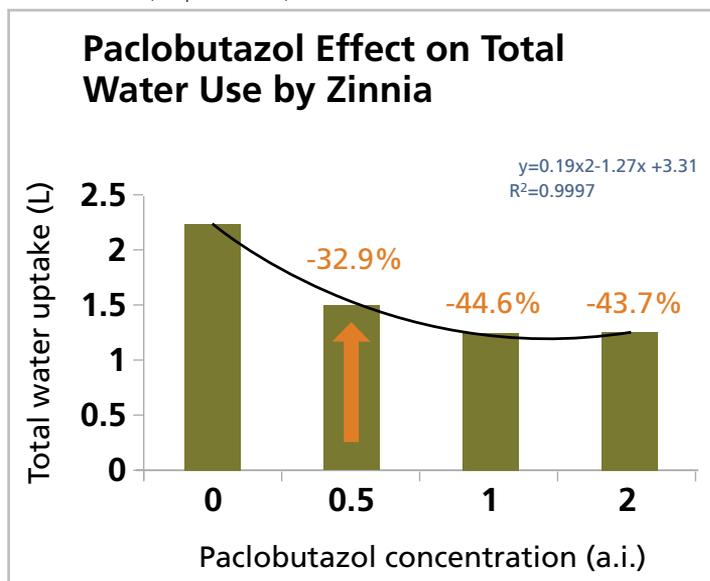


Figure 4. Based on a height control experiment, one can clearly see powdery mildew starting to infect the untreated plant on the left, while the plant on the right had been given a PGR drench about 4 weeks prior to this date and a powdery mildew infection had been reduced. PGRs will not provide season-long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

Evening Out Results with Piccolo 10XC

Brian Whipker, North Carolina State University

One of the most popular plant growth regulators (PGR) used in greenhouse floriculture production is paclobutrazol. Bonzi from Syngenta was the initial paclo registered in the U.S. Fine Americas offers Piccolo and their newer formulation of Piccolo 10XC. For growers who desire a greater degree of control, it's the top PGR in their toolbox.

Growers have made comments that sometimes the results of a paclo application are inconsistent. Below are some methods to use for improving the consistency of your results:

■ **Where does paclo uptake occur?** Paclo is actively taken-up by the plant in the roots, stems and leaves. Uptake is greatest in the roots and stems, and to a lesser extent, the leaves.

■ **Why is there a variation in uptake by the plant?** It's a function of how paclo is transported within the plant. The xylem is the water-conducting cells of plants. It moves water, nutrients and chemicals from the roots to the leaves. Paclo applied to the roots and stems is easily taken up by the plant and transported within the xylem tissue. That's why drench paclo applications are so effective and provide even results.

■ **Why are leaf applications not as effective?** Movement out of leaves relies upon the phloem. The phloem tissues are specialized cells that load and move assimilates (food) produced in the leaves to other parts of the plant. Paclo doesn't readily move into the phloem tissue, therefore, a foliar spray application has less effect than a root-applied drench.

■ **What is the basis of applying foliar sprays as a known volume over a known area?** Recommendations for applying PGRs as foliar sprays have varied over time. Initially, the basis was applying enough solution until the leaf glistens. It has also included applying sufficient volume until it just starts to drip from the leaves. Both of these recommendations are very subjective and varied from grower to grower. Hence, some growers obtained sufficient control of plant growth, while others had too little or too much.

Over time the recommendation has been modified to a more accurate basis of applying foliar sprays as a known volume over a known area. That's why the current labeled recommendation is to apply 1 gal. of spray solution over 200 sq. ft. of bench area. This basis has helped provide more consistent results across crops.

■ **What are the other effects of this spray volume over a known area?** Applying 1 gal. of spray solution over 200 sq. ft. of bench area means that the leaves are wet and there's extra solution that either dribbles down the stem or drips into the substrate. In fact, the recommended rate ranges provided on the paclo label is counting on a small degree of stem and root uptake to control plant growth.

■ **Can spray volume be used as a method of varying the dosage?** Yes, this is the basis of a srench application (applying 1.5 gal. of spray solution over 200 sq. ft. of bench area). The increased volume of spray that's applied means more of the solution comes in contact with the stems and drips down into the substrate for root uptake.

