Today’s Presentation

- 9:45 am – 9:50 am (5 minutes):
  - What Cultural and PGRs are available to manage vigor – Joyce Latimer
- 9:50 am – 10:05 am (15 minutes)
  - Configuring finished crops – Joyce Latimer
- 10:05 – 10:15 am (10 minutes):
  - Recognizing and diagnosing the causes of plant stunting – Brian Whipker
- 10:15 am – 10:20 am (5 minutes)
  - FlogibUse Tips – Brian Whipker
- 10:20 am – 10:35 am (15 minutes)
  - Fresco Enhancement Strategies – Brian Whipker
- 10:35 am – 10:45 am Questions

CULTURAL AND PGR TOOLS

JOYCE LATIMER
Cultural Practices

- Nutritional
  - Increase P rate
  - Greater ratio of NH₄⁻N to NO₃⁻N
- Temperatures
  - +DIF
- Light
  - Increase light intensity and/or amount

PGR Guide: Fine/GrowerTalks

- 2019-2020
  - Greenhouse PGR Guide by Brian Whipker of NC State University
- 2018-2019
  - Perennial PGR Guide by Joyce Latimer of Virginia Tech

PGR Types

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ancymidol</td>
<td>Abide, A-Test</td>
</tr>
<tr>
<td>Chlororniquat chloride</td>
<td>Citadel, Cycoact</td>
</tr>
<tr>
<td>Daminozide</td>
<td>Danide, B-Nine</td>
</tr>
<tr>
<td>Diflupyrrolic acid sodium</td>
<td>Jeradine</td>
</tr>
<tr>
<td>Ethephon</td>
<td>Calase, Threl</td>
</tr>
<tr>
<td>Flurprimidol</td>
<td>Topfer</td>
</tr>
<tr>
<td>Paclobutrazol</td>
<td>Picotee, Picotee 10 XG, (Novo), Pactel</td>
</tr>
<tr>
<td>Uniconazole</td>
<td>Consice, Stamina</td>
</tr>
<tr>
<td>Benazolinene (BA)</td>
<td>Configure</td>
</tr>
<tr>
<td>Gibberelins (GA)</td>
<td>Florigen, ProGibb T&amp;A</td>
</tr>
<tr>
<td>BA+GA</td>
<td>Fresco, Fascination</td>
</tr>
</tbody>
</table>

PGR Toolbox
2
GROWTH ENHANCEMENT WITH CONFIGURE

JOYCE LATIMER

Configure (Fine Americas, Inc.)

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

Chemical Approach to Branching – Redirecting Plant Vigor

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

Growth Enhancer: BA

• Increases number of cells
**Christmas Cactus**

*Increases branching*

**Hosta Production**

- BA at 3000 ppm, foliar spray
- Increased lateral bud break on the rhizome
- Increased divisions
- Increased sales

**Configure: Key Points for Hosta**

- Spring applications:
  - Actively growing with good root growth
  - Multiple applications of 500 to 1000 ppm at 2-week intervals
- Summer/Fall applications:
  - June/July planted hostas
  - Treat when resume active growth
  - Roots to the edge of the pot
  - Multiple applications of 1000 to 1500 ppm at 2-week intervals
  - Repeat Configure application(s) in Spring

**Configure on Echinacea**

- Magnus
- Sombrero Hot Pink
- White Swan
Configure on *Echinacea* Hybrids

- ‘Merlot’ at 4 WAT had increased basal branching and some control of flower stalk elongation

Configure: Key Points for *Echinacea*

- Spring applications:
  - In liner flat or within 3 weeks after planting liners
  - Plants actively growing with good root growth
  - Multiple applications of 300 to 600 ppm at 2-week intervals
- Summer/Fall applications:
  - As above with multiple applications of 300 to 600 ppm at 2-week intervals
  - Repeat Configure application(s) in Spring

Agastache ‘Purple Haze’

