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# GROWERTALKS

In partnership with Fine Americas, Inc.



## Plant Growth Regulators for Annuals

A Guide to Growing High-Quality Annuals

2017-18

By Brian Whipker, North Carolina State University

## Fine Americas Continues to Offer the Best in PGR Products and Services

Fine Americas, Inc. is proud to once again bring you this 2017-18 PGR Guide for annuals, in partnership with *GrowerTalks*, to help showcase the latest research in plant growth regulators in the market.

Ensuring growers' success by working with them as partners is a key goal for Fine Americas. This is why we offer our growers the broadest range of PGRs supported by a wide array of services and knowledge in the ornamental marketplace.

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As a quick resource, this guide also includes the PGR rate chart by crop and dilution table, providing growers a quick go-to resource for the entire year.

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Sincerely,

Gregory Johnson, President  
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# GROWERTALKS

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# Fresco Foliar Sprays Counteract Paclo Residual in Re-circulating Irrigation Water

Brian Whipker, North Carolina State University

Plant growth regulators (PGRs) are excellent management tools for controlling excessive stem elongation. By far the major workhorse used by growers is paclobutrazol (referred to as paclo [Piccolo, Piccolo 10XC, Bonzi, Paczol, Downsize]) because it has a high level of activity and it's cost-effective.

Many large growers often apply paclo overhead by boom irrigation. In addition, some collect and re-circulate their irrigation water. This can lead to a buildup of paclo and other crop protection chemicals in a re-circulating irrigation system.

Some growers with re-circulating irrigation systems have noticed that sensitive plants—such as wax begonias (Figure 1), pansies and vinca—appear to be stunted. Tests run by Fine Americas on irrigation water samples from re-circulating systems confirmed the presence of a low level of paclo (<100 parts per billion [ppb]). While this level is extremely low, it still can have a negative effect on growth of sensitive species. Growers are concerned and have asked for a solution to this stunted growth.

## Fresco—A growth enhancer

It's been asked if Fresco can be used to counteract the paclo effect. Fresco is labeled as a treatment to overcome the effects of an overapplication of gibberellins-inhibiting PGRs, such as paclo, uniconazole (Concise/Sumagic), flurprimidol (Topflor) and ancymidol (Abide/A-Rest). Fresco is a combination of 6-BA and GA4+7 and is used to promote growth.

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 is achieved. Re-application can be made if additional growth enhancement is desired. The goal is to apply only enough Fresco to overcome the "paclo effect"—too high of a rate will result in excessive stem 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. ▶



Figure 1. Some growers with re-circulating irrigation systems have noticed that sensitive plants, such as wax begonias, appear to be stunted.



Figure 2. Even the low-parts-per-billion dose of paclo in the irrigation water resulted in growth control.

## Counteracting Paclo Residual in Re-circulating Irrigation Water

Fine Americas approached North Carolina State University to conduct a Fresco foliar spray trial to determine suitable rates for overcoming very low rates of paclo in the irrigation water. We surveyed a number of growers to determine the typical irrigation regime used with re-circulating water systems and overhead boom watering is the most common method. This provided a baseline of the degree of growth control from leaf, stem and substrate uptake of paclo in re-circulating watering systems.

Wax begonia plugs (Super Olympia Rose) were potted into 1801-cell packs filled with Fafard 1P (a peat-based substrate). We mixed four different irrigation water treatments: 1) 0 ppb (parts per billion) paclo + 100 ppm N; 2) 5 ppb paclo + 100 ppm N; 3) 10 ppb paclo + 100 ppm N; and 4) 50 ppb paclo + 100 ppm N. The paclo used was Piccolo 10XC and the fertilizer used was 17-4-17 (a low phosphorus and low ammoniacal nitrogen-containing formula was used to limit any effects that those growth-promoting elements might have on plant growth). The irrigation water treatments were applied overhead each time the plants required watering, with a total of 10 irrigations being made over the course of the experiment.

To counteract the effects of the paclo, Fresco foliar sprays of 0, 1, 3 or 6 ppm (parts per million) were applied twice (two and three weeks after the plugs were transplanted) to each of the paclo irrigation water treatments. Thus, the plants received either 0, 2, 6 or 12 ppm Fresco in total. This setup gave a 4 paclo rate x 4 Fresco foliar spray rate factorial experiment. (Note we took the approach of applying Fresco as a foliar spray to target only sensitive plant species. Including Fresco in the irrigation water wouldn't be as cost effective as a foliar spray to targeted paclo-sensitive plants.)

### What we found

Even the low ppb dose of paclo in the irrigation water resulted in growth control (Figure 2). As the dose increased from 0 to 50 ppb, the wax begonia plants were more severely affected with less growth.

To counteract the paclo effect, the application of Fresco foliar sprays provided excellent results (Figure 3). When the paclo irrigation rate was 5 ppb, a 1 ppm Fresco foliar spray applied twice overcame the PGR effect. With 10 ppb of paclo in the irrigation water, the rate of 1 to 3 ppm of Fresco applied twice was sufficient. At the highest paclo rate studied (50 ppb), a Fresco rate of 3 ppm applied twice was optimal for promoting growth.

Rates higher than the optimal range listed above resulted in excessive stem stretch and upper leaf yellowing (Figure 4).



Figure 3. To counteract the paclo effect, the application of Fresco foliar sprays provided excellent results.

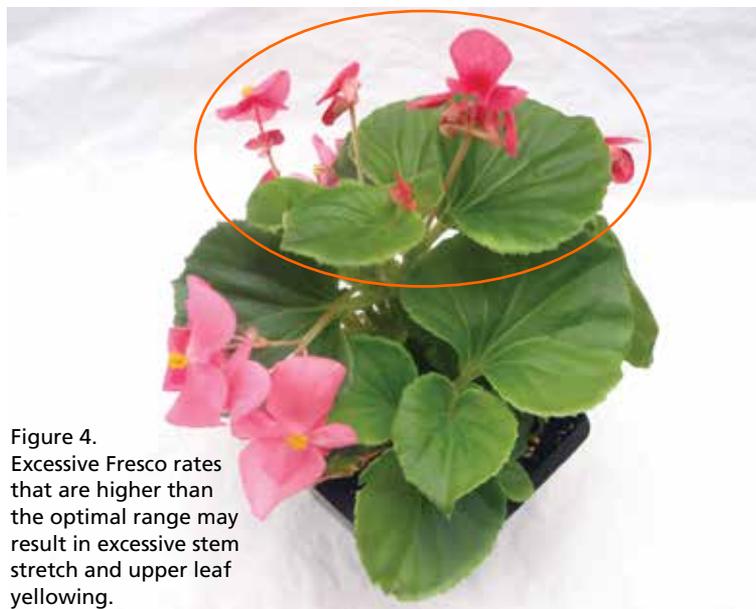


Figure 4. Excessive Fresco rates that are higher than the optimal range may result in excessive stem stretch and upper leaf yellowing.

### Take-home message

Until a suitable technique, such as carbon filtration, can be found to economically remove chemical residues from re-circulating irrigation water, Fresco foliar sprays offer a cost-effective method of counteracting the undesired effect of paclo residues in greenhouse re-circulating water systems on particularly sensitive plants. Individual growers will need to conduct their own tests to determine the level of paclo in their re-circulating irrigation water. Growers with their own trials can determine optimal Fresco foliar spray rates to enhance plant growth, using our results as a starting point, on sensitive plants like wax begonias, pansies and vinca. 🌱

## Fresco Foliar Sprays as a Growth Enhancer

Stalling of plant growth can be frustrating when you're trying to grow a full-sized plant for sale. Many factors can result in plant stall, including insufficient fertilization rates, sub-optimal temperatures, cloudy weather and plant growth regulator overdoses (anti-gibberellin PGRs, Figure 5). The question often asked by growers is, "How can I obtain a little additional growth?" The answer is Fresco.

### Additional tips for use:

1. Initially begin with the lower end of the recommended range.
2. The initial rate range should be between 1 to 3 ppm. Never apply 10 ppm or excessive stretch can occur.
3. Allow up to seven days to determine if you increased plant growth before making a second application.
4. Many growers will use half of the initial rate applied if the plants fail to take off.
5. Excessive rates will result in undesirable stretch and often requiring an application of an anti-gibberellin plant growth regulator, such as Piccolo 10XC, to check the elongation.
6. 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.
7. Drench applications will only work if the plant has adequate roots for Fresco uptake.
8. Follow the label recommendations, for it's the law. 

Figure 5. Plant growth can be stalled by many factors. In this case, an excessively high rate of flurprimidol was applied to the mum plants that resulted in a tight mounding habit.

Figure 6. Too high of a rate will result in excessive stem or peduncle stretch. As a test, the grower applied 10 ppm to a plant to determine the results.

Figure 7. Excessive peduncle stretch, which resulted from a 10-ppm foliar spray.

Figure 5



Figure 6



Figure 7



# 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 sprench 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 custom-

## 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.

ize 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 10% 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. 🍷

# Wide Assortment of Available PGRs

Brian E. Whipker, North Carolina University & Joyce G. Latimer, Virginia Tech

## 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). Below 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 are not 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 **Cycocel**)

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.

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

Chemical	Products
Ancymidol	<b>Abide</b> , A-Rest
Chlormequat chloride	<b>Citadel</b> , Cycocel
Daminozide	<b>Dazide</b> , B-Nine
Dikegulac sodium	Augeo
Ethephon	<b>Collate</b> , Florel
Flurprimidol	Topflor
Paclobutrazol	<b>Piccolo</b> , <b>Piccolo 10 XC</b> , Bonzi, Paczol, Downsize (drenches only)
Uniconazole	<b>Concise</b> , Sumagic
Benzyladenine (BA)	<b>Configure</b>
Gibberellin (GA <sub>3</sub> )	<b>Florgib</b> , ProGibb T&O
BA+GA <sub>4+7</sub>	<b>Fresco</b> , Fascination

### 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.

### Dikegulac sodium

(Commercial name: **Augeo**)

Augeo is registered for greenhouse and nursery use. Augeo temporarily stops shoot elongation, thereby promoting lateral branching. It's thus a pinching agent for ornamental crops including azaleas, bougainvillea, clerodendron, fuchsia, grape ivy, geranium, lantana, lipstick vine, verbena and some of the herbaceous perennials. Some phytotoxicity and distorted growth can occur with Augeo, so sufficient time is required to allow new plant growth to cover any damaged leaves. ►