So this allows growers to mix a paclo solution at one concentration and then vary the amount of spray volume applied over the bench area to ►

PGR Activity Influencing Factors



Chemical

Species

Chemical
Concentration

Cultivar

Application Type

Application
Number

Irrigation Frequency

Light

Development Stage

Temperature

Fertilizer

Application Interval

Spacing

Figure 1. Numerous cultural and environmental factors affect the efficacy of a plant growth regulator application. These must be taken into account when you're determining the rate to use on your crop.

customize a dose to a plant's needs. So plants that require less growth control, either because they're slow growing or not a vigorous cultivar, can have less spray volume applied and this will result in less effect.

On the opposite end of the spectrum, a higher volume of water per unit area will provide added control of vigorous cultivars. This is where a grower has the ability to practice the art of PGR applications to customize results.

■ **Why does it appear that my PGR application didn't work?** There are a number of factors that influence the effectiveness of a PGR application. Optimal rates vary of course by the species of plant, by cultivar vigor, timing (late applications may be less effective), fertilization rates (high P and ammoniacal-nitrogen rates stimulate more growth) and environmental conditions (Figure 1).

In fact, for foliar applications of a PGR, any environmental factor that hastens the drying of the leaf surface after a PGR is applied will have a negative impact on uptake. If the leaf dries too quickly, such as making an application in the middle of the day, then less of the PGR will be absorbed by the plant.

Figure 2. All 0.4% paclobutrazol formulations settle over time. Here, a clear separation of the clay-based particles is seen. The active ingredients settle out within a few days, but aren't visible.

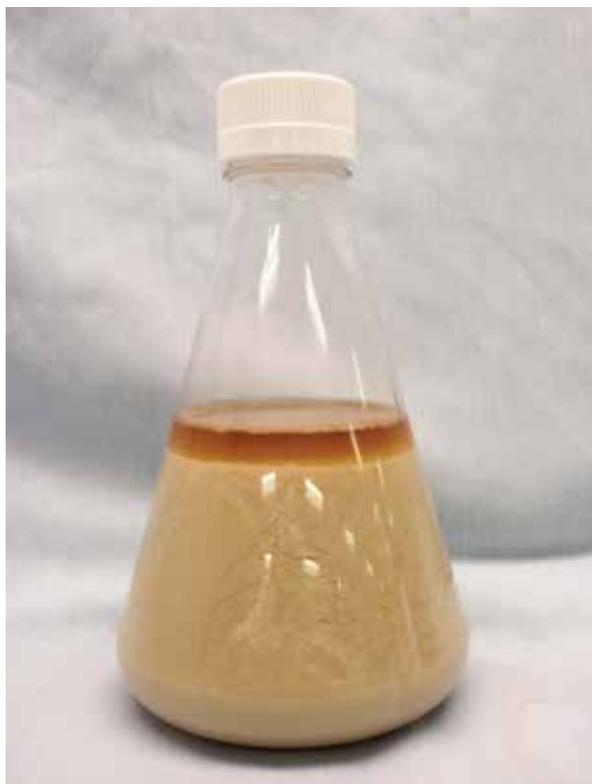


Figure 3. Leaving a "check plant" helps you determine the effectiveness of a plant growth regulator treatment.

In an experiment conducted at North Carolina State University, we applied a PGR foliar spray and allowed it to dry normally. The next morning, we lightly rewet the leaf surface by spraying the leaf with clear water until it glistened. (We avoided applying too much water that would have resulted in runoff.) The end result was an additional 10% of growth control occurred. So the application of any PGR foliar spray should be done when the leaves can remain wet for the longest time to obtain optimal results.

■ **Does my paclo settle in the jug?** The answer is yes for all the 0.4% formulations of paclo on the market. The active ingredient (a.i.) in the 0.4% formulations settles out fairly quickly in the jug. If given ample time, the clay particles and xanthan gum used to hold the a.i. in suspension will also settle out to the bottom of the container. (If you place the solution in a clear container, you can observe the clay particle settling after about two months [Figure 2].) That's why all the jugs of the 0.4% formulations state that you need to shake the container vigorously for two minutes. If the jug isn't shaken, then the solution at the top of the jug will contain less paclo and it will be more concentrated at the bottom of the jug. This will have dramatic effects on your results. So remember to shake, not stir, your 0.4% paclo jugs before use.

