

PGR Basics and PGR Use on Herbaceous Perennial Plants

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Production of Quality Plants

- Build a quality plant from the start
- Right plants
- Proper cultural conditions
- Proper chemical intervention
- Focus on quality
- Use tools available:
 - Develop plant architecture
 - Manage plant growth



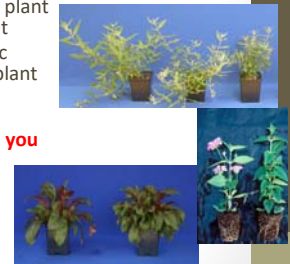
Cultural Practices

- Spacing
 - Light is best PGR
 - High light promotes branching
- Shearing/pinching
 - Moderate pruning promotes branching
 - Hard pruning promotes leaders
 - High labor costs



Selecting the “Right” Plant Growth Regulator

- PGRs are designed to affect plant growth and/or development
- PGRs are applied for specific purposes to affect specific plant responses
- **What specific response are you wanting to affect?**
 - Shoot elongation
 - Plant habit – branching
 - Flowering/Other
- Still more ART than Science!



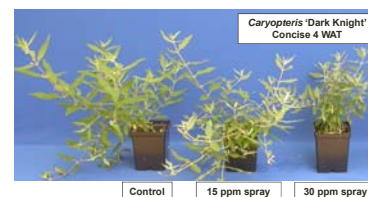
Expanding PGR Toolbox

Type	Chemical	Products
Anti-GA	Ancymidol	Abide, A-Rest
	Chlormequat Cl	Citadel, Cycocel
	Daminozide	B-Nine, Dazide
	Fluprimidol	Topflor
	Paclobutrazol	Bonzi, Paczol, Piccolo, Piccolo 10 XC, Downsize (<i>drenches only</i>)
	Uniconazole	Concise, Sumagic
Structural	BA	Configure
	GA	Florigib, ProGibb T&O
	BA+GA	Fascination, Fresco
	Dikegulac sodium	Atrimmec [Augeo]
	Ethephon	Collate, Florel

B.Whipker

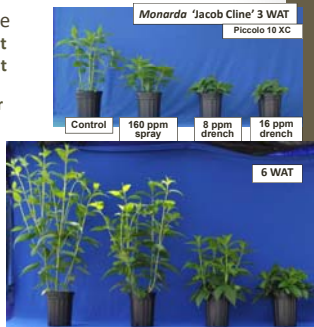
Choosing a PGR to Limit Shoot Elongation

- Use plant **growth** retardant – an anti-GA product
- Reduce growth **rate** not size
- Cannot “shrink” the plant



Benefits of Growth Retardants

- Control plant height/size
 - Less space used per plant
 - Can meet shipping height requirement
 - Can ship more plants per load
 - Buffer period of growth control



Additional Benefits of Growth Retardants (anti-GAs)

- Improve plant quality
 - Deeper color
 - Strengthen stems
- Increases disease resistance
 - Some cases
- Increase stress resistance
 - Have less shrinkage (production losses)
 - Have longer shelf life (production and retail)



PGRs – NO Soil Activity

- Typically short-term responses
- Uptake by leaves; good coverage required
- Labeled for use as spray applications
- Daminozide
 - **B-Nine WSG (OHP)**
 - Application in greenhouse or nursery; restricted to containers if not under cover
 - **Dazide (Fine Americas)**
 - Application inside enclosed structures (greenhouse, shadehouse) to containers only

PGRs – LIMITED Soil Activity

- Some root uptake
- Primarily foliar applications; good coverage required
- Chlormequat Cl (not labeled for chemigation)
 - Labeled for spray or drench applications
- **Cycozel (OHP)**
 - Applications in greenhouse or nursery; restricted to containers if not under cover
- **Citadel (Fine Americas)**
 - Application to containerized ornamentals in greenhouses

PGRs – Soil ACTIVE

- Taken up by shoot and root tissues
- Typically more potent than foliar only
- Ancymidol (labeled for chemigation except CA)
 - **A-Rest (SePRO)**
 - **Abide (Fine Americas)**
 - Labeled for use on containerized plants grown in nurseries, greenhouses, shadehouses or interiorscapes
- **Topflor (flurprimidol; SePRO)**
 - Labeled for chemigation
 - Labeled for use on containerized plants grown in nurseries, greenhouses, shadehouses (except NY, greenhouse only)
- **Topflor Granular (flurprimidol; SePRO)**
 - Topical application to containerized ornamentals

