Using PGRs to Enhance Production of Herbaceous Perennials

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Presented by:

- Crop and Cultivar
- Growth habit
- Clumping vs. upright
- Greenhouse vs. nursery
- Production time
  - Time of year
  - Length of production time
  - Container size
  - Green or in flower?

Expanding PGR Toolbox

<table>
<thead>
<tr>
<th>Type</th>
<th>Chemical</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-GA</td>
<td>Ancymidol</td>
<td>Abide, A-Rest</td>
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<td></td>
<td>Chlormequat CI</td>
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Cultural Practices

- Irrigation practices
  - Drier uses less PGR
- Growing temperatures
  - Less PGR if cooler
- Spacing
  - Light is best growth regulator
- Light levels
  - Less PGR if higher
- Shearing/pinching
  - Vigorous growth

Achillea ‘Red Beauty’

- Overwintered with or without slow-release fertilizer
- Same PGR regime??

With slow-release fert | No slow-release fert

Anti-GAs are Cell Elongation Inhibitors

Shoot Apex

New cell

Cell Expansion
**Gaura lindheimeri** ‘Whirling Butterflies’

- Control
- Sumagic 15 ppm
- Sumagic 30 ppm
- Sumagic 45 ppm
- Sumagic 60 ppm

- Growth retardants reduce GROWTH not height!

**Gaura lindheimeri** ‘Siskiyou Pink’

- Control
- B-Nine 5000 ppm
- B-Nine/Cycocel 5000/1500 ppm

**Benefits of Growth Retardants**
- **Control plant growth (height or size)**
  - Less space used per plant in production
  - Buffer period of growth control
  - Can meet shipping height requirements
  - Can ship more plants per load

- **Improve plant quality & uniformity**
  - Deeper color
  - Strengthen stems
  - Plant height impacts perceived quality (balance)

- **May increase disease resistance**

- **Increase stress resistance**
  - Have less shrinkage (production losses)
  - Have longer shelf life (production and retail)

**Grower Benefits**
- **Growers using PGRs:**
  - Reduce cost of production
  - Reduce shrinkage
  - Can ship more plants per load
  - Longer shelf life (greenhouse or retail)
  - PGRs ➔ higher quality and more saleable plants
  - Growers who use PGRs can make more MONEY!

**PGRs – NO Soil Activity**
- Typically short-term responses, multiple applications required
- Uptake by leaves; good coverage required
- Daminozide
  - B-Nine WSG (OHP)
  - Dazide (Fine Americas)

**Veronica ‘Sunny Border Blue’**

- Control
- B-Nine 5000 x 2
PGRs – LIMITED Soil Activity
- Some root uptake
- Primarily foliar applications; good coverage required
- Chlormequat Cl
  - Citadel (Fine Americas)
  - Cycocel (OHP)
- NOT labeled for chemigation
- Cycocel labeled for outdoor application
- Labeled for tank mix with daminozide

PGRs – Soil ACTIVE
- Taken up by shoot and root tissues
- Typically more potent than foliar only
- Ancymidol (labeled for chemigation)
  - Abide (Fine Americas)
  - A-Rest (SePRO)
- Flurprimidol (labeled for chemigation)
  - Topflor (SePRO)

Piccolo 10XC
- Fine Americas has introduced a more concentrated form of their paclobutrazol PGR Piccolo.
  - New formulation is 10x stronger
  - Smaller, more convenient package size: + 1 qt. Piccolo 10XC = 2.5 gal. Piccolo
- Overcomes the potential settling problems associated with all paclobutrazol formulations
- Trials throughout the U.S. by university researchers found similar efficacies with both Piccolo and Piccolo 10XC.

Tank Mix Daminozide/Chlormequat Cl
- B-Nine/Cycocel Tank Mix, 4 WAT
- Good control with single application

Veronica 'Icicle'
- Abide drenches at 2 fl. oz. per quart pot
- Plant ht: Control 10 inches vs. 8 ppm drench 4 inches
Relative Activity of Anti-GA PGRs

- Ancymidol
- Daminozide + Chlormequat
- Paclobutrazol
- Uniconazole
- Flurprimidol

Leaf: Less, Substrate: More

Impact of PGR Choice on Dosage

- PGRs w/ No or Limited Soil Activity
  - Dosage = rate (ppm of solution)

- Soil Active PGRs
  - Dosage = [ppm] x [volume]

Foliar Sprays

- Most often used, economics, ease of use
- Volume critical for soil active PGRs
- Uniformity of crop depends on uniformity of application
- Efficacy affected by environmental conditions and plant status

Soil Active = Volume is Critical!!

