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

PGRs for Perennial Liners and Finished Materials

Mara Grossman and Joyce Latimer
Virginia Tech Perennials Program
Blacksburg VA

Augeo (OHP, Inc.)
- Active ingredient 18% dikegulac-sodium
- Marketed as a branching agent
- Works by disrupting cell wall integrity, resulting in a pinching effect on the plant.
- Broad label for spray applications on ornamentals including bedding plants, herbaceous plants, perennials, woody ornamentals and trees.

Augeo – Keys to Use
- 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
- Apply to rooted, actively growing plants
- Plants should be stress free
- Apply sufficient volume to wet the foliage (2 qt/100 sf)

Configure (Fine Americas, Inc.)
- 6-BA (benzyladenine; promotes cell division)
- Label use on Christmas Cactus to promote vegetative branching (June to July) and increase flower bud count (September).
- Height control and branching of Hosta and Echinacea
- Supplemental label allows evaluation on additional crops

Configure - Keys to Use
- 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

Use Guide
Florel Brand Pustill (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

Methods and Materials
- URC into 72s
- Rooted under mist until roots visible on all 4 sides of plug

Methods and Materials
- Treatments were applied to six-packs of plugs
- Augeo
  - One or two applications of 400, 800 or 1600 ppm
- Configure
  - One or two applications of 300, 600 ppm
- Florel
  - One application of 500 ppm as either a spray or drench

Plants Studied
- Achillea ‘Moonshine’
- Agastache ‘Purple Haze’
- Aster ‘Professor Kippenburg’
- Campanula ‘Cherry Bells’
- Cosmos atrosanguineus
- Delosperma ‘Table Mountain’
- Gaillardia aristata ‘Galio Red’
- Gaura lindheimeri ‘Siskiyou Pink’
- Lavandula x intermedia ‘Provence’
- Leucanthemum x superbum ‘Snowcap’
- Nepeta x faassenii ‘Walker’s Low’
- Phlox paniculata ‘Bright Eyes’
- Rosmarinus officinalis ‘Will Hardy’
- Salvia nemorosa ‘May Night’
- Sedum spectabile ‘Autumn Joy’
- Verbena bonariensis ‘Lollipop’
- Veronica ‘Goodness Grows’

Configure on Achillea ‘Moonshine’
- Finished liners: no increased branches
- Finished plants: increased branches in 600x2
- Not responsive to Augeo

Configure on Agastache ‘Purple Haze’
- Finished liners at 3 WAT
- ↑ branches 40%
- ↓ root weight
- Reduction in root weight of liners did not affect appearance
Augeo on Aster ‘Anton Kippenburg’

Finished liners
- ↑ leaders 40%
- ↑ branches 30%
- 1600 ppm 3 WAT
- ↓ width, height

Finished plants
- No differences in branching after grow out.
- Not responsive to Florel

Configure on Aster ‘Anton Kippenburg’

- Significant phytotoxicity at 1 WAT
- Significant tip burn
- Did NOT grow out of damage at 3 WAT

Augeo on Campanula punctata

- Finished liners: ↑ branches 800 ppm
- Finished plants: no differences in branching
- Not responsive to Configure or Florel

Augeo on Cosmos atrosanguineus

- Treatment caused distorted leaves
- Increased leaders and branches persisted
- 1600 ppm
- Not responsive to Florel

Configure on Cosmos atrosanguineus

- Tested with Augeo and Configure
- Not responsive to Augeo or Configure as finished liners or finished plants

Delosperma cooperi ‘Table Mountain’

- Tested with Augeo and Configure
- Not responsive to Augeo or Configure as finished liners or finished plants
Finished liners
-  branches, height and shoot wt 1600

Finished plants
- 400 ↑ branches
- 1600 ↓ branches, height & shoot wt
- Flower delay 800, 1600

Finished plants treated twice
- 2 x 800
- 2 x 400

Configured on Gaillardia ‘Gallo Red’