**Table 2. Comparing Attributes of Plant Growth Regulators**

ATTRIBUTES	PLANT GROWTH REGULATOR							
	Chemical	Ancymidol	Chlormequat chloride	Daminozide	Daminozide + Chlormequat chloride	Ethephon	Flurprimidol	Paclobutrazol
Trade name(s)	<b>Abide, A-Rest</b>	<b>Citadel, Cycocel</b>	<b>Dazide, B-Nine</b>	—	<b>Collate, Florel</b>	<b>Topflor</b>	<b>Piccolo, Piccolo 10 XC, Bonzi, Downsize, Paczol</b>	<b>Concise, Sumagic</b>
Active ingredient (%)	0.0264%	11.8%	85%	—	21.7%/3.9%	0.38%	0.4% 4% (Piccolo 10 XC)	0.055%
<b>Activity level</b>	++	+	+	++	+	+++	+++	+++
<b>Multiple applications needed</b>	++	+++	+++	++	++	+	+	+
<b>Application type<sup>1</sup></b>								
Foliar spray	yes	yes	yes	yes	yes	yes	yes <sup>1</sup>	yes
Substrate drench	yes	yes	no	no	no	yes	yes	yes
Dips/Soaks	plugs/liners	plugs/liners	cuttings	-	plugs/liners	bulbs, plugs/liners	bulbs, plugs/liners	bulbs, plugs/liners
<b>Chemical absorption</b>								
Ease of absorption	+++	+	+	+	++	+++	+++	+++
Time (hours)	0.5-1.0	4	18-24	18-24	12-16	0.5-1.0	0.5-1.0	0.5-1.0
Factors that improve absorption	high humidity, limited air movement, cloudy days, early morning or late afternoon applications							
Translocation within the plant	+++	+++	+++	+++	—	+	+	+
<b>Absorption sites</b>								
Leaves	+++	+++	+++	+++	+++	++	++	++
Stems	+	+	—	+	—	++	++	++
Roots	++	+	—	—	+	+++	+++	+++
<b>Typical concentrations</b>								
Foliar sprays (ppm or mg/L)	15-50	1,000-3,000	1,250-5,000	Daminozide: 750-5,000 + Chlormequat 750-1,500	250-1,000	1-80	1-200	0.5-50
Drench (mg active ingredient per pot)	0.15-4.0 (1.25 to 33.8 ppm)	177-355 (1,500 to 3,000 ppm)	—	—	6-30 <sup>2</sup> (50 to 250 ppm)	0.01-2.0 (0.08 to 17 ppm)	0.01-8.0 (0.1 to 68 ppm)	0.01-1.0 (0.1 to 11 ppm)
<b>Other factors</b>								
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
<b>Shelf life</b>								
In the bottle (years)	<3	<2	<2	—	indefinite	<4	<4	<2
Mixed solution	within 24 hours	within 24 hours	within 24 hours	within 24 hours	within 4 hours	within 24 hours	within 1 week	within 24 hours

-- = Not applicable.

Degree of activity: (+) least to (++++) greatest

<sup>1</sup> Check label for legal uses

<sup>2</sup> Not yet available; pending label revision.

## Ethephon phosphonic acid

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

This material is absorbed by the plant tissue, and due to a change in pH once absorbed into the plant cells, releases ethylene. Collate and Florel are used to promote flower bud abortion and vegetative branching in crops. Collate and Florel are applied as a foliar spray at concentrations of 250 to 500 ppm. Drenches are also effective, but ethephon is not labeled for this use as of January 2016. See page 3 for the latest research on using drenches.

## 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 **Paczol**)

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 or as a substrate drench. 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.

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.

Not all plant growth regulators are used to control plant height. Others are used to cause flower bud abscission, increase branching, promote flowering and stimulate shoot elongation.

## 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 does not 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.

## 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 are also used to overcome the effects of an over-application of gibberellin-inhibiting plant growth retardants. 



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# Additional Benefits of PGRs

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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/Cycocel), daminozide (B-Nine/Dazide), flurprimidol (Topflor), and uniconazole (Concise/Sumagic). Chemicals that have a different mode of action—such as Augeo, Configure, Florel, Collate, Fascination or Fresco—don't have these added attributes so this article doesn't apply to them.

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

## 1. Greener leaves

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

First of all, with a PGR application, the new plant cells don't expand as much, so they're smaller. Smaller cells mean that the chlorophyll contained in the leaves is more densely packed, which makes the leaves darker green. In addition, ap-

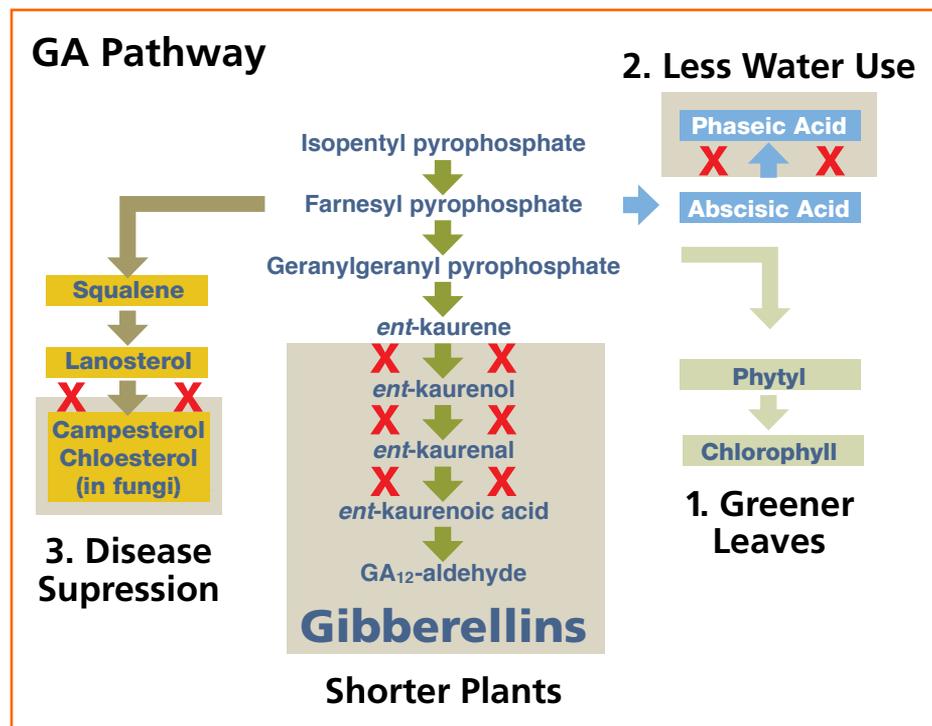
plying a PGR—which blocks the GA pathway—results in some secondary effects. In this case, an up-regulation, or increase, in the amount of chlorophyll produced by the plant (Figure 1).

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

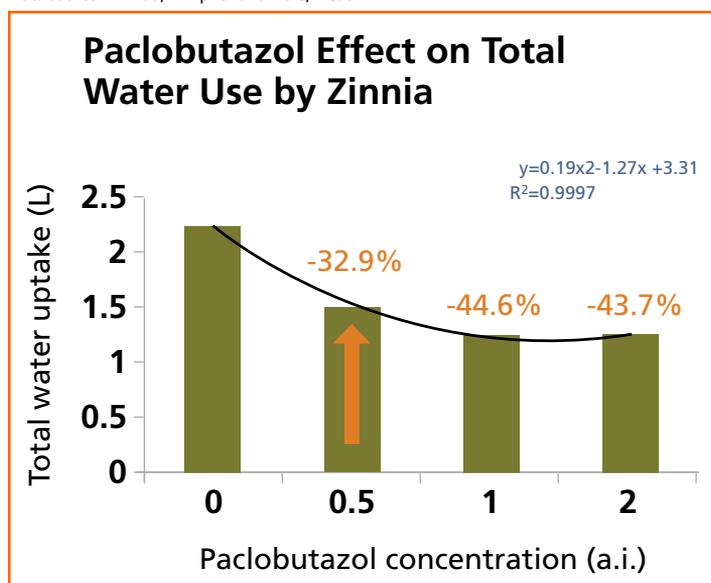


Figure 4. Based on a height control experiment, one can clearly see powdery mildew starting to infect the untreated plant on the left, while the plant on the right had been given a PGR drench about 4 weeks prior to this date and a powdery mildew infection had been reduced. PGRs will not provide season-long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

# Growth Regulators for Floricultural Crops in Greenhouses

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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](http://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/Cycocel	750 to 1,500 ppm spray	
		Dazide/B-Nine	2,500 ppm spray	Rate for use on plugs.
		Piccolo/Piccolo 10 XC/ Bonzi/Paczol	5 ppm spray	Can be applied once plant fills the pot, 2 to 3 weeks after transplanting.
	To increase branching	Florell/Collate	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/Paczol/Downsize	0.5 to 1 ppm drench	Apply to moderately moist substrate.
ACHMELLA OLERAEA	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Paczol	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/Cycocel+B-Nine	3,000 ppm + 1,500 ppm spray	Rates for compact genetics needing slight growth control.
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/Paczol	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/ Cyclocel	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.
AGERATUM, Plugs	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Paczol	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.

Disclaimer: The information and listed table rates of plant growth regulators are current as of January 2015. 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.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>ALCEA ROSEA</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	30 to 50 ppm spray	
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol/ Downsize</b>	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	
<b>ALTERNANTHERA (Joseph's coat)</b>	To control plant growth		25 to 132 ppm spray	
		<b>Abide/A-Rest</b>	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.
		<b>Citadel/Chlormequat E-Pro/ Cyclocel</b>	Spray	Apply only if needed. Not recommended on some cultivars due to potential phytotoxicity.
		<b>Dazide/B-Nine</b>	5,000 ppm spray	
		<b>Florel/Collate</b>	500 ppm spray	To keep plants more compact. Based on Texas A&M University trials.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol/Downsize</b>	30 to 45 ppm spray 4 ppm drench	Rate for <i>Alternanthera dentata</i> . To keep plants more compact. Apply to moderately moist substrate
<b>ALYSSUM</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	40 to 60 ppm spray	
		<b>Concise/Sumagic</b>	5 to 25 ppm spray	
		<b>Dazide/B-Nine</b>	2,500 ppm spray	
<b>ALYSSUM, Plugs</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	10 to 20 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
<b>AMARYLLIS</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	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	
<b>ANAGALLIS</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol/Downsize</b>	0.5 ppm drench	To keep plants more compact. Apply to moderately moist substrate.
<b>ANEMONE</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol/Downsize</b>	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.
<b>ANGELONIA</b>	To control plant growth	<b>Citadel + Dazide/Cycocel + B-Nine</b>	1,500 to 3,000 ppm Dazide/B-Nine + 750 to 1,000 ppm Citadel/Cycocel applied as a tank-mix spray	At planting, soft pinch to promote lateral shoot development.
		<b>Citadel/Cycocel</b>	1,500 ppm spray	
		<b>Concise/Sumagic</b>	10 to 20 ppm spray	Based on NC State University trials.
		<b>Dazide/B-Nine</b>	3,000 ppm spray	
		<b>Florel/Collate</b>	Spray	Not recommended.
		<b>Topflor</b>	45 to 60 ppm spray	Based on NC State University trials.
<b>AQUILEGIA</b>	To control plant growth	<b>Dazide/B-Nine</b>	3,000 to 5,000 ppm spray	

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
ARGYRANTHEMUM	To control plant growth	Citadel/Cycocel	750 to 1,500 ppm spray	
		Citadel+Dazide/Cycocel+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/Paczol	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/Florel	500 ppm spray	Apply one week after establishment.	
ASCLEPIAS	To control plant growth	Piccolo/Piccolo 10 XC/ Bonzi/Paczol	30 to 60 ppm 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/Paczol	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/Cycocel	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/Paczol	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.
	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/ Cyclocel	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.