PGRs – Soil ACTIVE

- Paclobutrazols (labeled for chemigation)
 - **Bonzi (Syngenta Professional Products)**
 - Sprays or drenches on containerized ornamentals in nurseries, greenhouses, shadehouses or interiorscapes
 - **Downsize (Greenleaf Chemical)**
 - Drenches only on containerized ornamentals in nurseries, greenhouses, shadehouses or interiorscapes
 - **Paczol (OHP)**
 - Sprays, drenches, or liner soaks on containerized ornamentals in nurseries, greenhouses, shadehouses or interiorscapes
 - **Piccolo & Piccolo 10 XC (Fine Americas, Inc.)**
 - Sprays permitted only in enclosed greenhouses
 - Drenches or liner soaks on containerized ornamentals in nurseries, greenhouses, shadehouses or interiorscapes

PGRs – Soil ACTIVE

- Uniconazoles
 - Not labeled for chemigation
 - Sprays or drenches on containerized ornamentals in greenhouses, shadehouses or lath structures
 - 8 to 10 times more potent than paclobutrazol
 - **Concise** (Fine Americas, Inc.)
 - **Sumagic** (Valent USA/NuFarm)

Timing of PGR Applications

- Plants should be actively growing and healthy
- Time the PGR application to the plant's growth and/or development
- Learn how your plants grow and develop so that you can anticipate interventions!
- Read the PGR label, PGR Guides and other resources for guidance



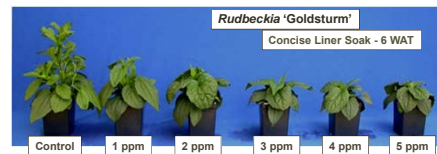
Timing to Reduce Growth Rate

- Apply PGRs when plants reach a predetermined number of leaves [bedding plant plugs]
- Or, a predetermined height [bedding plants, caladiums, cut flowers]
- Or, as stem elongation begins (just prior to stem stretch) [bedding plants, perennials]
- Or, x days after pinching or when laterals reach a predetermined length [Mums, azalea]
- Or, when flower stalks start to elongate [*Delphinium*], or reach the top of the foliage [*Echinacea*], or show color [*Astilbe*]



Timing to Avoid Delaying Flowering

- Use the appropriate PGR and rate
- Apply growth retardants well before flowering [Bedding plants]
- Or, after flower initiation [*Rudbeckia hirta*]
- Or, after flower stems elongate [*Digitalis*]



Foliar Sprays

- Foliar sprays are most often used, economics, ease of use
- Volume critical for soil active PGRs
 - Apply evenly to area not to plants
 - Impacts DOSAGE
 - Want a constant volume
 - Use pressure gauge and pressure regulator
- Uniformity of crop depends on uniformity of application



Selecting the Dosage

- PGRs w/ No or Limited Soil Activity
 - Dosage = rate (ppm of solution)
- Soil Active PGRs
 - Dosage = [ppm] x [volume]

Application Uniformity = Uniform Crop!



- Apply evenly to the area not to plants
- Use a constant volume – monitor equipment

Other Spray Application Notes

- Addition of surfactant may be necessary for plants with waxy leaves
 - **Check PGR label!!!**
- Spray applications have the most potential to delay flowering when applied late in crop
- Multiple applications may be required
- For nursery applications, pay attention to environmental conditions
 - Status of plant at time of application
 - To reduce phyto treat unstressed plants under moderate temperatures

Relative Absorption Time of Foliar Applications

PGR	Trade Names	Chemical Absorption (hours)
Ancymidol	Abide / A-Rest	0.5 to 1
Chlormequat	Citadel / Cycocel	4
Daminozide	B-Nine / Dazide	18 to 24
Ethephon	Collate / Florel	12 to 16
Flurprimidol	Topflor	0.5 to 1
Paclobutrazol	Bonzi / Paczol / Piccolo	0.5 to 1
Uniconazole	Concise / Sumagic	0.5 to 1

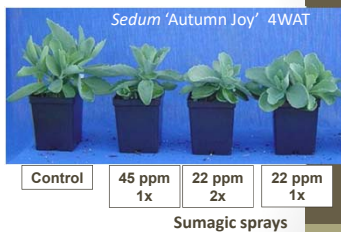
BWhipker

Environmental Factors to Improve PGR Absorption

- Low drying conditions after application
- Select cloudy days, early morning or late afternoon for foliar applications
- Moderate temperatures
- High relative humidity
- Limited air movement

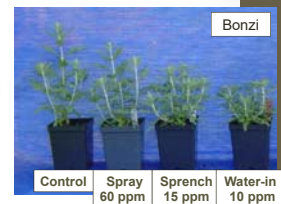
Reasons to Use Multiple Applications

- Reduce risk of overdose
- Easier to adapt to variable growing conditions or market
- More grower control
- Watering-in is the ultimate in growth control through multiple applications



Sprencches – High volume sprays

- Hybrid of spray and drench
- Soil ACTIVE PGRs
- 2-4 times the recommended spray volume
- Uses rate between spray and drench (one-half to one-quarter the spray rate)
- Can be more effective than spray