Finished plants
- ↑ branches, leaders, shoot weight
- ↓ height

Finished plants treated twice
- ↑ branches, leaders in plants treated once or twice
- No difference in height
- Flower delay

Configured on Gaillardia ‘Gallo Red’

Finished liners at 2 WAT

Configure on Gaillardia ‘Gallo Red’

Finished liners at 2 WAT

Finished plants
- ↑ branches, leaders
- 600 ↑ x1
- ↑ shoot dry weight all Configure trts

Finished plants
- ↑ branches, ↑ leaders 300 x2

Configure on Gaura ‘Siskiyou Pink’

Finished plants
- ↑ branches, leaders

Finished plants
- ↑ branches, leaders

Configure on Lavandula ‘Provence’

Finished liners
- ↑ branches 800, 1600
- ↓ height 1600
- Configure no effect branches

Finished plants
- ↑ branches 1600 x2, ↑ height, shoot wt 800 x2 or 1600 x2
- Configure: ↑ branches, ↑ shoot wt 600 x2

Configure on Lavandula ‘Provence’

Finished liners at 4 WAT

Finished liners:
- ↑ branches 100%, ↓ root weight

Finished plants:
- Grow out not affected by reduced root dry weight
- No differences in branching

Augeo and Configure on Nepeta

Finished plants treated twice

Finished liners at 2 WAT

Finished liners
- Augeo ↑ branches 800, 1600
- ↓ height 1600
- Configure no effect branches

Finished plants
- Augeo ↑ branches 1600 x2, ↓ height, shoot wt 800 x2 or 1600 x2
- Configure: ↑ branches, ↑ shoot wt 600 x2

Configure on Leucanthemum ‘Snowcap’

Finished liners at 4 WAT

Finished liners: ↑ branches 100%, ↓ root weight

Finished plants:
- Grow out not affected by reduced root dry weight
- No differences in branching

Augeo and Configure on Nepeta
Finished liners
- ↑ branches, 
- ↑ shoot wt 1600
- ↑ height 800, 1600

Finished plants
- No branching differences in plants treated once
- ↑ branches 2 x 1600
- ↑ height 1600

Finished liners
- ↑ leaders (150-350%)
- ↑ branches (20%)

Finished plants
- ↑ leaders, 800, 1600
- ↑ branches

Finished liners at 2 WAT
- Untreated
- 2 x 400
- 2 x 800
- 2 x 1600

Finished plants at 2 WAT
- Untreated
- 2 x 600

Finished liners at 4 WAT
- Untreated
- 400
- 800
- 1600

Finished plants after grow out
- Untreated
- 400
- 800
- 1600

Finished liners at 4 WAT
- Untreated
- 300 x 1
- 300 x 2
- 600 x 1

Finished plants at 4 WAT
- Untreated
- 300 x 1
- 300 x 2
- 600 x 1

Finished liners at 3 WAT
- Untreated
- 400 ppm
- 800 ppm
- 1600 ppm

Finished plants at 3 WAT
- Untreated
- 400 ppm
- 800 ppm
- 1600 ppm

Finished liners
- ↑ branches 40%
- 300 x 1 or 300 x 2
- Finished plants: no differences in branches

Finished plants
- ↑ branches 100%-200%
- ↑ height, shoot wt 1600
- Configure
- ↑ branches 300%

Finished plants
- ↑ branches 200%
- ↓ height, wt 800, 1600
- phyto – yellowing
- Configure
- ↑ branches 200%
Branching Agent Phytotoxicity

- Augeo
  - Verbena - distorted leaves - plants grew out normally
  - Sedum - yellowing
- Florel
  - Aster - significant tipburn
  - Cosmos - distorted leaves
  - No phyto