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>AZALEA</b> <i>continued</i>	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.
		<b>Florgib</b> /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.
		<b>Florgib</b> /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-0	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	3,125 to 6,250 ppm spray	
		<b>Florel/Collate</b>	2,500 to 5,000 ppm spray	
	To control plant growth, reduce bypass shoot elongation and promote flower bud initiation	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	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.
<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol/ 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	<b>Concise</b> /Sumagic	10 to 15 ppm spray	Apply at 1.5 qt per 100 sq. ft. of bench area.	
<b>BACOPA (SUTERA)</b>	To control plant growth	<b>Dazide</b> /B-Nine	750 to 1,500 ppm spray	At planting, soft pinch to promote lateral shoot development. Initially try with lower rate.
		<b>Piccolo</b>	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.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	1 to 2 ppm drench	
		<b>Florel/Collate</b>	150 to 200 ppm spray	Early spray will increase branching and reduce early flowering.
	To increase lateral branching	<b>Florel/Collate</b>	150 to 200 ppm spray	
<b>BEDDING PLANTS</b> <b>(Not specifically listed in this table)</b>	To control plant growth	<b>Abide</b> /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.
		<b>Citadel + Dazide</b> /Cycocel + B-Nine	800 to 5,000 ppm + 1,000 to 1,500 ppm Cycocel applied as a tank-mix spray	Use the highest rate of Cycocel that doesn't cause excessive leaf yellowing, and then adjust the B-Nine/Dazide rate up and down within the labeled range to attain the desired level of height control.
		<b>Piccolo</b> /Bonzi/Paczol	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.

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>BEDDING PLANTS</b> (Not specifically listed in this table) <i>continued</i>	To control plant growth	<b>Piccolo</b> /Bonzi/Paczol/ 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.
		<b>Citadel</b> /Cycocel	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.
		<b>Concise</b> /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	
		<b>Piccolo 10 XC</b>	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	<b>Florgib</b> /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.
			<b>Fresco</b> /Fascination	1 to 25 ppm spray
	To induce lateral or basal branching	<b>Configure</b>	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.
	<b>BEDDING PLANT PLUGS</b> (Not specifically listed in this table)	To control plant growth	<b>Abide</b> /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.
<b>Dazide</b> /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.	
<b>Citadel + Dazide</b> /Cycocel + B-Nine		800 to 5,000 ppm Dazide/B-Nine + 1,000 to 1,500 ppm Citadel/Cycocel applied as a tank-mix spray	Use the highest rate of Citadel/Cycocel that doesn't cause excessive leaf yellowing and then adjust the B-Nine/Dazide rate up and down within the labeled range to attain desired level of height control.	
<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol		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.	
<b>Citadel</b> /Cycocel		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.	
<b>Concise</b> /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.	

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>BEGONIA, Hiemalis (Elatior)</b>	To control plant growth	<b>Citadel</b> /Cycocel	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	781 to 1,562 ppm spray	
<b>BEGONIA, Seed (Wax)</b>	To control plant growth	<b>Abide</b> /A-Rest	3 to 15 ppm spray	Use lower half of rate range for plugs and upper range for finishing plants.
		<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
		<b>Florel/Collate</b>	500 ppm spray	Apply to increase lateral branching, prevent flower initiation and development, and inhibit internode elongation.
		<b>Concise</b> /Sumagic	Sprays	Not registered for use. Can result in excessive control.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	Sprays	Not registered for use. Can result in excessive control.
		Topflor	Sprays	Not registered for use. Can result in excessive control.
		<b>Citadel</b> /Cycocel	500 ppm spray	
		<b>Citadel + Dazide</b> /Cycocel + B-Nine	1,000 to 1,250 ppm Dazide/B-Nine +800 to 1,250 ppm Citadel/Cycocel applied as a tank-mix spray	
<b>BEGONIA, Tuberous</b>	To control plant growth	<b>Citadel</b> /Cycocel	250 to 500 ppm spray	Rate can be used on Stage 4 plugs or beginning 2 weeks after transplanting.
		<b>Citadel</b> /Cycocel	1,000 ppm spray	Rate for actively growing plants.
		<b>Dazide</b> /B-Nine	2,500 ppm spray	Rate for actively growing plants.
<b>BEGONIA, Vegetative</b>	To control plant growth	<b>Citadel</b> /Cycocel	750 to 1,000 ppm spray	
<b>BEGONIA, Vegetative (Dragon Wing)</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	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.
<b>BELLIS</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 ppm spray	If needed.
		<b>Concise</b> /Sumagic	5 ppm spray	If needed.
<b>BIDENS</b>	To control plant growth	<b>Dazide</b> /B-Nine	1,500 to 2,500 ppm spray	At planting, soft pinch to promote lateral shoot development.
		<b>Concise</b> /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	<b>Florel/Collate</b>	300 to 500 ppm spray	
<b>BOUGAINVILLEA</b>	To control plant growth	<b>Abide</b> /A-Rest	50 ppm drench	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	25 to 100 ppm drench	
	To increase lateral branching	Augeo	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.	
<b>BRACHYSCOME</b>	To control plant growth	<b>Florel/Collate</b>	500 to 1,000 ppm spray	To keep plants more compact. Based on Texas A&M University trials.
		<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>BRACTEANTHA, BRACTEATA</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 ppm spray	
		<b>Piccolo</b> /Bonzi/Paczol	20 to 30 ppm spray	
			1 ppm drench	
	<b>Concise</b> /Sumagic	10 to 20 ppm spray		
	To increase lateral branching	<b>Florel</b> / <b>Collate</b>	300 to 500 ppm	
<b>BROMELIAD</b>	To promote flower initiation	<b>Florel</b> / <b>Collate</b>	2,471 ppm spray	Cultivar response rates vary. Conduct your own trials to determine suitability and appropriate timing.
<b>BROWALLIA</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
<b>BULB CROPS (Not specifically listed in this table)</b>	To control plant growth	<b>Abide</b> /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.
		<b>Piccolo</b> / <b>Piccolo 10 XC</b> /Bonzi/Paczol	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.
		<b>Concise</b> /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.	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.
	<b>CALADIUM</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray
<b>Piccolo</b> /Bonzi/Paczol/ 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.
<b>Piccolo</b> /Bonzi/Paczol			60 ppm tuber soak	Soak tubers for 30 min. prior to planting.
<b>Piccolo 10 XC</b>			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.
<b>Topflor</b>	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.		

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>CALCEOLARIA</b>	To control plant growth	<b>Citadel</b> /Cycocel	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.
		<b>Dazide</b> /B-Nine	1,000 to 1,500 ppm spray	Used to control internode length.
<b>CALENDULA</b>	To control plant growth	<b>Dazide</b> /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.
		<b>Concise</b> /Sumagic	1 ppm spray	Plugs: Use at Stages 2 or 3.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	4 ppm spray	Plugs: Use at Stages 2 or 3.
<b>CALIBRACHOA</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	At planting, soft pinch to promote lateral shoot development. Multiple applications may be required.
		<b>Citadel + Dazide</b> /Cycocel + B-Nine	2,500 ppm Dazide + 500 to 1,500 ppm Citadel applied as a tank-mix spray	
		<b>Concise</b> /Sumagic	10 to 25 ppm spray	Try lower rate initially. Apply 2 weeks after transplanting.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	3 to 50 ppm spray	Use rates of 3 to 5 ppm for compact genetics needing slight growth control.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol/Downsize	3 to 8 ppm drench	Rates for compact genetics needing slight growth control. Begin with 1 to 2 ppm to determine suitable rates.
		<b>Florel/Collate</b>	300 to 500 ppm spray	Early spray will increase branching and reduce early flowering.
		Topflor	5 to 10 ppm spray	
<b>CALLA LILY (Zantedeschia)</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol/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.
		<b>Piccolo</b> /Bonzi/Paczol	20 ppm rhizome/tuber soak	Soak the rhizomes/tubers for 15 min. prior to planting.
		<b>Concise</b> /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	<b>Florgib</b> /ProGibb T&O	500 ppm rhizome/tuber soak	Soak the rhizomes or tubers for 10 min. prior to planting. See label for details.
<b>CAMPANULA</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	Use at visible bud.
		Topflor	10 to 30 ppm spray	Use at visible bud.
<b>CANNA LILY</b>	To control plant growth	Topflor	50 to 80 ppm spray	
<b>CELOSIA</b>	To control plant growth	<b>Abide</b> /A-Rest	7 to 26 ppm spray	
		<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	15 to 45 ppm spray	
		<b>Citadel</b> /Chlormequat E-Pro/Cyclocel	800 to 1,500 ppm spray	
		<b>Concise</b> /Sumagic	10 to 20 ppm spray	
		Topflor	10 to 40 ppm spray	Based on NC State University trials. Adjust rates for other locations.
<b>CELOSIA, Plugs</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	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
<b>CENTAUREA</b>	To control plant growth	<b>Abide/A-Rest</b>	10 to 15 ppm spray	
		<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	
<b>CENTRADENIA HYBRID</b>	To control plant growth	None	None	Plants grown with good light and optimal growing conditions generally do not need PGRs.
<b>CHRISTMAS CACTUS (Schlumbergera spp.)</b>	To increase branching under vegetative conditions	<b>Configure</b>	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	<b>Configure</b>	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.
<b>CHRYSANTHEMUM, Cut</b>	To reduce "neck" stretching	<b>Dazide/B-Nine</b>	2,500 ppm spray	Spray upper foliage 5 weeks after start of short-day treatment.
	To elongate peduncles of pompom-type mums	<b>Florgib/ProGibb T&amp;O</b>	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.
<b>CHRYSANTHEMUM, Perennial</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/Bonzi/Paczol</b>	50 to 200 ppm spray	
		<b>Piccolo/Piccolo 10 XC/Bonzi/Paczol/Downsize</b>	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	
<b>CHRYSANTHEMUM, Potted</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
		<b>Dazide/B-Nine</b>	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.
		<b>Piccolo/Piccolo 10 XC/Bonzi/Paczol</b>	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.
		<b>Piccolo/Piccolo 10 XC/Bonzi/Paczol/Downsize</b>	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.
		<b>Concise</b>	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.

## Growth Regulators for Floricultural Crops in Greenhouses

GROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>CHRYSANTHEMUM, Potted</b> <i>continued</i>	To control plant growth	<b>Concise</b> /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.
<b>CHRYSANTHEMUM, Garden</b>	To control plant growth	<b>Concise</b>	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.
		<b>Concise</b> /Sumagic	2.5 to 10 ppm spray	
	To increase lateral branching	Florel/ <b>Collate</b>	500 ppm spray	Florel and Collate applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.
<b>CHRYSOCEPHALUM APICULATUM</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 ppm spray	Plants pinched and grown with good light and optimal growing conditions generally do not need PGRs.
<b>CLARKIA (Godetia)</b>	To control plant growth	<b>Concise</b> /Sumagic	15 to 25 ppm drench	Trial rates for cultivar response. Rates based on older cultivars.
		<b>Dazide</b> /B-Nine	3,000 ppm foliar spray	Trial rates for cultivar response. Rates based on older cultivars.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	20 to 30 ppm drench	Trial rates for cultivar response. Rates based on older cultivars.
<b>CLEMATIS</b>	To control plant growth	<b>Abide</b> /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.
<b>CLEOME</b>	To control plant growth	<b>Abide</b> /A-Rest	7 to 26 ppm spray	
		<b>Citadel</b> /Chlormequat E-Pro/Cyclocel	800 to 1,500 ppm spray	
		<b>Dazide</b> /B-Nine	4,000 to 5,000 ppm spray	Multiple applications may be required. Make them at 7- to 10-day intervals.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	20 to 30 ppm spray	Multiple applications may be required. Make them at 7- to 10-day intervals.
<b>CLERODENDRUM</b>	To control plant growth	<b>Abide</b> /A-Rest	50 ppm spray	
			0.9 mg a.i. drench	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	100 ppm drench	
			0.5 mg a.i. drench	
	To increase lateral branching	Augeo	1,042 to 2,083 ppm spray	
<b>COLEUS PLUGS, Seed</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
<b>COLEUS, Seed</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	15 to 30 ppm spray	
		<b>Citadel</b> /Chlormequat E-Pro/Cyclocel	400 to 3,000 ppm spray	
		<b>Concise</b> /Sumagic	10 to 20 ppm spray	
		Topflor	20 to 40 ppm spray	Based on NC State University trials. Adjust rates for other locations.