Summary PGR Volume – Soil ACTIVE PGRs

- Volume is critical to growth regulation
 - Response
 - Uniformity
- Volume is a application tool
 - Increasing volume increases the dosage
 - Increasing volume increases root zone availability

Drenches – Soil Active PGRs

- Provides uniform growth control
- Correct dosage:
 - Correct volume & concentration
 - Volume increases with pot size
- Good soil moisture at application
- Typically one application
- Labor intensive application – unless using chemigation; automated equipment available
- Subirrigation: use ~½ drench rate



Hibiscus moscheutos 'Grenache'



- Sumagic saturated response between 0.5 and 1.0 ppm drench (10 fl.oz. per pot), 6 WAT

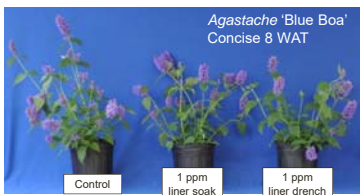
Early Growth Regulation with Liner Soaks or Liner Drenches

- Liner soaks
 - Dip root ball in PGR solution
 - Liners ready for irrigation = "dry"
 - Early control of vigorous crops
 - Flexibility of treatment (REI)
- Liner drenches
 - Drench the liner with PGR solution prior to transplant
 - Manually or use irrigation boom or water tunnel
 - Take care with volume – be consistent!!

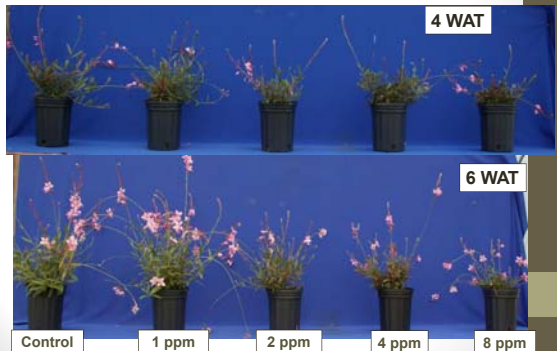


Liner Soaks or Liner Drenches?

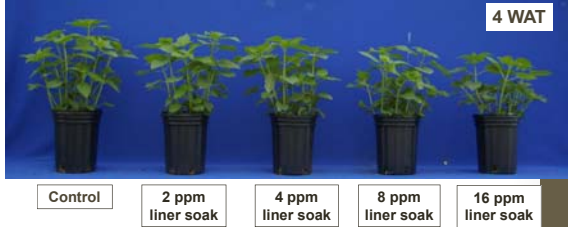
- Soak time is not critical – 30 sec to 2 min
 - Be consistent!!
- Drench volume affects efficacy
 - Be consistent!!
- Learn the ART of growth regulation!



Piccolo 10 XC Liner Soaks on *Gaura* 'Pink Fountain'



Piccolo 10 XC: *Monarda* 'Raspberry Wine'



Control 2 ppm liner soak 4 ppm liner soak 8 ppm liner soak 16 ppm liner soak

Miscanthus sinensis 'Gracillimus'



Control 1 ppm 2 ppm 3 ppm 4 ppm 5 ppm

- Concise liner soaks on divisions; 6 WAT
- Reduced pruning

Tips for Liner Soaks or Drenches

- For vigorous plants needing early control
- Liners ready for irrigation = "dry" liner
- Develop a consistent application protocol; Then determine a suitable rate
- No loss of effectiveness of soak solution
- Liner soak has less potential to delay flowering compared to overhead drench or foliar sprays
- Plant immediately or hold liners
- Reduces number of outdoor treatments required
- Not all soil-active PGRs labeled for liner soaks BUT they are labeled for drenches

Choosing PGRs to Match the Applicator

- Little to no experience?
 - Use PGRs with little or no soil activity
 - Typically short-term responses, multiple applications required
 - Daminozide [B-Nine; Dazide]
 - Chlormequat Cl [Citadel; Cycocel]
 - Tank mix of daminozide and chlormequat
 - Uptake by leaves; good coverage required but volume of application less critical



Control Dazide 5000 x 2

Choosing PGRs to Match the Applicator

- More experienced or chemigation available?
 - Use soil active PGRs - taken up by shoot and root tissues - ancymidol, paclobutrazols, uniconazole and flurprimidol
 - Application volume affects dose
 - More potent, longer lasting effects
 - Application uniformity CRITICAL!!