- Single application of 600 ppm Configure in liner stage
- Increased number of branches on finished plants
- Reduced elongation of new shoots
- More compact plant

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 *Penstemon*

- ‘Husker Red’ at 7 WAT
- Number of basal branches increased

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 increased branching of liners (6x) at 3 WAT
- Finished plants at 6 WAT
  - 600 x1 ppm NS
  - 600 x2 ppm 2.5x branches

### 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>Perstemon ‘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>

### Echeveria setosa

- Control
- 400 ppm
Configure - Keys to Use

- Stimulates - but does not cause – branching or flowering
  - Windows of opportunity
  - Active growth
- Short period of activity (~1 week)
  - Multiple applications generally beneficial
  - Minimum 2-week intervals
- Complete spray coverage required
  - Not actively transported throughout the plant

Overdoses

- PGRs are excellent tools for managing plant growth.
- Sometimes the rate of PGR applied exceeds the optimum and growth is excessively stunted.
- It is important to be able to recognize overdose symptoms and distinguish them from other problems.
- If an overdose occurs, what can be done to correct it?

Getting the Rate Right

- Rate recommendations are available for most crops.
- An online tool for calculating mixing rates is also available to avoid errors.
  
  **PGRCALC**
  
  http://extension.unh.edu/Agric/AGGHFL/AGGHFL.htm

Optimal Rates

- Control plant stretch
- Plants proportional to pot size
- Allow for tighter plant spacing
- Plants darker green and use less water

Excessive Rates

- If the rate is too high, growth control can be excessive.
- Problems include:
  - Stunted plants
  - Lack of leaf expansion
  - Flower delay and/or smaller size?
  - Poor establishment in the landscape
Plant Stunting

PGR Overdose
- Stunted plants
- Lack of leaf expansion
- Flower delay and/or smaller size?
- Poor establishment in the landscape

Stunted Growth

Plants at Retail

Stunted Growth – Paclo 2 ppm Drench

Stunted Growth – Paclo 2 ppm Drench

Flower size not always affected

Stunted Growth – Paclo 2 ppm Drench

Stunted Growth – Paclo 2 ppm Drench
Consistent Effect

Uneven PGR Drench Application

PGR Overdose – Counteraction Steps

Options

- Increase the fertilization rate
  - Especially ammoniacal-nitrogen and phosphorus
- Increase the growing temperatures
- Apply a growth stimulating PGR

BA + GA

- BA (6-Benzyladenine)
  – Configure (Fine)
- GA [Gibberellic acid (GA₃)]
  – Florgib 4L (Fine)
  – ProGibb T&O (Valent)
- BA + GA₄+7 combination
  – Fascination (Valent)
  – Fresco (Fine)
  - Supplemental label for promoting bract expansion in poinsettias.

Plant Growth Promotion

- Consider using a combination GA and BA product such as Fresco or Fascination.
  – Conduct trials on a small number of plants initially using 1 ppm unless previous experience warrants higher use rates. Following assessment of plant response, and if desired results are not evident, reapplication or an increase in rate may be warranted.
Other Mimics of Distorted Growth

**Plant Stunting**

- **Virus Infection**
  - Stunted plants
  - Leaf mottling
  - Leaf distortion (especially if thrips present)
  - Lack of flowering
  - Biotic problem: so pattern should be random

- **TSWV on Kalanchoe**

**Plant Stunting**

- **Herbicide Drift**
  - Stunted plants
  - Leaf distortion
  - Lack of flowering
  - Abiotic problem: so a pattern should be noticeable

- **2,4-D-like herbicide on Vinca**

**Plant Stunting**

- **Nutrient Deficiency**
  - Stunted plants
  - Leaf distortion
  - Lack of flowering
  - Abiotic problem: so a pattern should be noticeable