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>COLEUS, Vegetative</b>	To control plant growth	<b>Citadel + Dazide/Cycocel + B-Nine</b>	2,500 to 4,000 ppm + 1,000 to 1,500 ppm Cycocel applied as a tank-mix spray	See General Recommendations. Scheduling the crop to avoid excessive stretch is the most effective means of controlling growth.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	5 to 30 ppm spray	
			1 to 2 ppm drench	
		<b>Citadel/Chlormequat E-Pro/ Cyclocel</b>	800 to 1,500 ppm spray	
		<b>Concise/Sumagic</b>	5 to 20 ppm spray	Use rates of 5 to 10 ppm for compact genetics needing slight growth control.
<b>Collate/Florei</b>	500 ppm spray			
<b>COLUMBINE</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
<b>CONFLOWER (Echinacea spp.)</b>	To control plant growth	<b>Concise/Sumagic</b>	30 to 40 ppm spray	
	To increase branching	<b>Configure</b>	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.
<b>CONSOLIDA (Larkspur)</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
		<b>Concise/Sumagic</b>	5 ppm drench	
		<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	30 to 60 ppm spray	
<b>CONSOLIDA, Cut (Larkspur)</b>	To promote growth and stem elongation	<b>Florgib/ProGibb T&amp;O</b>	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.
<b>COREOPSIS</b>	To control plant growth	<b>Concise/Sumagic</b>	2 to 4 ppm spray	Rates for compact genetics needing slight growth control.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	3 to 100 ppm spray	Use rates of 3 to 6 ppm for compact genetics needing slight growth control.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol/Downsize</b>	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.
		<b>Topflor</b>	2 to 4 ppm spray	Rates for compact genetics needing slight growth control.
<b>CORNFLOWER (Centaurea)</b>	To control plant growth	<b>Abide/A-Rest</b>	7 to 26 ppm spray	
		<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	
<b>COSMOS</b>	To control plant growth	<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	
<b>CROSSANDRA</b>	To control plant growth	<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	Apply after pinch when new growth is 2-in. long.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	50 ppm spray	Apply 2 weeks after pinch.
<b>CUPHEA</b>	To control plant growth	<b>Dazide/B-Nine</b>	1,500 to 2,500 ppm spray	PGRs not required on compact cultivars.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	1 to 5 ppm spray	Initially, test on a few plants to determine rate for optimum control. Cuphea is sensitive to excessive rates.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol/Downsize</b>	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.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>DAFFODIL</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol/Downsize</b>	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.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	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.
		<b>Florel/Collate</b>	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.
<b>DAHLIA, Bedding Plant</b>	To control plant growth	<b>Abide/A-Rest</b>	7 to 26 ppm spray	
		<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	
		<b>Citadel + Dazide/Cycocel + B-Nine</b>	2,500 to 4,000 ppm + 1,000 to 1,500 ppm Cycocel applied as a tank-mix spray	
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	15 to 45 ppm spray	
		<b>Citadel/Chlormequat E-Pro/ Cyclocel</b>	800 to 1,500 ppm spray	
		<b>Concise/Sumagic</b>	10 to 20 ppm spray	
<b>DAHLIA PLUGS, Bedding Plant</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
<b>DAHLIA, Tuberous</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol/Downsize</b>	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	
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	Greater than 40 ppm tuber soak	Soak tubers for 20 min. prior to planting.
		<b>Concise/Sumagic</b>	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.
<b>DELPHINIUM</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
		<b>Concise/Sumagic</b>	5 ppm drench	
		<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	30 to 60 ppm spray	
<b>DELPHINIUM, Cut</b>	To promote plant growth and stem elongation	<b>Florgib/ProGibb T&amp;O</b>	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.
<b>DIANTHUS, Bedding Plant</b>	To control plant growth	<b>Abide/A-Rest</b>	7 to 26 ppm spray	
		<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	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.
		<b>Citadel/Chlormequat E-Pro/ Cyclocel</b>	800 to 1,500 ppm spray	
		<b>Concise/Sumagic</b>	3 to 5 ppm spray	

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>DIANTHUS PLUGS, Bedding plant</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	10 to 20 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
<b>DIANTHUS, Cut</b>	To promote plant growth and stem elongation	<b>Florgib/ProGibb T&amp;O</b>	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.
<b>DIANTHUS, Pot</b>	To control plant growth	<b>Concise/Sumagic</b>	15 ppm spray	
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	15 ppm spray	
<b>DIASCIA Hybrid</b>	To control plant growth	<b>Dazide/B-Nine</b>	1,250 to 5,000 ppm	At planting, soft pinch to promote lateral shoot development. Use higher rates on vigorous cultivars.
		<b>Concise/Sumagic</b>	5 to 15 ppm spray	Use lower rates to ensure taller flower spikes.
		<b>Florel/Collate</b>	200 to 500 ppm spray	Use 2 weeks after pinch.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	30 ppm spray 1 to 2 ppm drench	
<b>DIASCIA, Seed</b>	To control plant growth	<b>Abide/A-Rest</b>	20 ppm spray	Start application 7 to 10 days after transplant. Repeat 7 days later.
		<b>Concise/Sumagic</b>	5 to 10 ppm spray	To hold plants under warm conditions. Use caution, plants very responsive.
		<b>Dazide/B-Nine</b>	3,000 to 5,000 ppm spray	Start application 7 to 10 days after transplant.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	10 to 20 ppm spray	To hold plants under warm conditions. Use caution, plants very responsive.
<b>DICENTRA SPECTABILIS (Bleeding Heart)</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
		<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	Apply as new sprouts emerge from the pot. Repeat if needed due to non-uniform emergence.
<b>DICHONDRA ARGENTEA</b>	To control plant growth	<b>Citadel+Dazide/Cycocel+B-Nine</b>	1,000 ppm + 5,000 ppm spray	Also increases branching and improves silver color.
		<b>Dazide/B-Nine</b>	5,000 ppm spray	Also increases branching and improves silver color. Apply 2 weeks after transplanting.
<b>DIGITALIS</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	80 to 160 ppm spray	
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol/Downsize</b>	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	
<b>DOROTHEANTHUS BELLIDIFORMIS</b>	To control plant growth	None	None	Plants pinched and grown with good light and optimal growing conditions generally do not need PGRs.
<b>DRACAENA</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
<b>DUSTY MILLER (Senecio cineraria)</b>	To control plant growth	<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	
		<b>Concise/Sumagic</b>	30 ppm spray	
<b>EASTER LILY (See Lily, Easter)</b>				
<b>ECHEVERIA spp</b>	To induce offsets and induce flower development	<b>Configure</b>	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.

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>EGGPLANT</b>	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.
<b>ERYSIMUM</b>	To control plant growth	None	None	Plants grown with good light and optimal growing conditions generally do not need PGRs.
<b>EUPATORIUM</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	>240 ppm spray	
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol/Downsize</b>	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	
<b>EUPHORBIA HYPERICIFOLIA HYBRID</b>	To control plant growth	<b>Dazide/B-Nine</b>	2,500 ppm spray	Plant growth slow early on. Apply PGRs if control is needed.
		<b>Citadel+Dazide/Cycocel+B-Nine</b>	750 ppm + 2,500 ppm spray	
		<b>Florel/Collate</b>	Spray	Not recommended.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	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.
<b>EVOLVULUS</b>	To control plant growth	None	None	Plants grown with good light and optimal growing conditions generally do not need PGRs.
<b>EXACUM</b>	To control plant growth	<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	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.			
<b>FATSHEDERA</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
<b>FELICIA</b>	To control plant growth	<b>Citadel+Dazide/Cycocel+B-Nine</b>	1,000 to 1,500 ppm + 2,500 to 4,000 ppm spray	Pinch plant as needed to improve shape.
		<b>Citadel/Cycocel</b>	1,500 ppm spray	Applied to pinched plants.

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>FLOWERING/ FOLIAGE PLANTS, Herbaceous Species (Not specifically listed in this table)</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	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.
		<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol/Downsize</b>	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.
		<b>Citadel/Cycocel</b>	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 Cycocel 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 Cycocel are listed above.	
	<b>Concise/Sumagic</b>	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	<b>Florgib/ProGibb T&amp;O</b>	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.
			<b>Fresco/Fascination</b>	1 to 25 ppm spray
To induce lateral or basal branching	<b>Configure</b>	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.	
<b>FLOWERING/ FOLIAGE PLANTS, Woody Species (Not specifically listed in this table)</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
	<b>Dazide/B-Nine</b>	2,500 to 7,500 ppm spray	Two or more applications may be necessary if new growth begins to stretch or for enhanced coloration.	
	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol</b>	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.	
	<b>Piccolo/Piccolo 10 XC/ Bonzi/Paczol/Downsize</b>	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.	

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>FLOWERING/ FOLIAGE PLANTS, Woody Species (Not specifically listed in this table)</b> <i>continued</i>	To control plant growth	<b>Citadel</b> /Cycocel	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 Cycocel 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 Cycocel are listed above.
		<b>Concise</b> /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.
<b>FREESIA</b>	To control plant growth	<b>Abide</b> /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.
		<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol/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.
		<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol	50 to 200 ppm corm soak	Soak corms in the solution for 1 hour before planting. Cultivar response varies, so conduct your own trials.
<b>FUCHSIA</b>	To control plant growth	<b>Abide</b> /A-Rest	25 to 75 ppm spray	May also increase flowering.
		<b>Dazide</b> /B-Nine	1,250 to 2,500 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol	5 to 10 ppm spray	Make applications prior to visible bud to avoid delay.
		<b>Concise</b> /Sumagic	2 to 5 ppm spray	Make applications prior to visible bud to avoid delay.
	To increase lateral branching	Augeo	781 to 2,343 ppm spray	
		<b>Florel/Collate</b>	500 ppm spray	Florel and Collate 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	<b>Florgib</b> /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.	
<b>GARDENIA</b>	To control plant growth	<b>Abide</b> /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.
		<b>Dazide</b> /B-Nine	5,000 ppm spray	Spray when plants are at two-thirds final market size.
		<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol	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	2,343 to 4,687 ppm spray		
<b>GAURA</b>	To control plant growth	<b>Dazide</b> /B-Nine	3,000 to 4,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol	30 to 50 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol/Downsize	3.54 mg a.i. (30 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
		<b>Concise</b> /Sumagic	10 to 30 ppm spray	

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>GAZANIA</b>	To control plant growth	<b>Citadel</b> /Chlormequat E-Pro/ Cyclocel	1,500 ppm spray	Make applications prior to visible bud to avoid delay.
		<b>Dazide</b> /B-Nine	2,500 ppm spray	Make applications prior to visible bud to avoid delay.
<b>GERANIUM</b>	To control plant growth	<b>Abide</b> /A-Rest	26 to 66 ppm spray	See AGERATUM.
		<b>Piccolo</b> /Bonzi/Paczol	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.
		<b>Concise</b>	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.
		<b>Citadel</b> /Chlormequat E-Pro/ Cyclocel	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.
		<b>Piccolo 10 XC</b>	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.
		<b>Concise</b> /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	<b>Citadel</b> /Chlormequat E-Pro/ Cyclocel	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.
		<b>Florgib</b> /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	<b>Florgib</b> /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.
To increase lateral branching	Florel/ <b>Collate</b>	300 to 500 ppm spray	Labeled for zonal and ivy geraniums. Use the lower concentration for ivy geraniums. Florel and Collate will also provide some growth retardant effect and delay flowering. Read the label for restrictions on timing of applications.	
<b>GERANIUM, IVY</b>	To control plant growth	<b>Citadel</b> /Chlormequat E-Pro/ Cyclocel	750 to 1,500 ppm spray	
	To increase branching	Augeo	1,562 ppm spray	Labeled for ivy geraniums only.
		Florel/ <b>Collate</b>	200 to 300 ppm spray	
<b>GERANIUM, Seed</b>	To promote earlier flowering	<b>Citadel</b>	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	<b>Concise</b>	2 to 4 ppm spray	Apply when plant height is approximately 4 in. tall.
<b>GERBERA DAISY</b>	To control plant growth	<b>Abide</b> /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.
		<b>Dazide</b> /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.