### Summary of Branching Effects

<table>
<thead>
<tr>
<th>Plant</th>
<th>Configure</th>
<th>Augeo</th>
<th>Florel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achillea</td>
<td>↑ 600 x2</td>
<td>No effect</td>
<td>NA</td>
</tr>
<tr>
<td>Agastache</td>
<td>↑ 40%</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Aster</td>
<td>Phyto</td>
<td>↑ 30% 1600</td>
<td>No effect</td>
</tr>
<tr>
<td>Campanula</td>
<td>No effect</td>
<td>↑ 40% 800</td>
<td>No effect</td>
</tr>
<tr>
<td>Cosmos</td>
<td>Phyto</td>
<td>↑ 30%</td>
<td>No effect</td>
</tr>
<tr>
<td>Delosperma</td>
<td>No effect</td>
<td>No effect</td>
<td>NA</td>
</tr>
<tr>
<td>Gaillardia</td>
<td>↑ 600 x1 or 600 x2 flower delay</td>
<td>↑ 400; 800 or 1600 caused stunting, flower delay</td>
<td>NA</td>
</tr>
<tr>
<td>Gaura</td>
<td>↑ 20%</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Lavandula</td>
<td>↑ 20% 300 x2, 600 x1</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
Summary of Branching Effects con’t.

<table>
<thead>
<tr>
<th>Plant</th>
<th>Configure</th>
<th>Augeo</th>
<th>Floral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leucanthemum</td>
<td>↑ 100%</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Nepeta</td>
<td>↑ 50%</td>
<td>↑ branches height 800, 1600</td>
<td>NA</td>
</tr>
<tr>
<td>Phlox</td>
<td>↑ 50%</td>
<td>↑ branches height 1600</td>
<td>NA</td>
</tr>
<tr>
<td>Rosemary</td>
<td>↑ 40% 300x2 or 600x1</td>
<td>↑ 20% 400 or 800</td>
<td>No effect</td>
</tr>
<tr>
<td>Salvia</td>
<td>↑ 35% 300x1 or 300x2</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Sedum</td>
<td>↑ 200%-300%</td>
<td>↑ 100%-200% height 800, 1600</td>
<td>NA</td>
</tr>
<tr>
<td>Verbena</td>
<td>↑ 70%-140%</td>
<td>↑ 600-800%</td>
<td>↑ 250%</td>
</tr>
<tr>
<td>Veronica</td>
<td>↑ 100%-200%</td>
<td>↑ 1000%</td>
<td>↑ 600%</td>
</tr>
</tbody>
</table>

Summary

- Branching agents can improve branching during plug 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 plugs to finished containers.

Configure on Echinacea ‘Magnus’

Echinacea (# branches at 4 WAT)

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Control</th>
<th>Configure 600 ppm</th>
</tr>
</thead>
<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>
<td>2.6</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Final Number of Basal Branches

Echinacea purpurea ‘White Swan’ at 8 WAP

Earlier Pot Fill

- 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

Configure on *Gaillardia*

- G. arista ‘Dazzler’ at 4 WAT with 600 ppm
  - Breaks: Untreated 23.4 vs. Configure 153

Configure on *Lobelia cardinalis*

- Number of basal branches increased at 2, 4 and 6 WAT
  - 2WAT Control 3.8 vs Configure 12.8 breaks
  - 4WAT Control 7.3 vs Configure 12.9 breaks
  - 6WAT Control 10.6 vs. Configure 16 breaks

