Grower 101

Calculating Costs Part II: PGRs

Miscalculations can result in overapplication of PGRs and permanently stunted plants, like these geraniums.

Learn how to calculate the correct volume of PGR solutions needed for specific crops.

By Thomas Boyle

PGRs include naturally occurring compounds (referred to as plant hormones) as well as synthetic compounds. The most common PGRs used on floricultural crops are listed in Figure 1, right. This article will focus on PGRs that both promote or retard growth.

Application Methods

There are several methods for applying PGR solutions: 1) spraying the foliage and stems (foliar sprays); 2) drenching the growing medium; 3) dipping rooted or unrooted cuttings; 4) soaking rhizomes, tubers, bulbs or other storage organs; and 5) spraying the growing medium surface prior to potting.

PGR labels provide detailed information on the crops that can be treated and application methods that are appropriate for each crop. All of the common PGRs can be applied as foliar sprays (see Figure 2, page 48), but some application methods are more restricted. Sumagic (Valent U.S.A. Corporation), for example, is the only PGR listed in Figure 2, page 48, that is labeled for pre-plant ➧

Common PGRs For Ornamental Crops

Compound Classes	Examples	Horticultural Use Examples
Growth-promoting chemicals	ProGibb T&O (VC)[a]	Induces stem elongation in geraniums and fuchsias grown as standards (trees); partially substitutes for cold requirement for flowering in azalea.
	Fascination (VC)	Delays flower senescence and inhibits leaf yellowing in lilies.
Growth-retarding chemicals	A-Rest (SC) Cycocel (OHP) Bonzi (SP) B-Nine WSP (CC) Piccolo (FA) Sumagic (VC)	These chemicals control plant height, enhance foliage color and can increase plant resistance to moisture stress and air pollution.
	Florel Brand Pistill (MC)	Reduces stem elongation, increases branching, reduces leaf size and induces flower abortion in many crops; induces flowering in bromeliads.
	Atrimmec (PBI)	Breaks apical dominance and enhances lateral branching in many herbaceous and woody plants.
Anti-ethylene chemicals	Ethylbloc (AF) (1-methylcyclo-propene)	Prolongs post-harvest life of flowering potted plants and cut flowers that are sensitive to ethylene and decreases flower bud abscission or petal drop in ethylene-sensitive crops.
Root-inducing chemicals	Hormodin (OHP) Rootone (GT) Dip 'N Grow (DG)	Promotes root formation on cuttings from herbaceous and woody plants.

[a]*Initials in parentheses indicate the product's manufacturer/marketer. See right for a key and contact information.*

Figure 1: PGRs are used to increase the marketability, value and/or utility of many ornamental crops.

PGR Companies

These companies produce/market some of the most common plant growth regulators used on ornamental crops.

AgroFresh (AF)
(866) 206-1001
www.agrofresh.com

Chemtura Corp. (CC)
(203) 573-2000
www.chemtura.com

Dip 'N Grow, Inc. (DG)
(866) 347-6476
www.dipngrow.com

Fine Agrochemicals, Ltd. (FA)
(888) 474-3463
www.fine-americas.com

GardenTech (GT)
(800) 969-7200
www.gardentech.com

Monterey Chemical (MC)
(559) 499-2100
www.montereyagresources.com

OHP (OHP)
(800) 659-6745
www.ohp.com

PBI Gordon (PBI)
(800) 821-7925
www.pbigordon.com

SePRO Corp. (SC)
(800) 419-7779
www.sepro.com

Syngenta Professional Products (SP)
(866) SYNGENTA
www.syngentaprofessionalproducts.com

Valent U.S.A. Corp. (VC)
(800) 898-2536
www.valent.com

application to the growing medium surface prior to planting, and this method is labeled for use only on bedding plants.

Many growers prefer spray applications instead of drenches because large numbers of plants can be treated in a shorter period of time, so sprays are more economical in terms of labor costs. However, with drenches, the amount of active ingredient applied per pot is more consistent than with sprays (assuming the grower is careful to apply the same drench volume to each pot), so a more uniform PGR response can be obtained with drenches compared to sprays.

Calculating Spray Volume

This formula can be used to calculate the total volume of diluted PGR solution needed for sprays:

$$\textbf{\# gallons needed} = \frac{\textbf{Total \# of square feet to be treated}}{\textbf{Coverage (square feet treated per gallon)}}$$

Generally for sprays, 1 gal. of diluted PGR solution is applied to every 200 sq.ft. of growing area. However, PGR manufacturers vary in their recommended rates (see Figure 3, page 50).