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>GLADIOLUS</b>	To control plant growth	<b>Abide</b> /A-Rest	1.5 mg drench per 0.5 gal. pot	For container-grown plants.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	2.5 to 5.0 mg drench per 0.5 gal. pot	For container-grown plants.
<b>GLOXINIA</b> ( <i>Sinningia speciosa</i> )	To control peduncle length	<b>Dazide</b> /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.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	30 ppm spray	Can be applied when buds grow above the foliage.
			4 to 8 ppm drenches	For elongation control late in the season (10 weeks after transplant).
<b>GOMPHRENA</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
		<b>Citadel</b> /Chlormequat E-Pro/Cyclocel	800 to 1,500 ppm spray	
<b>GOODENIA</b>	To control plant growth	None	None	Plants grown with good light and optimal growing conditions generally do not need PGRs.
<b>GRAPE IVY</b>	To increase lateral branching	Augeo	781 to 1,562 ppm spray	
<b>GROUNDCHERRY</b>	To control plant growth	<b>Concise</b> /Sumagic	2 to 10 ppm spray	See precautions listed with EGGPLANT.
<b>GYPSOPHILA</b>	To accelerate plant growth, increase stem and flower number and increase flower uniformity	<b>Florgib</b> /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.
<b>HELENIUM AMARUM</b>	To control plant growth	<b>Dazide</b> /B-Nine	5,000 ppm spray	Apply after plant established (2 weeks after transplant).
<b>HELICHRYSUM PETIOLARE/H. ITALICUM</b> (Licorice plant)	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	1 ppm drench	Plants grown with good light and optimal growing conditions generally do not need PGRs.
	To increase lateral branching	<b>Florel/Collate</b>	300 to 500 ppm spray	Make first application after 2 weeks. Repeat in 2 weeks if needed (with larger pots).
<b>HELICONIA</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	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.
<b>HELIOTROPIUM ARBORESCENS</b>	To control plant growth	<b>Citadel</b> /Chlormequat E-Pro/Cyclocel	500 ppm spray	Rate for compact genetics needing slight growth control.
		<b>Citadel+Dazide</b> /Cycocel+B-Nine	750 to 1,000 ppm + 1,500 to 3,000 ppm spray	Rate for compact genetics needing slight growth control.
<b>HIBISCUS MOSCHEUTOS</b>	To control plant growth	<b>Citadel</b> /Cycocel	1000 ppm foliar spray	Multiple applications may be required.
		<b>Concise</b> /Sumagic	15 ppm foliar spray	

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>HIBISCUS ROSA-SINENSIS</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol	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.
		<b>Concise</b>	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.
		<b>Citadel</b> /Chlormequat E-Pro/ Cyclocel	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.
		<b>Concise</b> /Sumagic	0.025 to 0.2 mg a.i. drench per pot	
<b>HOLLY</b>	To control plant growth	<b>Abide</b> /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.
<b>HOLLYHOCK</b>	To control plant growth	<b>Piccolo</b> /Bonzi/Paczol	30 to 50 ppm spray	
		<b>Concise</b> /Sumagic	5 to 40 ppm spray	
<b>HOSTA</b>	To promote lateral growth on finished plants	<b>Configure</b>	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	<b>Configure</b>	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.
<b>HYACINTH</b>	To reduce stem topple	<b>Flore</b> / <b>Collate</b>	1,000 ppm spray	To reduce stem topple at time of full flower, apply foliar spray before florets have opened.
	To control plant growth	<b>Piccolo</b> /Bonzi/Paczol	100 ppm bulb soak	Ten minute soaks provided excellent results in NC State University trials. Cultivar response varied.
		<b>Concise</b> /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.			
<b>HYBRID LILY (See Lily, Hybrid)</b>				
<b>HYDRANGEA</b>	To control plant growth	<b>Abide</b> /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.
		<b>Dazide</b> /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	

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>HYPOESTES</b>	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.
		<b>Citadel</b> /Cycocel	400 to 1,500 ppm spray	Initially apply after second set of leaves have developed. If needed, reapply 2 weeks later.
		<b>Dazide</b> /B-Nine	1,000 ppm spray	Initially apply after second set of leaves have developed. If needed, reapply 2 weeks later.
<b>IMPATIENS, Seed</b>	To control plant growth	<b>Abide</b> /A-Rest	10 to 44 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	10 to 45 ppm spray	
		<b>Concise</b> /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	<b>Florel/Collate</b>	100 to 300 ppm spray	Use if better branching needed.
<b>IMPATIENS PLUGS, Seed</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	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.
<b>IMPATIENS, Vegetative</b>	To control plant growth	<b>Piccolo</b> /Bonzi/Paczol	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.
		<b>Florel/Collate</b>	100 to 300 ppm spray	Will improve branching.
<b>IMPATIENS, Seashell-type</b>	To control plant growth	<b>Piccolo</b> /Bonzi/Paczol	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.
<b>IOCHROMA</b>	To control plant growth	<b>Dazide</b> /B-Nine	5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	2 ppm spray	
<b>IPOMOEA</b>	To control plant growth	<b>Concise</b> /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.
		<b>Dazide</b> /B-Nine	2,500 ppm spray	Apply as needed.
		<b>Florel/Collate</b>	500 to 1,000 ppm spray	Will improve branching and control growth.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	8 ppm drench	Applied to plugs prior to transplanting.
<b>IRISINE HYBRID</b>	To control plant growth	<b>Citadel+Dazide</b> /Cycocel+B-Nine	1,000 to 1,500 ppm + 2,500 to 4,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	5 to 10 ppm spray	
		<b>Piccolo/Piccolo 10XC</b> /Bonzi/Paczol/Downsize	1 to 3 ppm drench	
<b>JACOBINIA (Pink)</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	5 to 10 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol/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	
<b>JERUSALEM CHERRY (Solanum pseudocapsicum)</b>	To control plant growth	<b>Citadel</b> /Chlormequat E-Pro	800 to 1,500 ppm spray	
		<b>Citadel</b> /Cycocel	400 to 1,500 ppm spray	
	To promote stem elongation for topiary	<b>Florgib</b> /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.

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>KALANCHOE</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
		<b>Dazide/B-Nine</b>	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.
		<b>Piccolo/Piccolo 10 XC/Bonzi/Paczol</b>	2 to 4 ppm spray	Trial to determine optimal rates and timing for your location.
	To increase lateral branching	Augeo	1,042 to 2,343 ppm spray	
	To control peduncle length	<b>Dazide/B-Nine</b>	1,200 to 5,000 ppm spray	Phytotoxicity possible if B-Nine/Dazide accumulates in cupped areas of certain cupped-leafed varieties.
<b>LACHENALIA sp.</b>	To control plant growth	<b>Concise/Sumagic</b>	20 ppm corm soaks	Rates based on trials at Cornell University.
		<b>Piccolo/Piccolo 10 XC/Bonzi/Paczol</b>	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.
<b>LAMIUM</b>	To control plant growth	<b>Concise/Sumagic</b>	5 ppm spray	
		<b>Piccolo/Piccolo 10 XC/Bonzi/Paczol</b>	30 ppm spray	
			1 ppm drench	
	To increase lateral branching	<b>Collate/Florel</b>	500 ppm spray	Improves branching and produces compact growth.
<b>LANTANA</b>	To control plant growth	<b>Citadel + Dazide/Cycocel + B-Nine</b>	2,500 to 5,000 ppm + 1,000 to 1,500 ppm Cycocel applied as a tank-mix spray	Cultivar response varies.
		<b>Piccolo/Bonzi/Paczol</b>	20 to 40 ppm spray	
		<b>Concise/Sumagic</b>	10 to 20 ppm spray	
	To increase lateral branching	Augeo	781 to 1,562 ppm spray	
		<b>Florel/Collate</b>	500 ppm spray	Florel and Collate applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.
<b>LAURENTIA AXILLARIS</b>	To control plant growth	<b>Abide/A-Rest</b>	2 to 4 ppm spray	
		<b>Dazide/B-Nine</b>	2,500 ppm spray	
		<b>Piccolo/Piccolo 10 XC/Bonzi/Paczol</b>	1 to 2 ppm drench	
<b>LIATRIS</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
		<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	
<b>LILY, Easter</b>	To control plant growth	<b>Abide/A-Rest</b>	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.

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>LILY, Easter</b> <i>continued</i>	To control plant growth	<b>Concise</b>	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).
		<b>Concise/Sumagic</b>	3 to 15 ppm spray	Apply when shoots average 3 in. tall.
	To prevent leaf yellowing	<b>Fresco/Fascination</b>	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.
			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.
		<b>Fresco/Fascination</b>	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.
<b>LILY, Hybrid</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/Bonzi/Paczol</b>	200 to 500 ppm spray	See CALADIUM.
		<b>Piccolo/Bonzi/Paczol</b>	5 to 30 ppm bulb soak	Soak bulbs in the solution for 15 min. prior to planting.
		<b>Piccolo/Piccolo 10 XC/Bonzi/Paczol/Downsize</b>	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.
		<b>Concise</b>	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).
		<b>Concise/Sumagic</b>	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.	
	<b>Topflor</b>	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	<b>Fresco/Fascination</b>	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	<b>Fresco/Fascination</b>	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
<b>LILY, Oriental</b>	To control plant growth	<b>Piccolo</b> /Bonzi/Paczol	100 to 200 ppm bulb soak	Ten minute preplant soaks provided excellent results in NC State University trials. Cultivar response varied.
		<b>Concise</b>	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.
		<b>Concise</b> /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.
		<b>Piccolo 10 XC</b>	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	<b>Fresco</b> /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	<b>Fresco</b> /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.	
<b>LINARIA HYBRIDA (Baby snapdragon)</b>	To control plant growth	<b>Dazide + Citadel</b> /B-Nine + Cycocel	2,500 ppm Dazide/B-Nine + 300 to 500 ppm Citadel/Cycocel applied as a tank-mix spray	Controlled plant growth, but didn't strengthen stems, as well as paclobutrazol sprays.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	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. Stengthened stems and improved flower coloration.
<b>LINER DIPS</b>	To control plant growth	<b>Piccolo</b>	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.
<b>LIPSTICK VINE</b>	To increase lateral branching	Augeo	521 to 1,042 ppm spray	
<b>LISIANTHUS (Eustoma)</b>	To control plant growth	<b>Abide</b> /A-Rest	0.5 mg a.i. drench	Cultivar response varies.
		<b>Concise</b> /Sumagic	5 to 10 ppm spray	Cultivar response varies.
		<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	Cultivar response varies.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	4 to 16 ppm drench	Cultivar response varies.
<b>LOBELIA</b>	To control plant growth	<b>Dazide</b> /B-Nine	1,500 to 2,500 ppm spray	
		<b>Concise</b> /Sumagic	1 to 10 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	4 ppm spray	
1 ppm drench	Can be used 3 to 5 weeks before sale to control stretch.			
<b>LOBULARIA</b>	To control plant growth	<b>Piccolo</b>	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.