The exception to the above jug shaking rule is Piccolo 10XC. It's a 4% concentrate that's a microemulsion concentrate (MEC) formulation. The advantage of an MEC formulation is the a.i. stays in solution and doesn't settle out.

■ **How do I know if an application actually worked?** The simple answer is to leave some untreated controls ("check plants" [Figure 3]). Check plants allow you to determine how effective a PGR application was and will provide insights on how you may want to modify your rates.

Paclo is a very effective PGR for greenhouse production of floriculture crops. By following the above tips, it will help you get the most effect out of your PGR applications. 🍷

Use of Piccolo 10XC on Poinsettias

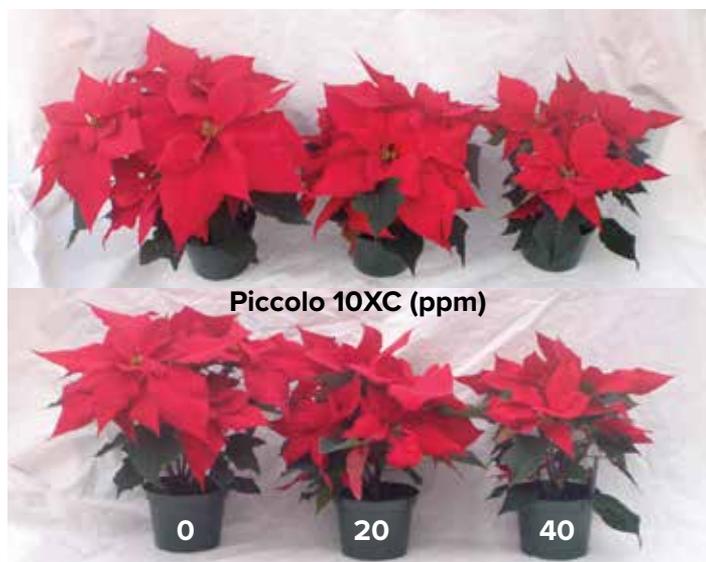
By Brian E. Whipker, North Carolina State University

Piccolo 10XC is an improved paclobutrazol formula introduced by Fine Americas. It has the advantage of not settling in the jug because of its clear formulation and is also 10 times more concentrated, thus making it easy to mix large volumes.

This pictorial guide highlights the use of Piccolo 10XC on poinsettias. The experiment was conducted at North Carolina State University in Raleigh. Rooted plugs were transplanted into 6-in. azalea pots containing Fafard 1P on August 13, 2018 and pinched to five nodes on August 26, 2018.

The plants were irrigated as needed with a 150 ppm N fertilizer solution of 13-2-13 Cal-Mag. The temperature set points of 65F nights/75F days (18C/23C) were used. Piccolo 10XC foliar sprays were applied on September 29, 2018 at a normal recommended rate of 20 ppm, 40 ppm, plus an untreated control.

The degree of growth control can be observed in the photographs and provide insight when you use Piccolo 10XC. 



Poinsettia Prestige Early, December 2



Poinsettia Majestic Pink, December 2



Poinsettia Premium Red, December 2



Poinsettia Saturnus, December 2

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 internodal elongation with the GA₄₊₇ and enhancement of axillary shoot growth with the BA. When mixed together, the combination provides a controlled stimulation of plant growth.

The other labeled option for enhancing plant growth is Florgib 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



Plants pictured above and below were initially treated with a Paclo drench of 8 ppm, which stopped growth.



Growth enhanced with a Fresco foliar spray from 2.5 to 10 ppm.

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



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

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.

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. Ⓢ

Enhancing Stem Elongation and Flowering in Ornamental Plants with Florgib 4L

By Brian Whipker, North Carolina State University

Florgib is a plant growth regulator (PGR) that's often overlooked by greenhouse growers. Its primary niche use is to enhance stem elongation, especially when growing larger tree style of plants (Figures 1 and 2). It's also used extensively with foliage plants to enhance flowering in species such as spathiphyllum (Figure 3). To find out where Florgib may be beneficial to your operation, let's review some of its uses.