Example 1. A grower is producing bedding plants in 806-cell packs in 1020 trays. The bedding plants are growing on 10 5x60-ft. benches. Determine the amount of B-Nine (Chemtura Corp.) solution needed for a spray application on the bedding plants.

1. List all variables to find out what is known and unknown:
   - 10 5x60-ft. benches of bedding plants.
   - PGR: B-Nine.
   - Recommended application rate for B-Nine sprays: 1 gal. per 200 sq.ft. (Coverage = 200 sq.ft per gal.).
   - Number of gallons of diluted B-Nine solution is unknown.
2. Perform calculations:
   - *# gallons needed* = $\frac{\textit{\# square feet treated}}{\textit{Coverage (square feet per gallon)}}$
   - *# gallons needed* = $\frac{\textit{10 benches x 5 ft. x 60 ft.}}{\textit{200 sq.ft. per gal.}}$
   - *3,000 sq.ft. ÷ 200 = 15 gal. of diluted B-Nine solution needed*

Example 2. A grower has 20 5x15-ft. benches of bedding plant plugs. Determine the amount of Bonzi (Syngenta Professional Products) solution needed for a spray application on the plugs.

1. List all variables to find out what is known and unknown:
   - 20 5x15-ft. benches of bedding plant plugs.
   - PGR: Bonzi.
   - Recommended rate for applying Bonzi as a spray on bedding plant plugs: 1 gal. per 200-400 sq.ft. Assume 1 gal. will be applied per 400 sq.ft. (Coverage = 400 sq.ft per gal.).
   - Number of gallons of diluted Bonzi solution is unknown.
2. Perform calculations:
   - *# gallons needed* = $\frac{\textit{\# square feet treated}}{\textit{Coverage (square feet per gallon)}}$
   - *# gallons needed* = $\frac{\textit{20 benches x 5 ft. x 15 ft.}}{\textit{400 sq.ft. per gal.}}$
   - *1,500 sq.ft. ÷ 400 = 3.75 gal. of diluted Bonzi solution needed*

Calculating Drench Volume

Use this formula to calculate the total volume of diluted PGR solution required for drenches:

$$\textbf{\# gallons needed} = \frac{\textbf{\# pots x drench volume per pot}}{\textbf{128 fl.oz. per gal.}}$$

Recommended drench volumes per pot are similar for most PGRs but differ slightly for Cycocel (OHP) (see Figure 4, page 50).

Example 3. A grower has 3,000 6-inch pots of poinsettias and wants to apply Bonzi as a drench for height control. How many gallons of diluted Bonzi solution are needed for the poinsettias?

1. List all variables to find out what is known and unknown:
   - 3,000 6-inch pots of poinsettias.
   - PGR: Bonzi.
   - Recommended drench volume for Bonzi: 4 fl.oz. per pot (see Figure 4, page 50).
   - Number of gallons of diluted Bonzi solution is unknown.
2. Perform calculations:
   - *# gallons needed* = $\frac{\textit{\# pots x drench volume per pot}}{\textit{128 fl.oz. per gal.}}$
   - *# gallons needed* = $\frac{\textit{3,000 pots x 4 fl.oz. per pot}}{\textit{128}}$
   - *12,000 fl.oz. ÷ 128 = 93.8 or approximately 94 gal. of diluted Bonzi solution needed*

Preparing Diluted Solutions

PGR recommendations typically come with a dilution table for each PGR. The dilution tables list the parts per million (ppm) of active ingredents and the corresponding amount of PGRs (in fluid ounces or milliliters) required to prepare 1 gal. (or liter) of diluted solution. The method I use for calculating diluted solutions does not require dilution tables but instead utilizes a single formula applicable for all PGRs. All the grower needs to do is plug in the desired concentration (in ppm) and the final volume of diluted solution and calculate the amount of PGR:

$$\textbf{Amount of PGR} = \frac{\textbf{Desired concentration (ppm) x Final volume (gallons)}}{\textbf{Conversion constant}}$$

The conversion constants are specific for each PGR and listed in Figure 5, page 51. There are two conversion constants for each PGR: one for fluid ounces per gallon and the other for milliliters per gallon.

Example 4. Determine the number of fluid ounces of Cycocel required for a 1,000 ppm spray on geranium seedlings if 25 gal. of diluted PGR solution will be prepared.

1. List all variables to find out what is known and unknown:
   - 1,000 ppm Cycocel to be applied as a foliar spray.
   - 25 gal. of diluted Cycocel solution needed.
   - Conversion constant is 922 (see Figure 5, page 51).