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>LOBULARIA</b> <i>continued</i>	To control plant growth	<b>Concise</b>	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	
<b>LOPHSOPERMUM (LOFUS)</b>	To control plant growth and improve branching	<b>Collate</b> /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.
<b>MANDEVILLA SANDERI (Dipladenia)</b>	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.
		<b>Dazide</b> /B-Nine	2,500 to 3,500 ppm spray	Use a PGR if needed. Multiple applications may be needed in warmer climates.
		<b>Dazide</b> /B-Nine + <b>Citadel</b> /Cycocel	1,000 to 1,500 ppm Dazide/B-Nine + 750 ppm Citadel/Cycocel spray	Use a PGR if needed. Multiple applications may be needed in warmer climates.
<b>MARIGOLD</b>	To control plant growth	<b>Abide</b> /A-Rest	13 to 33 ppm spray	
		<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	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).
		<b>Citadel</b> /Chlormequat E-Pro/Cycocel	800 to 1,500 ppm spray	
		<b>Concise</b> /Sumagic	10 to 20 ppm spray	
		Topflor	20 to 60 ppm spray	Based on NC State University trials. Adjust rates for other locations.
<b>MARIGOLD, Plugs</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	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.
<b>MATTHIOLA, Bedding Plant (Stock)</b>	To control plant growth	<b>Dazide</b> + <b>Citadel</b> /B-Nine + Cycocel	800 to 5,000 ppm Dazide/B-Nine + 1,000 to 1,500 ppm Citadel/Cycocel applied as a tank-mix spray	
<b>MATTHIOLA, Cut (Stock)</b>	To promote growth and stem elongation	<b>Florgib</b> /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.
<b>MELAMPODIUM</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 ppm spray	Use when plants reach 75% of marketable size to tone.
<b>MIMULUS</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 ppm spray	Use if needed. Delay in flowering possible with multiple applications.
<b>MONARDA</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	60 to 160 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol/Downsize	>0.48 mg a.i. (>4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
		<b>Concise</b> /Sumagic	15 to 30 ppm spray	

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>MONSTERA</b>	To control plant growth	<b>Abide/A-Rest</b>	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	
<b>MONTBRETIA</b>	To control plant growth	<b>Piccolo/Bonzi/Paczol</b>	20 to 30 ppm corm soak	Soak corms in the solution for 15 min. prior to planting.
<b>NARSISSUS</b>	To control plant growth	<b>Florel/Collate</b>	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.
<b>NASTURTIUM</b>	To control plant growth	<b>Citadel/Chlormequat E-Pro/Cyclocel</b>	800 to 1,500 ppm spray	Use only on non-food plants.
<b>NEMESIA</b>	To control plant growth	<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	Use on compact varieties to tone and hold crop.
		<b>Piccolo/Bonzi/Paczol</b>	10 to 20 ppm spray	Based on NC State University trials.
		<b>Collate/Florel</b>	250 to 500 ppm spray	Make final application 4 to 6 weeks before sale.
		<b>Concise/Sumagic</b>	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.
<b>NEPHTHYS, Green and Green Gold</b>	To control plant growth	<b>Abide/A-Rest</b>	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	
<b>NEW GUINEA IMPATIENS</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/Bonzi/Paczol</b>	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.
		<b>Piccolo/Bonzi/Paczol</b>	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.
		<b>Florel/Collate</b>	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.
<b>NEW GUINEA IMPATIENS, Plugs</b>	To control plant growth	<b>Piccolo 10 XC</b>	0.25 to 5 ppm spray	See Piccolo remarks for AGERATUM, Plugs.
<b>NICOTIANA</b>	To control plant growth	<b>Dazide/B-Nine</b>	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.
<b>NOLANA PARADOXA</b>	To control plant growth	<b>Florel/Collate</b>	500 ppm spray	To keep plants more compact. Based on Texas A&M University trials.
<b>OENOTHERA</b>	To control plant growth	<b>Concise/Sumagic</b>	5 to 10 ppm spray	Apply if needed.
<b>ORNAMENTAL CABBAGE and KALE (Non-food)</b>	To control plant growth	<b>Dazide/B-Nine</b>	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.
		<b>Concise/Sumagic</b>	2.5 to 8 ppm spray	Use higher rates for more vigorous cultivars. Cultivar response can vary. Recommendation based on North Carolina conditions.

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>ORNAMENTAL PEPPERS (Capsicum) (Non-food)</b>	To control plant growth	<b>Piccolo</b> /Bonzi/Paczol	20 ppm foliar spray	Recommendation based on North Carolina conditions for a moderately vigorous cultivar.
		<b>Concise</b> /Sumagic	5 to 15 ppm spray	
<b>ORNAMENTAL VEGETABLES (Non-food)</b>	To control plant growth	<b>Dazide</b> /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.
		<b>Concise</b> /Sumagic	10 to 25 ppm spray	Use higher rates for more vigorous cultivars. Recommendation based on North Carolina conditions.
<b>ORNITHOGALUM</b>	To increase stem length	<b>Florgib</b> /ProGibb T&O	100 ppm dip	Soak the bulbs for 20 minutes prior to potting.
<b>OSTEOSPERMUM</b>	To control plant growth	<b>Citadel</b> /Cycocel	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.
		<b>Concise</b> /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.
		<b>Dazide</b> /B-Nine	2,500 to 4,000 ppm spray	Can be applied 3 or 4 times (weekly) after pinch.
		<b>Dazide + Citadel</b> /B-Nine + Cycocel	1,500 to 3,000 ppm Dazide/B-Nine + 1,000 to 1,500 ppm Citadel/Cycocel 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.
		<b>Piccolo</b>	4 to 8 ppm liner root soak	See BACOPA. Rate based on Michigan State University trials.
		<b>Piccolo</b> /Bonzi/Paczol	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	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	15 to 30 ppm spray	
Topflor	20 to 60 ppm spray			
	1 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.		
<b>OTACANTHUS</b>	To control plant growth	<b>Dazide</b> /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.
<b>OTOMERIA</b>	To control plant growth	<b>Dazide</b> /B-Nine	1,700 ppm spray	Apply 1 to 3 times if needed to tone the plant.
<b>OXALLIS</b>	To control plant growth	<b>Abide</b> /A-Rest	33 ppm spray	To limit petiole stretch.
		<b>Concise</b> /Sumagic	0.1 mg a.i. / 4.5-in. pot drench	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	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> .			

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>PANSY</b>	To control plant growth	<b>Abide</b> /A-Rest	3 to 15 ppm spray	See AGERATUM.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	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.
		<b>Concise</b> /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.
<b>PANSY PLUGS</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	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.
<b>PENNISETUM GLAUCUM</b>	To control plant growth	<b>Collate</b> /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.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	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.
<b>PENNISETUM SETACEUM 'Rubrum'</b>	To control plant growth	<b>Concise</b> /Sumagic	5 ppm spray	First application can be made 21 days after transplanting. Repeat if needed 14 days later.
<b>PENSTEMON HARTWEGII</b>	To control plant growth	<b>Citadel+Dazide</b> /Cycocel+B-Nine	1,000 ppm + 2,500 ppm spray	Rates for moderately vigorous cultivars. Up to 2 sprays may be needed.
		<b>Concise</b> /Sumagic	5 to 10 ppm spray	Rates for moderately vigorous cultivars. Up to 2 sprays may be needed.
		<b>Dazide</b> /B-Nine	2,500 ppm spray	Rates for moderately vigorous cultivars. Up to 2 sprays may be needed.
		Florel/ <b>Collate</b>	Spray	Not recommended because of flower delay.
<b>PENTAS</b>	To control plant growth	<b>Abide</b> /A-Rest	2 to 4 ppm spray	
		<b>Citadel</b> /Cycocel	1,000 to 1,500 ppm spray	
		<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	2 to 3 ppm spray	
<b>PEPINO</b>	To control plant growth	Sumagic	2 to 10 ppm spray	See precautions listed with EGGPLANT.
<b>PEPPER</b>	To control plant growth	Sumagic	2 to 10 ppm spray	See precautions listed with EGGPLANT.
<b>PERENNIALS (Not specifically listed in this table)</b>	To induce lateral or basal branching	<b>Configure</b>	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.
<b>PERICALLIS (Cineraria)</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,000 ppm spray	Apply every 14 days, if needed.
<b>PERILLA</b>	To control plant growth	<b>Concise</b> /Sumagic	3 to 5 ppm spray	Apply if needed.
		<b>Dazide</b> /B-Nine	2,000 to 4,000 ppm spray	Apply 1 to 3 times as needed.
		<b>Dazide + Citadel</b> /B-Nine + Cycocel	2,500 to 4,000 ppm + 1,000 to 1,500 ppm Citadel/Cycocel applied as a tank-mix spray	
		<b>Piccolo</b> /Bonzi/Paczol	10 to 20 ppm spray	

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>PETUNIA, Seed</b>	To control plant growth	<b>Abide</b> /A-Rest	10 to 26 ppm spray	See AGERATUM.
		<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol	15 to 45 ppm spray	
		<b>Concise</b> /Sumagic	25 to 50 ppm spray	
		Topflor	20 to 60 ppm spray	Based on NC State University trials. Adjust rates for other locations.
<b>PETUNIA PLUGS, Seed</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
<b>PETUNIA, Vegetative</b>	To control plant growth	<b>Abide</b> /A-Rest	10 to 26 ppm spray	Multiple applications may be required.
		<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
		<b>Dazide</b> /B-Nine + Bonzi/ <b>Piccolo</b> /Paczol	2,500 ppm spray + 40 ppm Bonzi/ <b>Piccolo</b> /Paczol applied as a tank-mix spray	Recommendation based on NC State University trials.
		<b>Dazide</b> /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.
		<b>Piccolo</b> /Bonzi/Paczol	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.
		<b>Concise</b> /Sumagic	20 to 50 ppm spray	20 ppm worked well in NC State University trials.
		<b>Piccolo</b>	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	<b>Florel/Collate</b>	300 to 500 ppm spray	
<b>PHALAENOPSIS Orchids</b>	To increase flower number and earlier flowering	<b>Configure</b>	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	<b>Concise</b> /Sumagic	100 to 200 ppm spray	Apply when the flower spike length is 1 in. (3 cm).
<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol		250 ppm spray	Apply when the flower spike length is 1 in. (3 cm).	
<b>PHILODENDRON</b>	To control plant growth/vine control	<b>Abide</b> /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	
		<b>Citadel</b> /Cycocel	3,000 ppm spray	
		<b>Dazide</b> /B-Nine	2,500 to 7,500 ppm spray	
<b>PHLOX DRUMMONDII</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
<b>PHLOX MACULATA, (Hybrid)</b>	To control plant growth	<b>Concise</b> /Sumagic	5 to 10 ppm spray	
		<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
		Topflor	10 to 15 ppm spray	

## Growth Regulators for Floricultural Crops in Greenhouses

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.
PLECTRANTHUS	To control plant growth	Dazide + Citadel/B-Nine + Cycocel	1,500 to 2,500 ppm + 750 to 1,000 ppm Citadel/Cycocel 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/Paczol	5 to 20 ppm spray	Cultivars' responses to PGRs vary.
PLUMBAGO AURICULATA	To control plant growth	Collate/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 + Cycocel	800 to 2,500 ppm + 1,000 to 1,500 ppm Citadel/Cycocel 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/Paczol	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/Paczol/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/Cycocel	800 to 1,500 ppm spray	For natural season crops in N.C., don't apply Cycocel 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.	
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.