Configure on *Gaura ‘Siskiyou Pink’*

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

Configure on Perennials (600 ppm; *p*≤0.05)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Untreated</th>
<th>BA</th>
<th>WAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaura ‘Siskiyou Pink’</td>
<td>29.8</td>
<td>39.4</td>
<td>4</td>
</tr>
<tr>
<td>Euphorbia ‘Chameleon’</td>
<td>13.5</td>
<td>20.0</td>
<td>6</td>
</tr>
<tr>
<td>Gaillardia ‘Dazzler’</td>
<td>23</td>
<td>153</td>
<td>4</td>
</tr>
<tr>
<td>Heuchera x ‘Raspberry Ice’</td>
<td>11.8</td>
<td>18.1</td>
<td>4</td>
</tr>
<tr>
<td>Lobelia cardinalis</td>
<td>7.3</td>
<td>12.9</td>
<td>4</td>
</tr>
<tr>
<td>Penstemon ‘Husker Red’</td>
<td>6.2</td>
<td>7.7</td>
<td>4</td>
</tr>
<tr>
<td>Lychnis ‘Vesuvius’</td>
<td>3.1</td>
<td>5.3</td>
<td>4</td>
</tr>
<tr>
<td>Veronica ‘Icicle’</td>
<td>2.5</td>
<td>3.6</td>
<td>2</td>
</tr>
<tr>
<td>Coreopsis ‘Zagreb’</td>
<td>43.2</td>
<td>98.8</td>
<td>2</td>
</tr>
<tr>
<td>Leucanthemum x ‘Alaska’</td>
<td>9.5</td>
<td>14.9</td>
<td>2</td>
</tr>
</tbody>
</table>

Configure - Keys to Use

- Stimulates - but does not cause - branching or flowering
  - Windows of opportunity
  - Short period of activity (~1 week)
  - Multiple applications may be beneficial
  - Complete spray coverage required
  - Not actively transported throughout the plant
Augeo on *Gaillardia* ‘Gallo Yellow’

- Low rate increased branching
- Control 24.3 vs. 400 ppm 45.3 branches
- Rates >800 ppm severely stunted plants

Augeo on *Echinacea* ‘Sombrero Hot Pink’

- 800 and 1600 ppm increased branching; 8 WAT
- Control 6.0 vs. 1600 ppm 9.5 branches (fewer flowers)

Augeo on *Phlox* ‘Laura’

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

The Wow List To Get You Started

- *Cornus racemosa* ++ 1200+1
- *Rosa woodsii* ++ 1800
- *Cotoneaster* ++ 600 or 1200+2
- *Prunus besi* ++ 1200+1
- *Prunus tomentosa* ++ 1800
- *Prunus maritima* + all rate better than UTC
- *Acer ginnala* ‘Flame’ ++ 1200+.5
- *Buffalo berry* ++ 1200 + 0.5
- *Blueberry*+
- *Nuttall oak*+++ 

Augeo – Keys to Use

- 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
- Apply to well-rooted, actively growing plants
- Plants should be stress free
- Apply sufficient volume to wet the foliage (2 qt/100 sf); Trial starting point: 400 to 800 ppm foliar spray.

Expanding PGR Toolbox

<table>
<thead>
<tr>
<th>Type</th>
<th>Chemical</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-GA</td>
<td>Anoxymidol</td>
<td>Abide, A-Rest</td>
</tr>
<tr>
<td></td>
<td>Chlormequat Cl</td>
<td>Citadel, Cycoceil</td>
</tr>
<tr>
<td></td>
<td>Daminozide</td>
<td>B-Nine, Dazide</td>
</tr>
<tr>
<td></td>
<td>Flurprimidol</td>
<td>Topflor</td>
</tr>
<tr>
<td></td>
<td>Pardoflurazol</td>
<td>Bonzi, Pacuzol, Piccolo, Piccolo 10XC, Downsize (drenches only)</td>
</tr>
<tr>
<td></td>
<td>Uniconazole</td>
<td>Concise, Sumagic</td>
</tr>
<tr>
<td>Structural</td>
<td>GA</td>
<td>Conviron</td>
</tr>
<tr>
<td></td>
<td>GA+GA</td>
<td>Fascination, Fresco</td>
</tr>
<tr>
<td></td>
<td>Dihydroac sodium</td>
<td>Augeo</td>
</tr>
<tr>
<td></td>
<td>Ethephon</td>
<td>Floret</td>
</tr>
</tbody>
</table>

Augeo®

PLANT GROWTH REGULATOR
Anti-GAs are Cell Elongation Inhibitors

Gaura lindheimeri ‘Whirling Butterflies’

Growth retardants reduce GROWTH not height!