Application Methods For Major PGRs

PGR	Application Methods	Example Crops
A-Rest (SC)[a]	Foliar spray	Azaleas, bedding plants, pot mums
	Drench	Bedding plants, Easter lilies, poinsettias
Atrimmec (PBI)	Foliar spray	Begonias, English ivies, fuchsias, kalanchoes
B-Nine (CC)	Foliar spray	Bedding plants, foliage plants, hydrangeas
	Dip	Rooted or unrooted mum cuttings
Bonzi (SP)	Foliar spray	Bedding plant plugs, poinsettias, pot mums
	Drench	Bedding plants (6-inch or larger pots), bulb crops, poinsettias
	Soak	Caladium tubers, hybrid lily bulbs
Cycocel (OHP)	Foliar spray	Azaleas, bedding plants, hibiscus, poinsettias
	Drench	Pot asters, poinsettias, pot sunflowers
Fascination (VC)	Foliar spray	Easter lilies, LA hybrid lilies, oriental lilies
Florel Brand Pistill (MC)	Foliar spray	Bromeliads, fuchsias, geraniums, vinca vine
Piccolo (FA)	Foliar spray	Bedding plants, coreopsis, poinsettias
	Drench	Caladiums, calla lilies, pot mums
	Soak	Amaryllis bulbs, daffodil bulbs
ProGibb T&O (VC)	Foliar spray	Azaleas, calla lilies, poinsettias, spathiphyllums
Sumagic (VC)	Foliar spray	Bedding plants, Easter lilies, poinsettias, pot mums
	Drench	Bulb crops, Easter lilies, LA hybrid lilies, pot mums
	Dip	Rooted or unrooted mum cuttings
	Soak	Asiatic, LA hybrid and oriental lily bulbs
	Pre-plant spray on media surface	Bedding plants

[a]*Initials in parentheses indicate the product's manufacturer/marketer. See page 46 for a key and contact information.*

Figure 2. There are several methods for applying PGR solutions: Plant sprays and growing media drenches are used on crops established in containers, whereas dips or soaks are applied to cuttings or bulbs prior to potting.

Yoder®
...something better to grow on®

Setting the standard for garden mums

Prophets®

ec European Collection

Big, bold, beautiful and long lasting!

- Ball-shape habit
- Excellent stem flexibility
- Prolific bud count
- No pinching needed
- Uniform flowering
- Outstanding keeping quality
- Wide selection of colors and reliable bloom times — "Fresh All Fall"
- Extensive trialing in North America
- Disease-free cuttings

To order, contact your favorite sales representative or Yoder customer service.

YODER BROTHERS, INC.
800.321.9573, 330.745.2143
Fax 330.753.5294
www.yoder.com

Pictured top to bottom
Jacqueline USPPAF
Hankie USPPAF
Ashley USPPAF

THE FLOWER FIELDS

Write in 236

Recommended Spray Application Rates	
PGR	**Recommended Rates**
A-Rest (SC)[a]	1 gal. per 200 sq.ft.
Atrimmec (PBI)	1 gal. per 400-600 sq.ft.
B-Nine (CC)	1 gal. per 200 sq.ft.
Bonzi (SP)	1 gal. per 200-400 sq.ft. for plug trays or small containers; 1 gal. per 130 sq.ft. for larger plants
Cycocel (OHP)	Usually 1 gal. per 130-200 sq.ft. (1 gal. per 400 sq.ft. in some situations)
Fascination (VC)	1 gal. per 200 sq.ft.
Florel Brand Pistill (MC)	1 gal. per 160 sq.ft. for flower induction in bromeliads; no rate information on label for other uses
ProGibb T&O (VC)	Usually 1 gal. per 200 sq.ft. (amount depends on plant size and spacing)
Sumagic (VC)	Usually 1 gal. per 200 sq.ft. (see product label for exceptions)

[a]Initials in parentheses indicate the product's manufacturer/marketer. See page 46 for a key and contact information.

Figure 3. These are general recommendations for spray application rates; rates can vary based on geographic location and how much control is desired.

- Number of necessary fluid ounces of Cycocel is unknown.

2. Perform calculations:

- *Amount of PGR = $\frac{\text{Desired concentration (ppm) x Final volume (gallons)}}{\text{Conversion constant}}$*
- *Amount of PGR = $\frac{\text{1,000 ppm x 25 gal.}}{\text{922}}$*
- *25,000 ÷ 922 = 27.1 or approximately 27 fl.oz. of Cycocel needed*

Example 5. The grower in Example 3 with 3,000 poinsettias in 6-inch pots will be applying Bonzi as a drench. The recommended rate for drenching poinsettias with Bonzi is .25-3 ppm; the grower chooses to apply 1.5 ppm. How many milliliters of Bonzi will be needed if 94 gal. of diluted solution will be prepared?

