



Controlling Spring Crops Plant Height –Updated 1/19/02 By Using Growth Regulators, Temperature, and Fertilizer

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Potential Benefits from Chemical Growth Regulators include:

- Compact growth habit, thicker stems, better basal branching
- Improved foliage color, smaller “tougher” leaves
- Increased flower bud set
- Chemical pinching and altering bloom date (Florel®)

Overview of A-Rest®

- Primary plant responses: reduced internode elongation and darker foliage
- Lower activity level makes A-Rest®, “more forgiving” than Bonzi® and Sumagic®
- Favored for treatment during plug production due to predictable results.
- Absorbed by roots, leaves and stems then translocated to growing tips
- Relatively short residual effect on plant growth, 1-3 weeks for most crops
- Foliar sprays applied to runoff, approximately 1 gallon per 200 sq ft, drenches per chart on label. Chemigation is included on the label.
- No wetting agent recommended, tank mixes with B-Nine® have been trialed.
- Foliar sprays absorbed into plant tissue in 30 minutes
- Bark mixes reduce the effectiveness of drenching ~25-50%
- 12 hr REI

Overview of B-Nine®

- Primary plant responses: reduced internode elongation, darker foliage
- Lower activity level makes B-Nine® WSG, “more forgiving” than Bonzi® and Sumagic®
- Absorbed by leaves then translocated to growing tips
- Relatively short residual effect on plant growth, 7-14 days
- Foliar sprays applied just to the point of runoff at approximately 1 gallon per 200 sq ft, no drench applications.
- No additional wetting agent is recommended
- Only tank mixes with Bonzi® or Cycocel® are on the label, do not apply within 7 days of a copper spray to avoid burning
- Allow 8 hours for complete absorption of foliar applications
- Apply B-Nine® WSG early or late in the day for optimum absorption into leaves, especially during periods of high heat and/or low humidity.

- 24 hr REI

Overview of Cycocel®

- Primary plant responses: reduced internode elongation and darker foliage
- Lower activity level makes Cycocel®, “more forgiving” than Bonzi® and Sumagic®
- Absorbed by roots, leaves and stems then translocated to growing tips
- Relatively short residual effect on plant growth
- Foliar sprays applied just to glisten (~2-3 quarts per 200 sq ft), drenches per label rates. No chemigation permitted.
- Phytotoxicity can occur on young rapidly expanding leaves if rates are too high or foliar sprays are made heavier than to glisten
- No tank mixing is recommended except B-Nine® WSG and approved wetting agents
- Foliar sprays absorbed into plant tissue in 12-24 hours, best uptake is when slow drying will occur
- Bark mixes reduce the effectiveness of drenching
- 12 hr REI

Overview of Bonzi® and Sumagic®

- Primary plant responses: reduced internode elongation, darker foliage, and increased bud set in some plants
- High activity level- measure carefully, and trial on new varieties
- Absorbed by roots and stems, (not leaves) then translocated to growing tips
- Foliar sprays should be made at 45° degree angle to maximize stem contact, 1 gallon /200 sq ft, drenches and bulb dips per label rates
- Much more active in root zone than on stems, avoid spraying heavily enough that material runs down the stems into media
- Bark mixes reduce effectiveness of soil drenches ~25-50%.
- Avoid drift on to non-target plants
- No tank mixes except Bonzi® with B-Nine® WSG
- Foliar sprays absorbed into plant tissue in 30 minutes
- Medium to long residual effects on plant growth, drenches and bulb dips persist longer than foliar sprays
- Pre-plant media applications for bedding plants are on the label.
- No sub-irrigation with Sumagic®, Bonzi® may be sub-irrigated at ½ normal drench rate for a one time application
- Residual may persist in re-circulated water systems and impact very sensitive crops that follow
- Research has shown that overdoses may be resolved with gibberellic acid sprays at between 10 and 100 ppm. Trial and error to determine rates.
- 12 hr REI's

Overview of Fascination®

- Primary plant responses: preventing leaf yellowing, delaying flower senescence, increased bloom size, overcoming cold requirements for flower induction in certain plants.
- High level of activity, rate and dosage dependent
- Most research to date has been on lilies, expect more crops to be added to the label
- Combination of gibberellin and cytokinin growth hormones
- Apply morning or afternoon to avoid plant stress
- Foliar spray to the point of drip
- Avoid over-spray (especially growing tips) as it can cause unwanted stem elongation.
- Tank mixing and wetting agents are prohibited
- 4 hr REI

Overview of Florel®

- Primary plant responses: increases lateral branching, maintains vegetative growth by temporarily delaying flower initiation, reduces internode elongation
- Chemical pinching, labor savings
- Exaggerates stress in plants
- Delays bloom 5 weeks or more
- Newly expanded label includes numerous spring crops
- Spray plant surfaces evenly to the point of drip
- Highly alkaline water may need to be acidified to ensure Florel® works properly
- 48 hr REI

Note: Dr. Peter Konjoian has conducted extensive practical research on the many uses of Florel®. Please contact Konjoian's Floriculture Education Services for the most complete references on using Florel®. Phone 978-683-0692, e-mail Peterkfes@aol.com.