Other Potential Benefits of PGR Use

- Improved plant color
- Improved disease resistance
- Improved stress (drought, chilling) tolerance = better shipping and shelf life
- Increase stem strength = less damage during shipping and handling
- Improved plant quality and uniformity

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)
VFGA’s Herbaceous Perennials Production Update; Feb. 16, 2012

PGRs – LIMITED Soil Activity
- Some root uptake
- Primarily foliar applications; good coverage required
- Chlormequat Cl
  - Citadel (Fine Americas)
  - CycoceI (OHP)
- NOT labeled for chemigation
- CycoceI 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)

PGRs – Soil ACTIVE
- Paclorbutrazols (labeled for chemigation)
  - Bonzi (Syngenta Professional Products)
  - Downsize (Greenleaf Chemical)
  - Paczol (OHP)
  - Piccolo & Piccolo 10 XC (Fine Americas)
  - Uniconazoles (not labeled for chemigation)
  - Concise (Fine Americas)
  - Sumagic (Valent USA)

Piccolo 10XC
- Fine Americas has introduced a more concentrated form of their paclorbutrazol 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 paclorbutrazol formulations
  - Trials throughout the U.S. by university researchers found similar efficacies with both Piccolo and Piccolo10XC.

Relative Activity of Anti-GA PGRs

<table>
<thead>
<tr>
<th>Ancymidol</th>
<th>Daminozide + Chlormequat</th>
<th>Paclorbutrazol</th>
<th>Uniconazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>\textit{Less}</td>
<td>\textit{More}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Impact of PGR Choice on Dosage
- PGRs w/ No or Limited Soil Activity
  - Dosage = rate (ppm of solution)
- \textbf{Soil Active PGRs}
  - Dosage = [ppm] \times [volume]
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 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

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 Dip – Bonzi on Perovskia

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

Application Uniformity = Uniform Crop!

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

Environmental Conditions
- Status of plant at time of application
  - Water status
  - Temperature
  - Turgid, unstressed plant absorbs better
  - Time of day as affects plant stress

Relative Absorption Time of Foliar Application

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

Summary PGR Volume – Soil
ACTIVE PGRs

• Volume depends on application method
• Volume is critical to control
  • Uniformity of application and response
• Volume is a application tool
  • Increasing volume increases the dosage
  • Increasing volume increases root zone availability

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

Concise on Rudbeckia ‘Goldsturm’

Concise on Rudbeckia ‘Goldsturm’

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
  • Plant height impacts perceived quality
  • PGRs: higher quality and most saleable
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 timing; check your math
- **Read the label**
  - Pay close attention to equipment to apply proper volume
- **Keep records** to refine your skill/art

PGR Calculators

- New Hampshire / NCSU
  - [http://extension.unh.edu/Agric/AGGHFL/AGGHFL.htm](http://extension.unh.edu/Agric/AGGHFL/AGGHFL.htm)
- Android app, working on iPhone
- OHP PGR calculator
  - New Apple app program for iPhone, iPod, or iPad
  - Available at the Apple App store for free.

For More PGR Information

- Product labels and use guides, such as from Fine Americas: [www.fine-americas.com/Content/prodL.asp?id=85](http://www.fine-americas.com/Content/prodL.asp?id=85)
- Univ Maryland IPM [http://www.ipmnet.umd.edu/greenhouse/grnhs_pubs.htm](http://www.ipmnet.umd.edu/greenhouse/grnhs_pubs.htm)
- North Carolina State University: [www.ces.ncsu.edu/depts/hort/floriculture/crop/crop_PGR.htm](http://www.ces.ncsu.edu/depts/hort/floriculture/crop/crop_PGR.htm)
- Michigan State University: [www.flor.hrt.msu.edu/pgrs](http://www.flor.hrt.msu.edu/pgrs)
- Product representatives
- Experienced growers in your area

For More Information:

Mara Grossman; mgrossman@vt.edu
Joyce Latimer; jlatime@vt.edu

[http://www.horticulture.vt.edu/floriculture](http://www.horticulture.vt.edu/floriculture)