10 ppm Sumagic

Choosing a PGR to Increase Shoot Elongation

- To increase shoot growth
 - Use gibberellins (GA₃ or combo with BA)
 - Elongation of stems/flower stalks like cut flowers
 - Counteracts PGR overdoses by restoring GAs



Growth retardant overdose



3 ppm GA 2 WAT

Choosing a PGR to Affect Plant Habit

- Use a branching agent to affect habit
 - Apply or activate plant hormones
 - Activate dormant buds
 - Stimulate adventitious buds
 - Axillary buds grow out normally
- Options include
 - Benzyladenine [Configure, Fine Americas]
 - Ethephon [Collate, Fine Americas; Florel, Monterey Chemical]
 - Dikegulac sodium [Atrimmec, PBI Gordon]



Timing to increase branching/pot fill?

- A substitute for manual pinching or shearing
- Apply branching agents when plant has sufficient stem development for branching
- Number of nodes or lateral buds
- Has enough foliage to intercept and absorb your PGR application

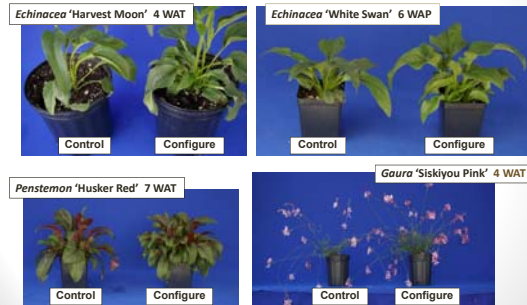


Configure on *Veronica* 'Goodness Grows'



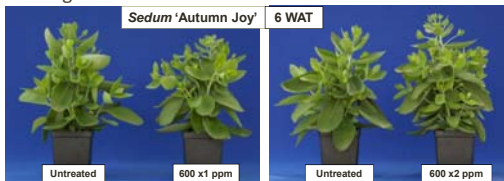
- Finished liners at 4 WAT, all treatments had an increase in number of branches, control 2.3 vs 9.3
- Finished plants: no differences in branches

Configure Improves Branching and Pot Fill



Multiple Applications – Branching Agents

- Configure applications at least 2 weeks apart to avoid phytotoxicity
- Tank mix second app with paclobutrazol to control elongation



Configure applied once = no increase

Configure applied twice = 2.5x branches

Tips on Branching Agents

- Generally improves branching during liner production
- Apply after rooting (plants coming off mist)
- Note phytotoxic effects on some crops
- Short-term activity in crops; multiple applications recommended
- Make second applications shortly after transplanting liners to finished containers (note ethephon effects on flowering and growth regulation of Augeo/Atimtec)
- For photos of additional crops, visit our website:
 - <http://www.hort.vt.edu/floriculture/presentations.html>

Choosing a PGR to Affect Flowering or Other Processes

- Regulating flowering
 - Ethephon (Florel or Collate) releases ethylene inside the plant
 - Abortion of flowers, enhances branching, may reduce elongation; used in propagation or to delay or synchronize flowering
 - Some crops responsive to gibberellins (GA_3) to enhance flowering Ex. Florist azalea, some cut flowers, statice, calla lilies
- Other
 - Gibberellin combos reduce lower leaf yellowing of LA hybrid lilies and "whiten" poinsettia bracts



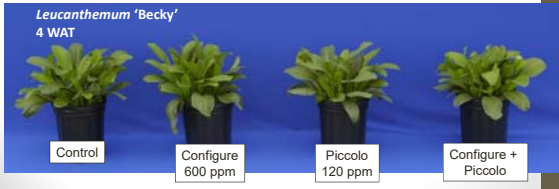
Plants are People, too!

- They have preferences!
- Some plants respond better to some products than to others
- Use all our resources to help you narrow the field
 - Look under the "Grower Resources" tab at <http://fine-americas.com/>
 - 2017-2018 PGR Guide for Annuals
 - 2016-17 PGR Guide for Perennials



The "Right" Plant Growth Regulator

- Right chemical for the job
 - Retardant vs.(?) branching (growth enhancers)
- Right chemical for the applicator's experience level
- Right chemical, rate and timing for the plant
- Learn the ART of growth regulation!



Benefits of Using PGRs

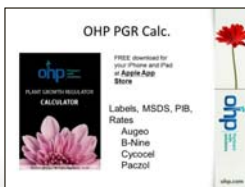
- Grower using PGRs:
 - Less space used per plant (↓ cost of prod)
 - Have less shrinkage (↓ production losses)
 - Have longer shelf life (production and retail)
 - Can meet shipping height requirements
 - Can ship more plants per load
- PGRs improve plant quality
 - Plant height impacts perceived quality
 - Improved branching and pot fill
- Results in higher quality and more saleable plants



****Higher profits!****

PGR MIX MASTER

- Brian Krug (formerly of Univ. New Hampshire) & Fine Americas, Inc.
- Now web-based app
- <http://e-gro.org/mixmaster/>



VIRGINIA TECH
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<http://e-gro.org/>

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