Factors Affecting Performance of Growth Regulators

- Time of year/climate
- Temperature regime- (see section on "DIF")
- Stage of crop development
- Type of sprayer and spraying technique
- Variation in response by cultivar
- Cultural practices: fertilizer, water, spacing, etc
- Bark content of soil (drenches)

Growth Regulator Recommendations by Crop

Use the following recommendations only as a starting point for your own trials. As was mentioned previously, many factors influence how a growth regulator will work under your growing conditions. The products mentioned below have been used successfully by growers in the mid-Atlantic area over the past several years. In addition, growth

regulators other than those mentioned may also be effective. **Read and follow all label directions before applying growth regulators.**

Spring Bedding Plants- all treatments are foliar sprays unless otherwise indicated

Ageratum- 6 true leaf stage, B-Nine® WSG 2500 ppm, Bonzi® 20 ppm, or Sumagic® 20 ppm. Hawaii series may not require any treatment.

Alyssum- Bonzi® at 30-45 ppm has some effect when sprayed when true leaves are present. Cool day temperatures are the best height control. After hardening off alyssum will tolerate frost and finish well outside.

Begonia (fibrous)- when plants are the diameter of a quarter or larger apply Cycocel® 750 ppm. White varieties are more vigorous, use Cycocel® 1000 ppm. B-Nine® WSG 5000 ppm also effective. **No** Bonzi® or Sumagic®.

Begonia (tuberous)- 3-4" tall plants 750 ppm Cycocel®. **No** Bonzi® or Sumagic®.

Browallia- 6 true leaf stage, B-9 WSG® 5000 ppm, or Bonzi® 30 ppm, do not use regulators on dwarf varieties.

Carnations (seed)- 3" tall, Bonzi® 30 ppm, Cycocel® 3000 ppm

Celosia (dwarf crested), normally not required. 6 true leaf stage, B-Nine® WSG 2500 ppm, or Bonzi® 15 ppm. (tall plume) – 6 true leaf stage B-Nine® WSG 5000 ppm, Bonzi® 30 ppm, or Sumagic® 15 ppm

Coleus- 4 to 6 true leaves, Bonzi® 30 ppm, or Sumagic® 20ppm

Dahlia (seed)-6 true leaf stage B-Nine® WSG 5000 ppm, Bonzi® 30 ppm, or Sumagic® 15 ppm

Dianthus 3" tall, Bonzi® 30 ppm, or Cycocel® 3000 ppm

Dusty Miller- 6 true leaf stage, Bonzi® 30-45 ppm, or Sumagic® 30 ppm

Geraniums (seed)- Purchased plugs are typically already treated once with Cycocel®. Every 2-3 weeks use Cycocel® @ 750-1000 ppm. Warmer weather may require shorter re-application intervals. Bonzi® and Sumagic® are extremely active on seed geraniums even at 2ppm. Use only Cycocel® if possible.

Gomphrena- 6 true leaf stage, B-Nine® WSG 5000 ppm, or Bonzi® 20 ppm

Hypoestes (polka dot plant)- 4-6 true leaf stage, Cycocel® 1500 ppm

Impatiens (seed, regular)- purchased plugs are usually already treated. 7-14 days after planting plugs, Bonzi® 20-30 ppm, or Sumagic® 5-10 ppm. A large flush of blooms appears 4 weeks after treatment.

Lisianthus (dwarf) none required, (tall) 6 true leaf stage Bonzi® 30 ppm, or B-Nine® WSG 5000ppm

Lobelia- 2-3 " tall, Bonzi® 30 ppm, or Sumagic® 15 ppm. Limited effectiveness on fountain types.

Marigold (dwf French and medium)- at 1st visible bud, B-Nine® WSG 2500 ppm , Bonzi® 15 ppm, or Sumagic® 5-10 ppm. (tall)- 6 true leaf stage B-Nine® WSG 5000 ppm, Bonzi® 30 ppm, or Sumagic® 15 ppm.