Gibberellins

Gibberellic acid (GA₃) is a compound that's naturally produced in plants to stimulate growth (stem elongation). Gibberellins were initially identified in Japan during the 1920s as a metabolic by-product of the plant fungus *Gibberella fujikuroi*. Gibberellins in *Gibberella fujikuroi* lead to the extensive stem growth of infected rice plants. This is a similar stem elongation response we observe with a scab infection (*Sphaceloma poinsettiae*) of poinsettias (Figure 4). Since that time, over 130 GA types have been discovered by scientists. The number after the GA designates the type; currently, in commercial greenhouse production, we mainly rely upon GA₃, GA₄ and GA₇.

Gibberellin-containing formulations available from Fine

Florgib 4L contains 4.0% gibberellic acid (GA₃) as the active ingredient. It's used to enhance stem elongation and flowering in some foliage plants. Fresco is another Fine Americas product that contains 1.8% gibberellin, but the gibberellins are in a different form (GA₄₊₇) and the formulation also contains 1.8% benzyladenine (BA). The (GA₄₊₇)+BA mixture contained in Fresco is more effective at stimulating plant growth after a PGR overdose and at inhibiting lower leaf yellowing of Easter lilies.



Figure 1. Stem elongation of tree forms of poinsettia is enhanced with the use of Florgib applications.

Example uses of Florgib

■ **Tree forms of geraniums and poinsettias:** With both types of plants, it's important to establish the plants within the pots. Normally, it takes two to four weeks for extensive root systems to develop. With geraniums, apply 250 ppm Florgib weekly for four to five weeks. With poinsettias, apply 50 to 100 ppm of Florgib weekly for four to five weeks. Excessively high rates will result in undesirable, excessive stem stretching. Many growers will apply a 0.5 ppm paclobutrazol (Piccolo) drench once the desired amount of stem length has been achieved to slow top growth.

■ **Calla lilies (*Zantedesia sp.*):** Application of Florgib by soak or spray increases flowering, controls height and shortens days to flowering. As a soak, use a 100 ppm to 500 ppm solution. Spray applications are generally made at concentrations between 50 and 100 ppm to plants to stimulate flowering. For best results, trials should be conducted to determine desired rates and timings for optimum responses under local growing conditions.

■ **Spathiphyllum sp.:** Application to foliage will stimulate flowering for breeding and other purposes. Applications between 250 and 1,000 ppm stimulate the production of flowers, increasing the flexibility of production and the ability to sell plants in flower. For best results, trials should be conducted to determine desired rates and timings for optimum responses under local growing conditions.

■ **Caladium sp.:** Application will influence flowering. Soaking bulbs in solutions of between 250 ppm and 1,000 ppm will produce a favorable result. For best results, trials should be conducted to determine desired rates and timings for optimum responses under local growing conditions and specific varieties.

■ **Foliage plants:** For additional information about the use of gibberellins in foliage plants, use the link to the article by R.J. Henny and J. Chen, "Using Gibberellic Acid and Ethepon to Induce Flowers on Tropical Foliage Plants": <http://edis.ifas.ufl.edu/ep447>.

Avoiding carryover effect

When used as a normal foliar spray application of Florgib or Fresco at the volume of 2 qt. per 100 sq. ft., the potential for carryover of any gibberellin is practically nonexistent. Drench applications of Fresco in particular are



Figure 2. Tree forms of other plant species, such as geraniums, can be grown with the use of Florigib to stimulate stem elongation.



Figure 3. Flowering in spathiphyllum is enhanced with foliar sprays of Florigib.

Table 1. Mixing table for desired Florigib 4L concentrations.

Desired Concentration [ppm (parts per million) (GA ₃)]	Milliliters (ml) of Florigib per Liter of spray solution	Milliliters (ml) of Florigib per Gallon of spray solution	Fluid Ounces of Florigib per Gallon of spray solution
50	1.5	5.6	0.19
100	3.0	11.2	0.4
250	7.4	28.0	0.95
500	14.8	56.0	1.9
1,000	29.6	112.0	3.8