- **Boron deficiency on impatiens**

**Distorted Growth – Virus**

**Distorted Growth – Herbicide Drift**

**Distorted Growth – Virus**
Distorted Growth – Boron Deficiency

Plant Stunting

**Excessive fertility**
- Stunted plants
- Leaf distortion
- Lack of flowering
- Abiotic problem: so a pattern should be noticeable

**Excessive EC on impatiens**

Plant Stunting

**Thrips feeding**
- Stunted plants
- Leaf distortion
- Lack of flowering
- Thrips visible
- Biotic problem: so a random pattern may be seen

**Thrips on ipomoea**

Plant Stunting

**Broad Mites**
- Stunted plants
- Leaf distortion
- Lack of flowering
- Mites only visible under 100X magnification
- Biotic problem: so a random pattern may be seen

**Broad mites on gerbera**

Distorted Growth – Broad Mites

Distorted Growth – Broad Mites
**Plant Stunting**

**Unknown Cause**
- Stunted plants
- Many small leaves in a mass
- Lack of flowering
- Unconfirmed diagnosis at PDIC

**Overcoming PGR Overdoses**
- Double check your math and application volume to help get the correct dose.
- Be able to recognize and differentiate distorted plant growth symptoms among the possible causes.
- If a corrective action is required, use the tools of fertilization, temperature and growth promoting PGRs to help overcome stalled growth.

**Stem Elongation**

<table>
<thead>
<tr>
<th>Chemical</th>
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<tbody>
<tr>
<td>Gibberelin (GA₃)</td>
<td>Florgib, ProGibb T&amp;O</td>
</tr>
<tr>
<td>Benzyladine (BA) + Gibberelin (GA₄₇)</td>
<td>Fascination, Fresco</td>
</tr>
</tbody>
</table>

- **Goal:**
  - Create tree form plants
- **Use:**
  - Geraniums, Poinsettias

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**Distorted Growth – Broad Mites**

**Plant Stunting**

**Agrobacterium**
- Stunted plants
- Many small leaves in a mass
- Lack of flowering
- Biotic problem: but because it is often mechanically spread, a problem may involve all plants of a group.

**Agrobacteria on geranium**

**Heuchera**

**Overcoming PGR Overdoses**

**Stem Elongation**

**FLORGIB USE STRATEGIES**

**BRIAN WHIPKER**
Cell Elongation

• GA influences cell expansion

Shoot Apex

New cell

Normal

Cell Expansion

GA

Cell Expansion

• Expansion (size) varies
• Not cell number!

GA Results:
Larger Plants

GA

Normal

Stem Elongation

• GA Tips:
  – Geraniums:
    • Establish plant, then apply 250 ppm weekly for 4 to 5 weeks.
  – Poinsettias:
    • Establish plant, then apply 50 to 100 ppm for 4 to 5 weeks.
  – High rates result in excessive stretch
  – Once desired stem length is achieved, paclodrench at 0.5 ppm will slow top growth

Applying GA increases cell elongation.

Balloon Flower with stalled growth at right.
Enhancing Peony Growth

Joyce Latimer
Professor and Extension Specialist

Florgib Applications

• Reported to improve flowering under insufficient chilling and increase number of flowers
• GA₃ (Florgib) applied at beginning of forcing or early in Spring outdoors
  – 0 or 100 ppm at 8.5 fl. oz. per gallon pot

GA₃ on ‘Sarah Bernhardt’ Peony

• 100 ppm GA₃ (Florgib) drench at 8.5 fl.oz./pot prior to emergence
• GA₃ reduced time to emergence and time to flower while increasing the average number of shoots/pot

GA₃ on ‘Inspecteur Lavergne’ Peony

• 100 ppm GA₃ (Florgib) drench at 8.5 fl.oz./pot prior to emergence
• GA₃ reduced time to emergence and time to flower while increasing the average number of shoots/pot

Growth Stimulation

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<td>Fascination, Fresco</td>
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</table>

• Goal:
  – Promote plant growth
  – Overcome PGR overdoses
• Use:
  – Annuals, Perennials

5

FRESCO USE STRATEGIES

BRIAN WHIPKER
Stunted Growth

• Many factors can result in plant stall:
  – Insufficient fertilization rates,
  – Sub-optimal temperatures,
  – Cloudy weather, and
  – Plant growth regulator overdoses (anti-gibberellin PGRs).
• How to stimulate a little additional growth?