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

Application Uniformity

- Control
- 10 ppm Sumagic

Application Uniformity = Uniform Crop!

- 10 ppm Sumagic
- 50 ppm Bonzi

Control 1 gal/200 sf 2 gal/200 sf
**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
- Uniformity of application produces uniform response
- Volume is an application tool

**Environmental Factors Improving 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

**Liner Dips/Soaks – Soil Active PGRs**

- Dip root ball in PGR solution
- Plugs ready for irrigation = “dry” plug
- Early control of vigorous crops
- Flexibility of treatment (REI)

**Liner Dip – Bonzi on *Perovskia***

- Goal is to provide baseline control of vigorous crops
- Make additional treatments later if necessary

**Liner Dip – Concise on *Miscanthus***

- *Miscanthus sinensis* ‘Gracillimus’
- Crops less responsive to spray applications
Liner Dips/Soaks

- Plugs ready for irrigation = “dry” plug
- Time not critical – 30 sec to 2 min
- Be consistent
- Plant immediately or hold them
- No loss of effectiveness of dip solution
- Less potential to delay flowering compared to overhead drench or foliar sprays

Chemical Approach to Branching

**Goal is to improve plant architecture**

- Release apical dominance
- Increase branching and improve quality
- Substitute for pinching
  - Pinching labor intensive
  - Pinching delays growth and bloom

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Floret Brand Growth Regulator

(Monterey Chemical)

- Ethylene releasing compound
- Absorbed by leaves
- Delays flowering
  - Excessive at high rates
- Enhances branching
- Used on stock plants, hanging baskets, pansies
- Broad label

Configure (Fine Americas, Inc.)

- 6-BA (benzyladenine; promotes cell division)
- Stimulates – but does not cause – branching or flowering
  - Windows of opportunity
- Short period of activity
  - Multiple applications may be beneficial
- Complete spray coverage required
  - Not actively transported throughout the plant

Augeo (OHP, Inc.)

- Active ingredient ≥8% dikegulic-sodium
- Marketed as a branching agent
- Apply early in the crop cycle to stimulate branching and allow ample time for new leaf growth to cover any yellowing or leaf necrosis that may occur
- Broad label for spray applications on ornamentals
Configure on *Agastache* ‘Purple Haze’

- Finished liners
  - ↑ branches 40%
  - ↓ root weight

- Finished plants
  - Reduction in root weight of liners did not affect growth or appearance

Configure on *Gaura* ‘Siskiyou Pink’

- Finished liners at 3 WAT

- **Control 600 ppm**
  - Increased number of shoots per pot at 4 WAT
  - Control 5 vs. Configure 7.3 shoots/pot
  - Increased lateral branching of shoots at 4 WAT
  - Control 29.8 vs. Configure 39.4 branches/pot

- Untreated

Augeo and Configure on *Nepeta* ‘Walker’s Low’

- Untreated

- **Au 800**, **Au 1600 ppm**
  - ↑ branches
  - 1600 ppm ↓ height

- **Conf 600 ppm**
  - No effect branches

- Finished plants treated twice

  - **Au 800** ppm: ↑ branches 800 ppm or 1600 ppm ↓ height & shoot wt
  - **Conf 600** ppm: ↑ branches, ↑ shoot wt 600 ppm

Configure on *Phlox* ‘Bright Eyes’

- Untreated

- **2 x 600 ppm**
  - ↑ branches
  - ↑ shoot wt 600 ppm

- 600 ppm
Finished liners at 4 WAT

Finished liners, all trts
- ↑ leaders (250-350%)
- ↑ branches (20%)

Finished plants 800, 1600
- ↑ leaders
- ↑ branches

Augeo on Rosmarinus ‘Hill Hardy’

Augeo and Configure on Sedum ‘Autumn Joy’

Finished plants treated twice

Augeo and Configure on Sedum ‘Autumn Joy’

Finished liners
- Augeo 800, 1600 branches 100%
- Height, shoot wt 800, 1600

Configure
- ↑ branches 300%

Finished plants
- Augeo 800, 1600 branches 100%
- Height, wt 800, 1600

Configure
- ↑ branches 300%

Summary – Branching Agents

- Branching agents can improve branching during plugliner production
- Decreases in rooting do not affect finished plant quality
- Branching agents have phytotoxic effects on some crops
- Branching agents have limited activity in some crops which indicates a value in reapplying branching agents to the plants shortly after transplanting liners to finished containers.