Nicotiana- 6 true leaf stage, Bonzi® 20 ppm

Pansy- when plants are covering 75% or more of soil, Bonzi® 2.5-5 ppm, Sumagic® 3 ppm, A-rest® 15 ppm, or tank mix Cycocel® 1500 ppm with B-Nine® WSG 2500 ppm. Note: summer grown pansies for fall sales requires higher rates, consult Griffin's fall pansy bulletin.

Petunia (not including waves or similar)- 1 ½" diameter, B-Nine® WSG 5000 ppm. Repeat applications of B-Nine® WSG delay blooming, follow-up B-Nine® WSG application with Bonzi® 30-45 ppm or Sumagic® 30 ppm if needed.

Phlox (annual)- 4 true leaf stage, B-Nine® WSG 2500 ppm

Portulaca- 3" or longer stems, limited benefits from Bonzi® 30 ppm or Sumagic® 30 ppm.

Salvia (dwarf splendens)- 4-6 true leaf stage, B-Nine® WSG 5000 ppm, Bonzi® 30 ppm, or Sumagic® 10 ppm. (Victoria blue and similar)- 6 true leaf stage B-Nine® WSG 2500 ppm, Bonzi® 20 ppm, or Sumagic® 5 ppm.

Snapdragon (dwarf)- 4-6 true leaf stage, Bonzi® 30 ppm, B-Nine® WSG 5000 ppm, or Sumagic® 30 ppm. (med-tall) same as dwarf except sell plants green.

Verbena (seed grown upright)- 6 true leaf stage, B-Nine® WSG 5000 ppm, Bonzi® 30 ppm, or Sumagic® 20 ppm.

Vinca – 4 to 6 true leaf stage, B-Nine® 2500 ppm, or A-rest® 15 ppm. Note: Bonzi® can cause black spots on foliage.

Viola- treat when foliage covers 75% or more of soil, Bonzi® 2.5 ppm may delay bloom 1 week, or Sumagic® 1-3 ppm.

Zinnia (dwarf)- 4 true leaf stage, B-Nine® WSG 5000 ppm, Bonzi® 30 ppm, (tall)- B-Nine® WSG 5000 ppm, or Bonzi® 30-45 PPM. Sell green.

Spring Container Grown Material- all treatments are foliar sprays unless otherwise indicated.

Argyranthemum- More vigorous cultivars can be treated with B-Nine® WSG 2500 ppm, 30 ppm Bonzi or a 2ppm Bonzi drench. Florel® research on this crop is not complete but can be trialed at 500 ppm as soon as plants are established.

Bacopa- as soon as established, Florel® 500 ppm. Bonzi® 30 ppm foliar spray or B-Nine® 2500 ppm are somewhat effective.

Bidens- as soon as established, Florel® 500 ppm

Bracteantha, (strawflower)- as soon as established , Florel® 500 ppm. Additional treatments are generally not required. If needed, B-Nine® 2500 ppm, or Bonzi® 30 ppm. 2 ppm Bonzi drench is also effective.

Caladium- pre-plant tuber dip for de-eyeing and height control, Bonzi® 30 ppm soak for 30 minutes, or Florel® 2000 ppm for two hours. After tuber dip allow to air dry and plant the next day. Note Florel® has a 48 hr REI.

Calibrachoa (Million bells®, Liracashowers®, etc)- as soon as established Florel® 500 ppm, follow up with: B-Nine® WSG 5000 ppm, Sumagic® 20 ppm, or Bonzi® 30 ppm. 2 applications of B-Nine® WSG will delay flowering. 2-4 ppm Bonzi drench is also effective.

Coleus (vegetative hybrid)- as soon as established Florel® 500 ppm. Can be followed up with: Bonzi® 30 ppm , or Sumagic® 20 ppm.

Diascia- as soon as established, Florel® 500 ppm. Can be followed up with if needed: B-Nine WSG® 2500 ppm, or Bonzi® 30 ppm.

Fuchsia- as soon as established, Florel® 500 ppm. 30 ppm Bonzi® 2-4 weeks after the last pinch increases bud count and somewhat reduces internode elongation.

Geranium (cutting zonal), as soon as established, Florel® 500 ppm. Follow up with Cycocel® 1500 ppm as needed, or Bonzi® 5ppm for compact varieties, 10-15 ppm for others when they are 75% or more of desired size. Bonzi® 0.5 ppm drench can be used on container grown plants when they are near desired finished size. Longer lasting than Bonzi® foliar sprays, so only use on containers where you do not need much more size.

Geranium, Ivy- as soon as established, Florel® 500 ppm. Follow up with Cycocel® 1500 ppm as needed, or Bonzi® 10-15 ppm when they are 75% or more of desired size.