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>PORPHYROCOMA POHLIANA (Brazilian Fireworks)</b>	To improve foliage color and for earlier flowering	<b>Piccolo/Piccolo 10 XC/</b> Bonzi/Paczol	3 to 5 ppm spray	Height control generally not needed and rates above 5 ppm can cause leaf puckering.
<b>PORTULACA OLERACEA</b>	To control plant growth	<b>Abide/A-Rest</b>	7 to 26 ppm spray	
		<b>Concise/Sumagic</b>	15 to 30 ppm spray	
		<b>Piccolo/Piccolo 10 XC/</b> Bonzi/Paczol	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	<b>Citadel/Cyclocel</b>	5,000 ppm spray	Apply 5 to 6 days after pinching to improve branching of cuttings.
		<b>Collate/Floreel</b>	300 to 500 ppm spray	Recommendations based on Michigan conditions. Defoliation can occur with rates greater than 300 ppm.
<b>POTHOS</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
		<b>Dazide/B-Nine</b>	2,500 to 7,500 ppm spray	
		<b>Piccolo/Piccolo 10 XC/</b> Bonzi/Paczol	4 to 6 mg a.i. drench for a 8-in. pot; apply 10 fl. oz./8-in. pot	
<b>PRIMULA ACAULIS</b>	To control plant growth	<b>Dazide/B-Nine</b>	1,000 to 2,500 ppm spray	PGRs usually not required.
<b>PRIMULA OBCONICA</b>	To control plant growth	<b>Dazide/B-Nine</b>	5,000 ppm spray	PGRs usually not required.
<b>PURPLE CONEFLOWER</b>	To control plant growth	<b>Concise/Sumagic</b>	30 to 40 ppm spray	
<b>PURPLE PASSION</b>	To control plant growth	<b>Abide/A-Rest</b>	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.
<b>RANUNCULUS</b>	To control peduncle length	<b>Dazide/B-Nine</b>	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.
<b>ROSE, Pot</b>	To control plant growth	<b>Concise/Sumagic</b>	0.1 to 0.2 mg a.i./pot drenches	Usually only a single application is made.
		<b>Piccolo/Piccolo 10 XC/</b> Bonzi/Paczol	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.
<b>SALVIA, Annual</b>	To control plant growth	<b>Abide/A-Rest</b>	10 to 26 ppm spray	
		<b>Dazide/B-Nine</b>	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC/</b> Bonzi/Paczol	20 to 60 ppm spray	
		<b>Citadel/Chlormequat E-Pro/</b> Cyclocel	800 to 1,500 ppm spray	
		<b>Concise/Sumagic</b>	5 to 10 ppm spray	
		Topflor	20 to 80 ppm spray	Based on NC State University trials. Adjust rates for other locations.
<b>SALVIA PLUGS, Annual</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC/</b> Bonzi/Paczol	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>SALVIA FARINACEA</b>	To control plant growth	<b>Citadel+Dazide</b> /Cycocel+B-Nine	1,000 ppm + 2,500 ppm spray	Apply if growth control is needed.
		Florel/ <b>Collate</b>	Spray	Not recommended because of flower delay.
<b>SALVIA GUARANITICA</b>	To control plant growth	<b>Citadel+Dazide</b> /Cycocel+B-Nine	1,000 to 1,500 ppm + 2,000 to 3,500 ppm spray	
<b>SALVIA HYBRID</b>	To control plant growth	<b>Dazide</b> /B-Nine	1,500 to 2,500 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol/Downsize	0.5 to 1 ppm drench	
<b>SALVIA LONGISPICATA x FARINACEA</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 to 3,000 ppm spray	
<b>SALVIA PATENS</b>	To control plant growth	<b>Citadel+Dazide</b> /Cycocel+B-Nine	1,000 ppm + 2,500 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol/Downsize	1 ppm drench	Trial rate before use.
<b>SALVIA, Perennial</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	40 to 60 ppm spray	
<b>SALVIA, Vegetative</b>	To control plant growth	<b>Dazide</b> /B-Nine	1,000 to 2,000 ppm spray	Multiple applications may be needed to tone crop.
		<b>Dazide + Citadel</b> /B-Nine + Cycocel	2,000 to 3,500 ppm + 1,000 to 1,500 ppm Citadel/Cycocel applied as a tank-mix spray	
<b>SANVITALIA</b>	To control plant growth	<b>Dazide</b> /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.
<b>SCAEVOLA AEMULA</b>	To control plant growth	<b>Concise</b> /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.
		<b>Dazide</b> /B-Nine	2,500 ppm spray	
		<b>Piccolo</b> /Bonzi/Paczol	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. Scaevolols are very responsive to paclobutrazol.
			45 to 60 ppm spray	Recommendations based on NC State University trials.
		Topflor	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	Florel/ <b>Collate</b>	300 to 500 ppm spray	Apply early, typically 2 to 3 weeks after pinching. Late applications can delay flowering.	
<b>SCHEFFLERA</b>	To control plant growth	<b>Abide</b> /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. may vary with pot size.
	<b>Dazide</b> /B-Nine	2,500 to 7,500 ppm spray		
To increase lateral branching	Augeo	3,125 ppm spray	Labeled for Schefflera arboricola only.	

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CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>SCHIZANTHUS</b>	To control plant growth	<b>Abide</b> /A-Rest	1 to 2 ppm spray	
		<b>Dazide</b> /B-Nine	1,500 to 3,000 ppm spray	
<b>SCOPARIA</b>	To control plant growth	<b>Dazide</b> /B-Nine	1,000 to 2,500 ppm spray	Use to tone plants if needed.
<b>SCUTELLARIA JAVANICA (Skullcap)</b>	To control plant growth	<b>Dazide + Citadel</b> /B-Nine + Cycocel	2,500 ppm Dazide/B-Nine + 1,000 ppm Citadel/Cycocel tank mix spray	Begin applications 2 to 3 weeks after transplanting. Repeat as needed every 2 weeks.
<b>SEMPERVIVUM spp.</b>	To induce offsets	<b>Configure</b>	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.
<b>SHASTA DAISY</b>	To control plant growth	<b>Concise</b> /Sumagic	15 to 30 ppm spray	
<b>SHRIMP PLANT</b>	To control plant growth	<b>Abide</b> /A-Rest	25 to 50 ppm spray	Apply after plants established.
		<b>Dazide</b> /B-Nine	1,000 ppm	Apply after plants established.
	To increase lateral branching	Augeo	781 to 1,562 ppm spray	
<b>SNAPDRAGON, Seed (ANTIRRHINUM)</b>	To control plant growth	<b>Abide</b> /A-Rest	10 to 26 ppm spray	
		<b>Concise</b> /Sumagic	25 to 50 ppm spray	
		<b>Dazide + Citadel</b> /B-Nine + Cycocel	800 to 1,000 ppm Dazide/B-Nine + 800 to 1,000 ppm Citadel/Cycocel applied as a tank-mix spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	30 to 90 ppm spray	Apply at an early stage of plant growth with good stem coverage, especially for vigorous varieties.
<b>SNAPDRAGON PLUGS, Seed (ANTIRRHINUM)</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	10 to 20 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
<b>SNAPDRAGON, Vegetative (ANTIRRHINUM)</b>	To control plant growth	<b>Piccolo</b> /Bonzi/Paczol	30 to 60 ppm spray	
		<b>Concise</b> /Sumagic	20 to 45 ppm spray	
	To control plant growth and peduncle stretch	<b>Dazide</b> /B-Nine	1,500 ppm spray	Use during periods of high temperatures.
<b>SPATHIPHYLLUM</b>	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	<b>Florgib</b> /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.
<b>STATICE, Cut (Limonium)</b>	To promote plant growth and stem elongation	<b>Florgib</b> /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	<b>Florgib</b> /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.
<b>STEPHANOTIS, Pot</b>	To tone plant growth	<b>Dazide + Citadel</b> /B-Nine + Cycocel	100 ppm + 100 ppm spray	Controls vine elongation and shortens days until flowering.
<b>STOKESIA</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	40 to 80 ppm spray	

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>STREPTOCARPUS</b>	To control plant growth	<b>Abide</b> /A-Rest	10 to 50 ppm spray	Rate based on Louisiana State University trial.
		<b>Dazide</b> /B-Nine	1,500 to 2,500 ppm spray	Supplier rate recommendation.
	To delay premature bloom and promote additional plant growth	<b>Collate</b>	250 to 1000 ppm spray	Optimal rates varied significantly by cultivar. Conduct your own trials to determine optimal rates for each <i>Streptocarpus</i> series and specific cultivar. Results based on Iowa State University trial.
<b>STROBILANTHES DYERIANUS</b> (Persian Shield)	To control plant growth	<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol	30 ppm spray	
<b>SUNFLOWER</b>	To control plant growth	<b>Citadel</b> /Chlormequat E-Pro/ Cycocel	800 to 1,500 ppm spray	
		<b>Piccolo</b> /Bonzi/Paczol	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.
		<b>Concise</b> /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 1 to 2 mg a.i. (8.45 to 16.9 ppm) drench for a 6-in. pot	
<b>TALINUM PANICULATUM</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 to 3,500 ppm spray	For toning the crop. Apply once after transplanting.
<b>TECOMA STANS</b>	To control plant growth	<b>Dazide + Citadel</b> /B-Nine + Cycocel	2,500 ppm Dazide/B-Nine + 1,000 ppm Citadel/Cycocel tank mix spray	Begin applications 2 to 3 weeks after transplanting. Repeat as needed every 2 weeks.
<b>THUNBERGIA ALATA</b>	To control stem elongation/plant growth	<b>Dazide + Citadel</b> /B-Nine + Cycocel	2,500 ppm Dazide/B-Nine + 1,000 ppm Citadel/Cycocel tank mix spray	Apply to cuttings in propagation.
<b>TIBOUCHINA</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 ppm spray	
<b>TOMATILLO</b>	To control plant growth	Sumagic	2 to 10 ppm spray	See precautions listed with EGGPLANT.
<b>TOMATO</b>	To control plant growth	Sumagic	2 to 10 ppm spray	See precautions listed with EGGPLANT.
<b>TORENIA FOURNIERI</b>	To control plant growth	<b>Concise</b> /Sumagic	5 to 15 ppm spray	Apply if growth control is needed.
		<b>Dazide</b> /B-Nine	1,500 to 2,500 ppm spray	Apply if growth control is needed.
<b>TORENIA spp.</b>	To control plant growth	<b>Dazide</b> /B-Nine	1,500 ppm spray	Apply if growth control is needed
		<b>Florel/Collate</b>	Avoid use	Florel and Collate significantly delay flowering.
<b>TROPICAL PLANTS</b> (Not specifically listed in this table)	To induce lateral or basal branching	<b>Configure</b>	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.