Augeo and Florel on Veronica ‘Goodness Grows’

Finished liners at 3 WAT

Finished liners
- Augeo and Florel ↑ branches
- Stunting Au 1600

Finished plants
- Augeo and Florel ↑ branches
- Stunting Au 800, 1600

Summary – Branching Agents

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PGRs for Branching: Key Points

- Spring applications before or at transplant if actively growing
- Configure
  - 300 to 600 ppm (multiple) applications
- Augeo
  - 400 to 800 ppm single application
  - Multiple appl if first is in liner stage
- Florel
  - 350 to 500 ppm single application in plug tray (if 6 to 8 weeks from market window)

Specific Crop Responses

- These are SOUTHERN, single application, rates
- Northern growers start with half the growth retardant rates
- Test rates and application methods under your greenhouse or nursery conditions
Configure on *Echinacea* ‘Magnus’

**Echinacea** (# branches at 4 WAT)

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Control</th>
<th>Configure 600 ppm</th>
</tr>
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<tbody>
<tr>
<td>Magnus</td>
<td>3.8</td>
<td>6.6</td>
</tr>
<tr>
<td>White Swan</td>
<td>2.4</td>
<td>11.4</td>
</tr>
<tr>
<td>Doubledecker</td>
<td>1.2</td>
<td>4.6</td>
</tr>
<tr>
<td>Ruby Star</td>
<td>4.4</td>
<td>11.2</td>
</tr>
<tr>
<td>Tiki Torch</td>
<td>1.7</td>
<td>4.1</td>
</tr>
<tr>
<td>Merlot</td>
<td>1.3</td>
<td>2.9</td>
</tr>
<tr>
<td>Fragrant Angel</td>
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**Final Number of Basal Branches**

*Echinacea purpurea* ‘White Swan’ at 8 WAP

- **Untreated**
- **600 ppm Configure**

**Earlier Pot Fill with Configure**

- *Echinacea* ‘White Swan’ at 4 WAP
- Improved pot fill with earlier applications

**Configure: Key Points for *Echinacea***

- **Spring applications:**
  - In plug flat or within 3 weeks after planting plugs
  - Actively growing with good root growth
  - Single application of 600 ppm or multiple applications of 300 ppm at 2-wk interval
- **Summer/Fall applications:**
  - As above with multiple applications of 300 to 600 ppm
  - Repeat Configure application(s) in Spring

**Augeo on *Echinacea* ‘Sombrero Hot Pink’**

- 800 and 1600 ppm Augeo increased branching; 8 WAT
- Control 6.0 vs. 1600 ppm 9.5 branches (fewer flowers)
**Echinacea ‘Ruby Star’**

- Topflor <45 ppm
- Multiple appl of 20 to 25 ppm

**Echinacea PGR Recs**

- Sumagic/Concise: 15 to 30 ppm; 1 ppm drench
- Piccolo/Piccolo 10 XC/Bonzi/Paczol/Downsize: 30 to 40 ppm sprays; 6 ppm drench
- B-Nine/Dazide: 5000 ppm, multiple appl
- B-Nine/Dazide –Citadel/Cycocel: 5000/1500 ppm
- Topflor: 25 ppm
- Abide/A-Rest: 30 ppm
- Configure: 300 to 600 ppm (multiple)
- Augeo (finish only): 800 ppm

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**Coreopsis grandiflora ‘Sunray’**

- Paclobutrazol 80+ppm, multiple applications
- Concise/Sumagic 40 to 60 ppm, cv dependant
- B-Nine/Dazide 5000 ppm; Tank Mix also effective

**Coreopsis ‘Sweet Dreams’**

- Piccolo 10XC; Quadratic reductions in height and width with increasing rate
- No treatment effect on days to flower

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- Paclobutrazol 80+ppm, multiple applications
- Concise/Sumagic 40 to 60 ppm, cv dependant
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**Coreopsis ‘Sweet Dreams’**

- Paczo liner dip, 4 WAT
- “Dry” plugs, 2 min
- Configure on Coreopsis 'American Dreams'
- Battlefield Farms

- Bonzi sprays, 4 WAT, little control

- Bonzi drenches, 4 WAT, moderate control

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

- Sumagic, multiple applications, 4 WAT
**Monarda 'Jacob Cline'**

- Topflor foliar spray, 4 WAT

**Monarda PGR Recs**

- Cultivar differences
- B-Nine/Dazide multiple appl 5000 ppm
- Concise/Sumagic 15 to 30 ppm
- Little response to paclobutrazol
- Topflor <30 ppm