Bonzi® 0.5 ppm drench can be used on container grown plants when they are near finished size. Longer lasting than Bonzi® foliar sprays, so only use on containers where you do not need much more size.

Helichrysum (“trailing dusty miller”)- as soon as established, Florel® 500 ppm

Heliotrope- as soon as established, Florel® 500 ppm. “Atlantis” is naturally compact and requires no additional treatment. B-Nine® WSG 2500 ppm can be used on more vigorous varieties.

Impatiens (dbl)-as soon as established, Florel® 300 ppm. May be followed by Bonzi® 20-30 ppm, or Sumagic® 5ppm. Cut rates in half for variegated leaf varieties. 1.0-2.0 ppm Bonzi® drench can be used instead of foliar sprays when plants are 75% of finished size. Drench application not recommended for variegated varieties.

Impatiens, (N.G.)- not generally required. Florel® 300 ppm as soon as established will keep plants vegetative if pre-mature flowering is a problem. Higher rates can cause substantial flower delay.

Ipomoea (sweet potato vine)- as soon as established, Florel® 500 ppm.

Lamium- as soon as established, Florel® 500 ppm.

Lantana- as soon as established, Florel® 500 ppm. B-Nine® WSG 5000 ppm, or Bonzi® 30-50 ppm are somewhat effective in reducing internode elongation.

Lobelia (vegetative)- B-Nine® WSG 5000 ppm, or Bonzi® 30 ppm.

Nemesia (except Compact Innocence)- B-Nine WSG® 2500 ppm (Ecke recommends treatment before flower buds are visible), Bonzi® 30 ppm, or Sumagic® 30 ppm.

Petunia (vegetative, wave and similar)- as soon as established, Florel® 500 ppm. B-Nine® WSG 5000 ppm, multiple applications will delay bloom, Bonzi® 30-75 ppm, or Sumagic® 20-30 ppm. Bonzi® 2-4 ppm drenches when vegetation is uniformly over the side of the pots provides outstanding control of internode elongation.

Portulaca, trailing (purslane)- as soon as established, Florel®300 ppm. 500 ppm applications has caused defoliation in some cases, per Peter Konjoian.

Scaevola- as soon as established, Florel® 500 ppm. Bonzi® 30 ppm, or Sumagic® 10-20 ppm.

Snapdragon (vegetative trailing)- as soon as established, Florel®500 ppm. B-Nine® WSG 5000 ppm, Bonzi® 30 ppm, or Sumagic® 20 ppm.

Strobilanthus- B-Nine® 2500 ppm, or Bonzi® 30 ppm.

Torenia (vegetative)- Usually none needed, responds to 2500 ppm B-Nine® WSG.

Verbena (vegetative trailing)- as soon as established, Florel® 500 ppm. B-Nine® WSG 5000 ppm, Bonzi® 30 ppm, or Sumagic® 10-20 ppm.

Vinca vine- as soon as established, Florel® 500 ppm, repeat every 2 weeks to keep internodes short.

Growth Regulator Calculations- Use the following conversions to calculate rates of growth regulators:

A-rest®, .5oz per gallon equals 1 ppm.

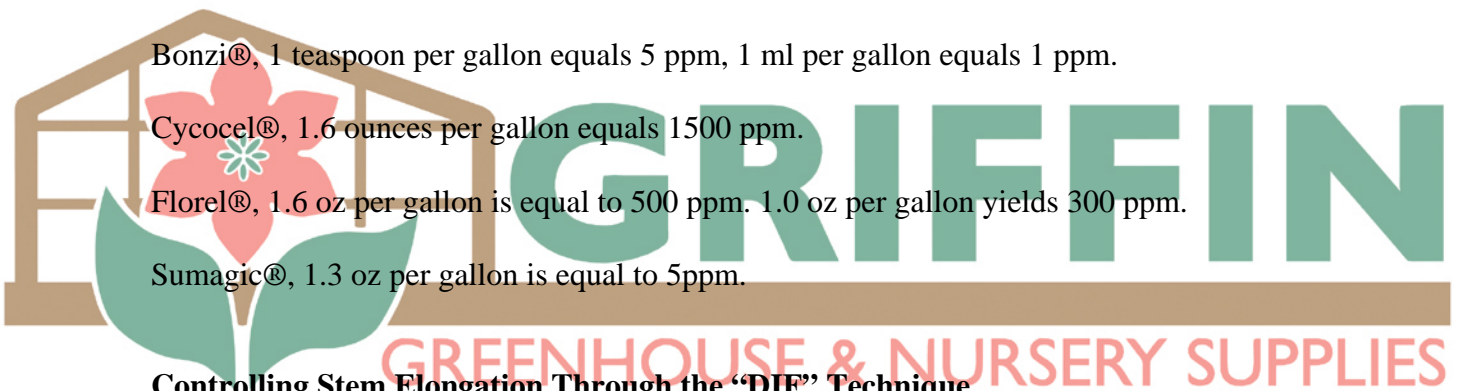
B-Nine® WSG, 1 scoop equals 1 level tablespoon. Each scoop (Tbbs) equals 1250 ppm when added to a gallon of water. Note: older formulation- B-Nine® SP, the large end of the scoop equals 2 level teaspoons and 2 scoops equals 2500 ppm.