## Growth Regulators for Floricultural Crops in Greenhouses

CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS
<b>TULIP</b>	To control plant growth	<b>Abide</b> /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.
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol/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.
		<b>Piccolo</b> /Bonzi/Paczol	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.
		<b>Concise</b> /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	
<b>VERBENA, Annual</b>	To control plant growth	<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	15 to 30 ppm spray	
		<b>Citadel</b> /Chlormequat E-Pro/Cycocel	800 to 1,500 ppm spray	Begin applications 7 days after pinching. Repeat as needed every 2 weeks.
		<b>Concise</b> /Sumagic	15 to 30 ppm spray	
	To increase lateral branching	Augeo	521 to 1,042 ppm spray	
		<b>Florel/Collate</b>	500 ppm spray	Florel and Collate applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.
<b>VERBENA PLUGS, Annual</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	5 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.
<b>VERBENA, Perennial</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	120 to 160 ppm spray	
		<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol/Downsize	>0.36 mg a.i. (>3 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot	
<b>VERBENA, Vegetative</b>	To control plant growth	<b>Dazide + Citadel</b> /B-Nine + Cycocel	2,000 to 3,500 ppm Dazide/B-Nine + 750 to 1,000 ppm Citadel/Cycocel applied as a tank-mix spray	See General Recommendations.
		<b>Piccolo</b>	8 to 12 ppm liner root soak	See BACOPA. Rate based on Michigan State University trials.
		<b>Citadel</b> /Chlormequat E-Pro/Cycocel	1,500 to 2,000 ppm spray	
		<b>Concise</b> /Sumagic	5 to 10 ppm spray	Apply as needed.
		<b>Dazide</b> /B-Nine	1,500 to 2,500 ppm spray	Do not apply within 2 weeks of a Florel or Collate application.
		<b>Florel/Collate</b>	250 to 300 ppm spray	Make last application 8 weeks before sale.
<b>VERONICA</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> /Bonzi/Paczol	20 to 40 ppm spray	
		<b>Concise</b> /Sumagic	20 to 40 ppm spray	

## Growth Regulators for Floricultural Crops in Greenhouses

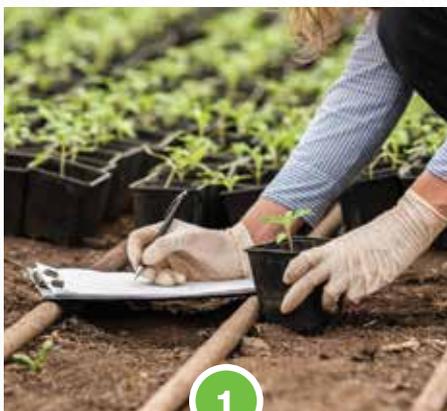
CROP	PURPOSE	CHEMICAL	RATE*	PRECAUTIONS AND REMARKS	
<b>VINCA</b> <b>(Catharanthus)</b>	To control plant growth	<b>Abide</b> /A-Rest	5 to 18 ppm spray		
		<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray		
		<b>Citadel</b> /Chlormequat E-Pro/ Cyclocel	800 to 1,500 ppm spray		
		<b>Concise</b> /Sumagic	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.	
<b>VINCA VINE</b> <b>(<i>Vinca spp.</i>)</b>	To increase lateral branching	<b>Florel</b> / <b>Collate</b>	500 ppm spray	Florel and Collate applications will provide some growth retardant effects and delay flowering. Read the label for restrictions on timing of applications.	
<b>VIOLA</b>	To control plant growth	<b>Concise</b> /Sumagic	1 to 5 ppm spray		
<b>WANDERING JEW</b>	To control plant growth	<b>Abide</b> /A-Rest	26 to 132 ppm spray		
<b>WOODY</b> <b>LANDSCAPE PLANT</b> <b>(Not specifically listed in this table)</b>	To control plant growth	<b>Abide</b> /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		
		<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol	100 ppm spray		See BEDDING PLANTS.
		<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol/Downsize	0.47 mg a.i. (4 ppm) drench for a 6-in. pot; apply 4 fl. oz./6-in. pot		
		<b>Concise</b> /Sumagic	10 to 50 ppm spray		
1 to 2 ppm drench					
<b>ZINNIA</b>	To control plant growth	<b>Abide</b> /A-Rest	7 to 26 ppm spray		
		<b>Citadel</b> /Chlormequat E-Pro/ Cyclocel	800 to 1,500 ppm spray		
		<b>Concise</b> /Sumagic	5 to 25 ppm spray		
		<b>Dazide</b> /B-Nine	2,500 to 5,000 ppm spray	Multiple applications may be required. Use higher rates for summer crops.	
		<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol	15 to 45 ppm spray		
<b>ZINNIA PLUGS</b>	To control plant growth	<b>Piccolo/Piccolo 10 XC</b> / Bonzi/Paczol	4 to 10 ppm spray	Timing of application should normally begin at the 1 to 2 true leaf stage.	

# ORNAMENTAL GROWERS ACCESS TOP-OF-THE-LINE PLANT GROWTH REGULATORS, TOOLS FOR DYNAMIC MARKETPLACE

*Fine Americas delivers innovation and quality to help growers improve productivity*

Ornamental growers face multiple business challenges ranging from labor shortages to an uncertain economy, ongoing technology and production changes to increased government regulations. And while at times it may feel overwhelming, these growers continue to look for, learn about and adopt ways to “do it better.” That is why Fine Americas, Inc., an industry leader in plant growth regulators (PGRs), is focused on delivering innovative, high-quality products and best-in-class research and tools to help growers improve plant quality and support their businesses in an ever-changing marketplace.

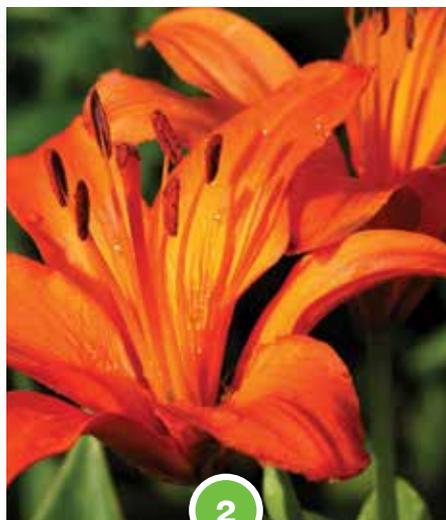
As the industry’s PGR leader, Fine Americas has always listened to what ornamental growers need most. Today, it continues to respond to growers’ needs by conducting ongoing research and bringing new products to market that will continue to make their operations even more efficient and profitable.



## The Importance of Research

To meet increasing demands in an ever fluctuating environment, ornamental growers constantly look for new and better ways to improve their plants. They must work to make plants more consistent in quality and marketability. Fine Americas not only delivers plant growth regulators, but also helps growers by listening to their needs and requests – and then identifying and developing new products, formulations, concentrations, expanded labels and new registrations to meet these needs. And that starts with research.

Fine Americas works with university researchers; and in that work, the company has helped to identify new uses for PGR products like Concise®, Fresco® and Piccolo® 10 XC (attributes such as improved plant uniformity and structure). Once products are developed and new uses are identified, the company works closely with university researchers and distributors to provide growers with the latest information.



## Commitment to Quality

Fine Americas puts quality first. It is certified to ISO 9001:2008 and maintains strict controls to ensure that all products are manufactured to the highest possible standards. From there, employees strive to maintain those standards throughout the entire supply chain.



## Grower Access to Information, Insight

Providing growers with access to university research is important, so Fine Americas provides this data and other PGR tools on its website. Resource materials include this yearly PGR guide, assorted educational videos and other valuable online tools.

Growers also may participate in quarterly training sessions to expand their PGR knowledge base while helping share the positive attributes of PGR usage in the ornamental community. Via training sessions and one-on-one visits with growers, Fine Americas takes pride in working with their customers to customize PGR recommendations and usage based on the customers’ growing practices, crops and other environmental factors – another aspect that sets the company apart from other ornamental PGR vendors.

For more than 30 years, ornamental growers worldwide have relied on Fine Americas to provide them the best of the best when it comes to PGRs. The company invests in its growers as it focuses on the development, manufacturing and marketing of PGRs for the greenhouse ornamental, tree growth and turf markets – as well as increasing the focus in the agricultural sector. This diversity is what makes Fine Americas stand out as a recognized center of excellence for PGR technology.

**To learn more about how  
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888-474-FINE (3463) toll-free.**

# Collate Use Tips

Brian E. Whipker, North Carolina University

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

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

**Temperatures.** In addition, Collate activity is linked to active plant growth.

Applications made when temperatures are below 60F (15.5C) or higher than 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.

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

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

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

**Optimal concentrations.** For most plants, Collate spray rates are typically at 500 ppm. Complete spray coverage is required because Collate isn't trans-

located in the plant. This is especially important for plants such as garden mums. Incomplete spray applications will result in uneven growth and flowering. Research has shown that drench and pre-plant liner soak application rates are lower—in the range of 50 to 250 ppm. While a label amendment has been applied for to allow drench applications of Collate, it has not yet been approved.

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

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

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



Effect of a Collate foliar spray on Coleus Oxford Street

# Dilution Table

## Formulated product per gallon of solution

PPM AI	Abide/ A-Rest (milliliters)	Dazide/ B-Nine (grams)	Citadel/ Cycocel (milliliters)	Collate (milliliters)	Concise/ Sumagic (milliliters)	Piccolo/ Bonzi/ Paczol (milliliters)	Piccolo 10 XC (milliliters)	Topflor (milliliters)	Configure (milliliters)	Augeo (milliliters)
0.5	7				4	0.5	0.05	0.48		
1.0	14				8	1.0	0.1	0.96		
5.0	72				38	5.0	0.5	4.8		
10	143				76	10	1.0	9.6		
25	359				189	25	2.5	23.9		
30	430				227	30	3.0	28.7		
40	573				303	40	4.0	38.2		
50	717			0.8	379	50	5.0	47.8	9.0	
100	1433			1.6	758	100	10.0	95.5	18	
200			6.5	3.1		200	20.0	191.0	36	
400			13	6.2					72	7.3
500			16	7.8					90	9.1
800			26	12.5					144	14.7
1,000		4.5	32	15.6					180	18.2
1,250		5.6	40	19.5						22.8
1,500		6.8	48	23.5						27.3
2,000		9.0	64	31.2						36.4
2,500		11.1	80	39.3						45.5
5,000		22.3		79.4						91.0

When mixing PGRs, great care needs to be given to accurately measure and apply the chemical. Drench applications vary by pot size and desired dose, so refer to the product label for exact mixing instructions. 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.

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 to each pot. The volume of drench applied increases with the pot size (specifics are listed on each product label). 

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