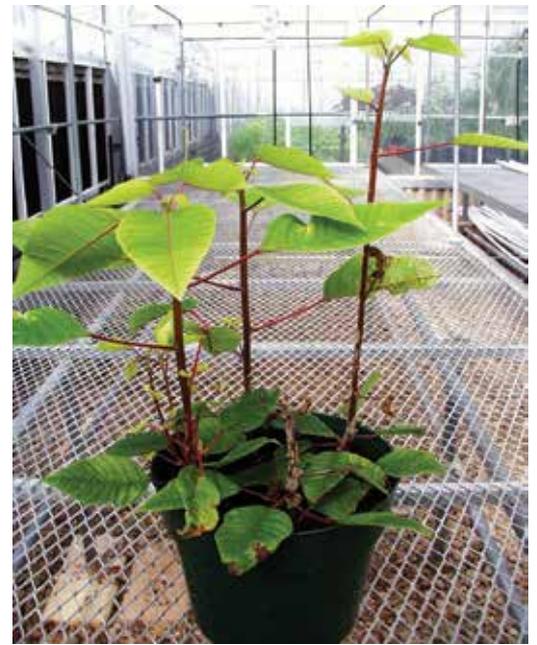


Figure 4. The discovery of gibberellins occurred after the study of rice elongation caused by a fungal infection. This same stem elongation response occurs with a poinsettia scab infection.

becoming more popular, especially with preventing lower leaf yellowing of Easter lilies.

If some of the drench solution comes in contact with concrete floors it can accumulate and cause unwanted stem elongation of any subsequent crop. To avoid this, research by Erik Runkle at Michigan State University recommends applying a 500 ppm solution of baking soda (sodium bicarbonate) to bind up the GA, thus making it non-reactive to plants.

Additional usage tips

Florigib isn't readily translocated within plants, thus all parts of the plant or crop should be covered thoroughly by the spray to obtain the desired result. Typical application rates are between 50 and 500 ppm. Foliar sprays should be applied at the volume of 2 qt. of water per 100 sq. ft. of growing area. The pH of the water used for mixing should be less than 8.5. A target pH of 6.5 to 7.0 is preferred.

Absorption of Florigib into the plant is greatest under slow drying conditions. Early morning or late applications will be more effective because of the slower drying conditions. Avoid applying Florigib when daytime conditions cause rapid drying (hot, sunny, windy weather). Florigib should be reapplied if significant rainfall occurs within two hours of application. 

Abide: Plugs & More!

By Brian E. Whipker, North Carolina State University

Ancymidol, the active ingredient in Abide and A-Rest, has a unique niche of providing safe and effective control of excessive stretch during plug production. Some plug species tend not to respond to daminozide (Dazide or B-Nine) or chlormequat chloride (Citadel or Altercel) applications. This makes ancymidol the perfect alternative of offering a greater degree of control and due to its milder chemistry without the overdose potential associated with the more potent paclobutrazol (Piccolo 10XC, Bonzi, or Pac O) or uniconazole (Concise or Sumagic) sprays.

In the book "Plug and Transplant Production" by Roger Styer and David Koranski, they recommend ancymidol for pansy and vinca plugs at 10 ppm due to effectiveness and the

low chance of stunting. The chemical cost for ancymidol is greater, but for high-value plug flats, safe and reliable control is important.

In addition, Abide can also be used during finish production. Historically, ancymidol was the primary go-to PGR for bulb crops. It's still used by some growers, but over time, uniconazole has replaced it. Ancymidol is favored by some fall pansy producers in the Southeast, especially for the initial crop being grown during periods of excessive summer heat. They prefer the degree of control and safety that ancymidol offers.

In studies we conducted at NC State University, we explored the use of Abide foliar sprays on bedding plants. Spray rates applied twice at a two-week interval starting after roots had