**Penstemon digitalis ‘Husker Red’**

- Concise reduced height, width, and shoot dry weight

**Penstemon ‘Laura’**

**Penstemon PGR Recs**

- Concise/Sumagic: 5 to 10 ppm sprays; <0.5 ppm drench
- Piccolo/Piccolo 10 XC/Bonzi/Paczol: 25 to 30 ppm sprays; 8 to 16 ppm liner dips
- B-Nine/Dazide: 5000 ppm, multiple appl
- Tank Mix: B-Nine/Dazide + Citadel/Cycocel: 5000 + 1500 ppm
- Topflor: unknown, test 20 to 30 ppm sprays
- Configure: 600 ppm
**Phlox subulata ‘Apple Blossom’**

- Piccolo gave moderate control of plant width at 6 WAT

**Phlox paniculata ‘David’**

- Concise liner dips on hard to control crops
- “Dry” plugs, 2 min.
- 6 WAT

**Augeo on Phlox paniculata ‘Laura’**

- 1600 ppm increased branching at 4 WAT
- Control 13.3 vs. 1600 ppm 26.8 branches
- No phyto but 3200 ppm stunted plants

**Configure on Phlox ‘Laura’**

- Configure increased branching, 6 WAT
- Control 15.7 vs. 600 ppm 21.0 breaks

**Concise on Rudbeckia ‘Goldsturm’**

- Spray 4 WAT
- Drench 4 WAT

**Concise on Rudbeckia ‘Goldsturm’**

- Drench 4 WAT
- Liner Dip 6 WAT
**Salvia leucantha**

- Linear height response to increasing rates

- Control 60 ppm
  - 45 ppm
  - 30 ppm
  - 15 ppm

**Sumagic 'Indigo Spires'**

- Sumagic moderate control at 45 to 60 ppm, 2 WAT, persisted through 4 WAT

**Salvia PGR Recs**

- B-Nine/Dazide at 5000 ppm, multiple applications
- B-Nine/Dazide – Citadel/Cycocel Tank Mix, good response
- Piccolo/Piccolo 10 XC/Bonzi/Paczol: 60 to 80 ppm, multiple applications
- Concise/Sumagic: 15 to 30 ppm
- Topflor: 45 ppm

**Sedum 'Autumn Joy'**

- Bonzi, 4 WAT, good control with higher rates

- Control 75 ppm
  - 40 ppm
  - 80 ppm
  - 120 ppm
  - 160 ppm

**Sedum 'Autumn Joy'**

- Topflor, multiple applications
**Benefits of Using PGRs**

- Grower using PGRs:
  - Less space used per plant (reduce cost of production)
  - Have less shrinkage (reduce production losses)
  - Have longer shelf life (production and retail)
  - Can meet shipping height requirements
  - Can ship more plants per load
- Plant height impacts perceived quality
  - PGRs: higher quality and most saleable

**Veronica ‘Icicle’ – 4 WAT**

- Spray 40 ppm Bonzi
- Drench 2 ppm Pic 10XC

**Veronica repens ‘Sunshine’**

- Piccolo, 6 WAT, excessive control

**Recordkeeping**

- Keep untreated plants as controls
- Note PGR, rates, and volumes
- Note growth stages and development, cultural details
- Note weather conditions at and after application
- Record assessment of effect of the treatment

**Successful PGR Use**

- Learn about PGRs
- Plan to use PGRs
  - Do your own research and testing; leave untreated plants
- PGRs are tools just like fertilizer and water
  - Know your plant materials
  - Adjust rates and timing to environmental conditions and your own cultural practices
- Practice using PGRs
  - Use proper rate and volume; check your math
  - Read the label
  - Pay close attention to equipment to apply proper volume
  - Keep records to refine your skill/art

**PGR MIX MASTER**

- Univ. New Hampshire & Fine Americas, Inc.
- Apple Store for iPad & iPhone
- Android Market for Android
- Blackberry version at UNH site
- [http://extension.unh.edu/Agric/AGMIX/PGRMIXMASTERHome.htm](http://extension.unh.edu/Agric/AGMIX/PGRMIXMASTERHome.htm)
For More PGR Information

- Product labels and use guides, such as from Fine Americas: www.fine-americas.com/Content/prodL.asp?id=85
- Virginia Tech: http://pubs.ext.vt.edu/430/430-103/430-103.html
- Virginia Tech PGR rates for perennials (searchable database): http://www.hort.vt.edu/floriculture
- Univ Maryland IPM http://www.ipmnet.umd.edu/greenhouse/gnhs_pubs.htm
- North Carolina State University: www.ces.ncsu.edu/depts/hort/floriculture/crop/crop_PGR.htm
- Michigan State University: www.flor.hrt.msu.edu/pgrs
- University of New Hampshire Floriculture Calculators http://extension.unh.edu/Agric/AGGHFL/PGRMixMasterHome.htm

For More Information:

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