1. List all variables to find out what is known and unknown:

Drench Volume Recommendations				
	Drench Volume (fluid ounces per container)			
Container Diameter/Type	**A-Rest (SC)[a]**	**Bonzi (SP)**	**Cycocel (OHP)**	**Sumagic (VC)**
2¼- to 3-inch pot	-	-	2	-
4-inch pot	2	2	3	-
5-inch pot	3	3	4	-
6-inch pot	4	4	6	4
8-inch pot	10	10	8	-
10-inch pot	25	25	-	-
10-inch hanger	-	15	-	-
12-inch pot	40	40	-	-

[a]Initials in parentheses indicate the product's manufacturer/marketer. See page 46 for a key and contact information.

Figure 4. These are the general drench volumes recommended by manufacturers for four PGRs. Use the equation listed in the text to calculate the amount of PGR needed for preparing diluted solutions. Rates can vary based on geographic location and how much control is desired.

- 1.5 ppm Bonzi to be applied as a drench.
- 94 gal. of diluted Bonzi solution needed.
- Conversion constant is 1.06 (see Figure 5, page 51).
- Number of milliliters of Bonzi is unknown.

2. Perform calculations:

- *Amount of PGR = $\frac{\text{Desired concentration (ppm) x Final volume (gallons)}}{\text{Conversion constant}}$*
- *Amount of PGR = $\frac{\text{1.5 ppm x 94 gal.}}{\text{1.06}}$*
- *141 ÷ 1.06 = 133 ml of Bonzi needed*

Example 6. A grower has 1,600 Easter lilies growing in 6-inch pots. The recommended rate for Sumagic applied as a drench on Easter lilies is .25-.5 ppm. How many gallons of diluted Sumagic solution are needed to drench the lilies, and how many fluid ounces of Sumagic will be needed if the application rate is .5 ppm?

1. List all variables to find out what is known and unknown:
   - 1,600 6-inch pots of Easter lilies.
   - .5 ppm Sumagic to be applied as a drench.
   - Recommended drench volume for Sumagic: 4 fl.oz. per 6-inch pot (see Figure 4, page 50).
   - Number of gallons of diluted Sumagic solution is unknown.
   - Number of fluid ounces of required Sumagic is unknown.
   - Conversion constant is 3.91 (see Figure 5, right).
2. Perform calculations:
   - $\#\ gallons\ needed = \frac{\#\ pots \times drench\ volume\ per\ pot}{128}$
   - $\#\ gallons\ needed = \frac{1{,}600\ pots \times 4\ fl.oz.\ per\ pot}{128}$
   - *6,400 ÷ 128 = 50 gal. of diluted Sumagic solution needed*
   - $Amount\ of\ PGR = \frac{Desired\ concentration\ (ppm) \times Final\ volume\ (gallons)}{Conversion\ constant}$
   - $Amount\ of\ PGR = \frac{.5\ ppm \times 50\ gal.}{3.91}$
   - *25 ÷ 3.91 = 6.4 fl.oz. of Sumagic needed to prepare 50 gal. of diluted solution* GPN

Thomas Boyle is a professor in the Department of Plant, Soil & Insect Sciences at the University of Massachusetts. He can be reached at tboyle@pssci.umass.edu or (413) 545-3586.

Conversion Constants

PGR	Fluid ounces per gallon[b]	Milliliters per gallon[c]
A-Rest (SC)[a]	2.06	0.07
Atrimmec (PBI)	1,563	52.8
B-Nine (CC)	6,641	225
Bonzi (SP) or Piccolo (FA)	31.3	1.06
Cycocel (OHP)	922	31.2
Fascination (VC)	140	4.74
Florel Brand Pistill (MC)	305	10.3
ProGibb T&O (VC)	264	8.93
Sumagic (VC)	3.91	0.132

[a]Initials in parentheses indicate the product's manufacturer/marketer. See page 46 for a key and contact information.
[b]Ounces (avoirdupois) per gallon for B-Nine WSG.
[c]Grams per gallon for B-Nine WSG.

Figure 5. There are two conversion constants for each PGR: one for fluid ounces per gallon and the other for milliliters per gallon.

LearnMore
For more information related to this article, go to www.gpnmag.com/lm.cfm/gp050606