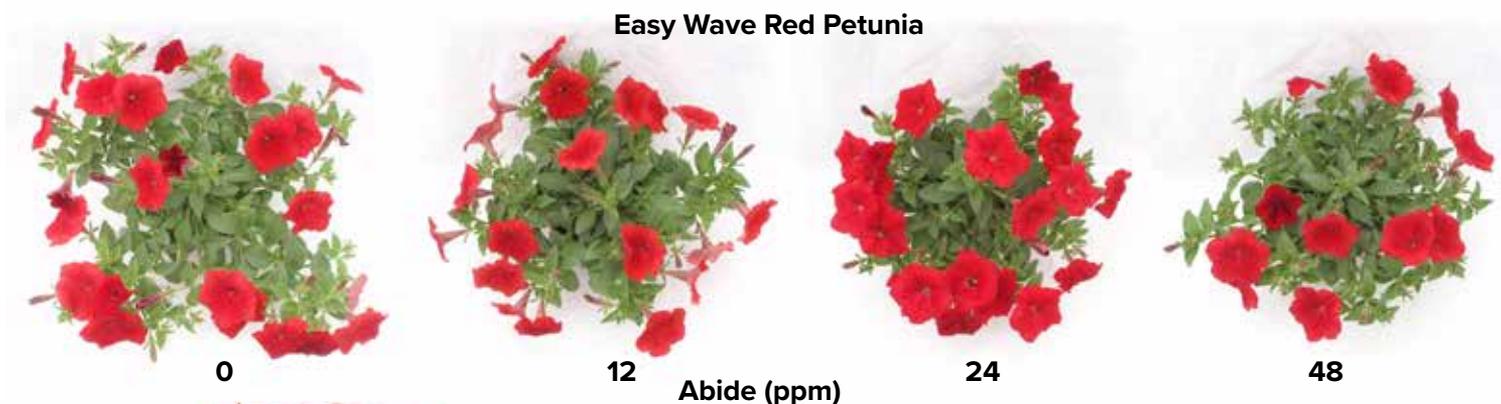


Figure 1. Growth control of petunia with Abide foliar sprays.



Figure 2. Abide foliar sprays control snapdragon growth.

Super-Charged Succulents

By Paul Cockson, Gabby Barajas & Brian Whipker, North Carolina State University

The wide array of colors, shapes and sizes help make succulents one of the more popular segments of greenhouse production. One of the challenges of succulent production is their slow growth and long production cycle.

Growers asked us the question: Could growth be enhanced? This project explored the possibility of enhancing succulent growth with a plant growth regulator (PGR).

Based on our experience, we decided that a combination of both GA and BA contained in a product such as Fresco could be the best option. This article highlights the exciting results of our study.

Our approach

We obtained unrooted cuttings of six succulents species from Dümmer Orange. Cuttings were rooted for three weeks and then transplanted into 4.5-in. azalea pots containing a peat-based substrate (80 peat and 20 perlite by volume, Oldcastle C/20 mix). The plants were allowed to establish roots to the side of the pot and then a substrate drench of Fresco was applied at 0, 2.5, 5, 10 or 20 ppm in a volume of 2 oz. supplied per pot. The photos illustrate the results after about three months of growth.

Results

Growth was enhanced with Fresco drench rates between 10 to 20 ppm for most species (Figures 1 to 5). The goal is to provide additional growth without causing excessive plants stretch. Excessive rates may result in too much growth, as seen with the 20-ppm rate on *Senecio crassissimus*. Therefore, growers will need to conduct their own trials to determine optimal rates for the species they're producing under their environmental conditions.

No growth enhancement occurred with the jade plant (*Crassula ovata*; Figure 6). This may indicate that higher rates should be evaluated to determine if growth can be increased.

Conclusions

Our results found that a Fresco substrate drench of between 10 to 20 ppm can be utilized to speed up the growth of succulents. Plants could be sized up earlier for market and this may offer fixed cost savings (cost per square foot per week) to growers to help improve their economic bottom line. 



Fresco Drenches (ppm)

Figure 1. Growth of *Senecio crassissimus* was increased with Fresco drench rates between 10 and 20 ppm. Growth might be considered excessive with the 20-ppm rate.



Fresco Drenches (ppm)

Figure 2. Larger plants of *Pachyphytum bracteosum* occurred with Fresco drench rates between 10 and 20 ppm.



Fresco Drenches (ppm)

Figure 3. Slightly larger plants of *Echeveria* Blue Bird occurred with Fresco drench rates between 10 and 20 ppm.



Fresco Drenches (ppm)

Figure 4. Slightly larger plants of *Pachyveria corvus* occurred with Fresco drench rates between 10 and 20 ppm.



Fresco Drenches (ppm)

Figure 5. Plant size of *Echeveria rosea* increased with Fresco drench rates between 10 and 20 ppm.



Fresco Drenches (ppm)

Figure 6. No growth improvement of *Crassula ovata* occurred with any of the Fresco drench rates between 10 and 20 ppm.

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Dilution Table

Formulated product per gallon of solution

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

A syringe is a convenient method for measuring out small volumes of chemical. They can be purchased at most drug stores.

Note that on a syringe 1 cc equals 1 ml.

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

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

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. 📌