Bonzi®, 1 teaspoon per gallon equals 5 ppm, 1 ml per gallon equals 1 ppm.

Cycocel®, 1.6 ounces per gallon equals 1500 ppm.

Florel®, 1.6 oz per gallon is equal to 500 ppm. 1.0 oz per gallon yields 300 ppm.

Sumagic®, 1.3 oz per gallon is equal to 5ppm.



Controlling Stem Elongation Through the “DIF” Technique

- “DIF” stands for the difference between the night temperature and the day temperature. This can be expressed as either a positive or a negative number. For example, night 55°, day 65°: “DIF” = +10. Conversely, night 65°, day 55°: “DIF” = -10.
- Predicting stem elongation by “DIF”. All other factors being equal, the more positive the “DIF”, the greater the potential for stem elongation, or stretching. The reverse is also true. Negative “DIF” values produce more compact plants. A plant being grown with a “DIF” of +15 will be taller than one grown with a “DIF” of +5. Finished crop height can be predicted and directed by altering the “DIF”.
- Is “DIF” practical? Running a crop at a strongly negative “DIF” for a long period of time is neither economical nor necessary. You may run a strongly negative “DIF” (-5 or -7) for a period of time to achieve a specific goal. Strongly negative “DIF”s can have undesirable effects on certain plants. Plugs grown under a

strongly negative “DIF” often turn chlorotic, though it can also be observed on mature plants. Leaf angle also changes in some crops. These effects can be quickly reversed by returning to a positive “DIF”.

- “Morning Temperature Dip” technique- Researchers have discovered that most of the stretch occurs in the first 3 to 4 hours beginning exactly at daybreak. By lowering your temperature below the night temperature at daybreak for a couple of hours, you can go a long way toward reducing stretch. Even if afternoon temperatures are significantly higher than night temperatures, you have greatly reduced stretch.
- Benefits of using “DIF”- by manipulating temperature in your greenhouses you can reduce or eliminate the need for growth regulators on many crops. Following the “DIF” and “Morning Temperature Dip” techniques will result in increased ventilation, lower relative humidity, and hence less foliar diseases.

Scheduling for Proper Plant Height

Keeping good records leads to fine-tuning production schedules. Make sure you include your temperature and fertilizer schedule as well as any growth regulator treatments in your crop notes. Every spring season has weather patterns all its own, but over time you can take much of the guesswork out of crop timing.

Fertilizer’s Impact on Plant Height

While most growers would agree that the amount of fertilizer applied to a crop influences finished height, not all growers have been instructed in how the type of fertilizer impacts stem elongation. Fertilizers high in ammonia form nitrogen encourage softer growth and stem elongation. Ammonia and urea sources of nitrogen together should make up no more than 40% of your fertilizer program for spring crops. It has long been known that phosphorus deprivation reduces stem elongation in many crops. Most of the newer fertilizers reflect the industry wide move toward using less phosphorus relative to the amount of nitrogen and potassium. Some introductions over the past few years are: 21-5-20, 13-2-13, 15-2-20, and 20-5-19, with phosphorus represented by the middle number. Phosphorus is important in root growth and other vital functions in the plant. Consider reducing but not trying to eliminate phosphorus from your feed program as one part of your overall efforts to reduce unwanted stem elongation.

Watering Practices Impact Plant Height

“He/She who holds the hose grows the rose!” Watering practices can have a profound effect on finished plant height. A plant that never experiences any water stress will be taller than the plant that does, if all other factors are equal. You can get too much of a good thing however. Excessive water stress lengthens crop time and can reduce quality by yellowing lower leaves. Aim for a watering regime that keeps soil moisture out of the “luxury” zone, but is not so severe that it adversely affects plant growth. Many growers

agree that teaching watering to a new employee is the most difficult part of the training process because so much “feel” needs to be developed to make good irrigation decisions.

Conclusion

Use all of the tools available to you to in your efforts to control the height of your spring crops. In most situations a combination of the various tools mentioned in this document will yield the best and most economical results.