Enhancing Growth

• Fresco / Fascination applications:
  – Recommended spray rates: 1 to 5 ppm.
  – Begin with lowest rate
    • Make an application
    • Then wait 7 days to determine if the desired level of growth is achieved.
  – Reapplication can be made if additional growth enhancement is desired.
    • Use half of the initial rate applied

Slow Growth

• How do you overcome stalled growth?

Stalled Growth

• The use of a growth promoter PGR can help.
  – Fresco and Fascination are a combination of 6-BA and GA4+7
  – Application Methods:
    • Foliar spray (Fresco / Fascination)
    • Substrate Drench (Fresco only)
    • Chemigation (Fresco only)

Enhancing Growth

• Goal: to apply only enough BA+GA to promote sufficient growth or overcome the PGR effect.
  – 1 to 5 ppm range works in most cases
    • Response rate can vary significantly by cultivar.
  – Start with a small trial to determine optimal rates.
Fresco foliar sprays increased plant growth

Fresco for Overcoming PGR Overdose
Plants initially treated with a Paclo drench of 8 ppm which stopped growth.

Growth enhanced with a Fresco foliar spray from 2.5 to 10 ppm.

Enhancing Growth
• Too high of a rate will result in excessive stem stretch.

Enhancing Growth
• And peduncle stretch.

Excessive Rates
Excessive stretch and upper leaf yellowing from too high of a rate of Fresco / Fascination foliar sprays.

Excessive Rates
Spill of chemical concentrate (100X rate at 300 ppm)
Additional Use Tips

- Excessive rates will result in undesirable stretch, and often requiring an application of an anti-gibberellin plant growth regulator such as Piccolo 10XC to check elongation.

Additional Use Tips: Poinsettias

- Drench applications maybe more effective than spray applications on poinsettias.
- Spray applications may cause bleaching of red bracts to a dusty pink coloration (greening).
  - Test sprays on a few plants to determine the results before applying it to your entire crop.

Greening of Bracts

- Excessive foliar sprays of BA+BA

Take Home

- Growth stimulation is possible with Fresco / Fascination foliar sprays.
- Must have enough time for new growth to appear.
  - Or have the possibility that sufficient stem elongation can occur with plants with terminal flowers.

Gaura ‘Whirling Butterflies’

Veronica ‘First Love’
Enhancing Succulent Growth

Gabby Barajas, Paul Cockson, and Brian Whipker
Floriculture Extension and Research

Enhancing Growth

- Rooted cuttings potted: 11 Jan.
- Peat-based substrate
- Fresco applications:
  - Drench rates: 2.5, 5, 10 or 20 ppm.
  - 2 ounces per 4.5-inch pot
  - Applied: 22 Feb
  - Data: ~3 months later

**Senecio crassissimus**

Fresco Drenches (ppm)

**Pachyphytum bracteosum**

Fresco Drenches (ppm)

**Echeveria ‘Blue Bird’**

Fresco Drenches (ppm)

**Pachyveria corvus**

Fresco Drenches (ppm)
Enhancing Growth

**Echeveria rosea**

<table>
<thead>
<tr>
<th>Fresco Drenches (ppm)</th>
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<tr>
<td>0</td>
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</table>

Enhancing Growth

**Crassula ovata**

<table>
<thead>
<tr>
<th>Fresco Drenches (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

No Effect at Concentrations Used

- Fresco drench applications of 10 to 20 ppm stimulated growth of most, but not all, species
- May be an option for filling out pots of slower growing succulents.

Questions

*Thanks for Attending!*

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**Step 3:** Click to Evaluate