Attributes of Cherry Quality

- Size
- Firmness
- Absence of Physical Defects
- Uniform Color / Maturity
- Sheen / Luster
- Stem Condition
- Taste
  - Size, soluble solids, firmness
Factors Influencing Cherry Quality

- **Horticultural Management**
  - Rootstock, Training System, Pruning, Crop Load Management, Nutrition, Irrigation, Insect & Pathogen Control

- **Harvest Maturity**

- **Harvest Practices**

- **Post-Harvest Practices**

- **Environment**

- **Plant Growth Regulators**

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Plant Growth Regulators

- Substances that, through physiological action, accelerate or retard growth, or alter the behavior of the plant or the produce of the plant.

- Usually by mimicking, enhancing, blocking, or antagonizing plant hormones

- **5 Classes of Plant Hormones**
  - Abscisic Acid
  - Auxins
  - Cytokinins
  - Ethylene
  - Gibberellins

- **About 45 Recognized Plant Growth Regulators**
  - 12 registered on sweet cherry
Plant Growth Regulators Registered on Sweet Cherry in the US

- Abscisic acid
- AVG
- 6-BA
- CPPU
- Kinetin
- Ethephon
- 1-mcp
- Prohexadione calcium
- Hydrogen Cyanamide
- Gibberellin A₃
- Gibberellins A₄ + A₇
- Homobrassinolide

Other Important Classes

- **CAN 17**
  - Harpin Protein
  - Biostimulants
  - Certain Fungicides
  - Certain Herbicides

Plant Growth Regulators Directly Impacting Sweet Cherry Quality Attributes

- CPPU
- Size
- Homobrassinolide
- Firmness
- **Gibberellin A₃**
  - Direct Positive Effect on All 7 Quality Attributes
    - Firmness
    - Size
    - Reduced Physical Defects
    - Uniform color / Maturity
    - Stem Condition
    - Taste

Structure of Gibberellin A₃

C₁₉H₂₂O₆
The 2 Most Powerful Plant Growth Regulators Available to Improve Quality

If you don’t use these judiciously, PGRs will not help you. These can turn soft 12-row cherries into firm 9 row cherries. Other PGRs can’t.

Gibberellin A3
- GA₃; Gibberellic Acid
- One of 136 different gibberellin isomers
- Stimulates cell expansion and cell division
- Increases cell wall plasticity (Ca++)
- Role in Physiological processes:
  - Cell enlargement
  - Ripening
  - Flowering
  - Fruit set
  - Breaking dormancy
  - Seed germination
  - Sex expression
  - Delayed senescence
GA₃ Benefits on Sweet Cherry

- Delays Maturity
  - Harvest management & market timing
- Enhances Fruit Quality
  - Increases Fruit Firmness
  - Increases Fruit Size
  - Increases (but delays) Soluble Solids
  - Increases Luster
  - Maintains color and turgidity of stems longer
  - Reduces physical defects
    - Pitting, Bruising, Mechanical
  - Improves storage life & quality

GA₃ Possible Adverse Effects

- Increased susceptibility to rain splits
  - Increased severity of rain splits
- Potential reduction of red blush on blonde cherries
  - From over-dosing
- Development of blind wood
  - From over-dosing
- Reduced flowering (return bloom)
  - From over-dosing
  - More effect on 1-yr old basal buds than spurs
  - Timing related
    - Bud differentiation
  - Could be a benefit
Maximizing Response to GA<sub>3</sub>

Factors Influencing Response

- **Orchard Factors**
  - Cultivar
  - Tree Vigor
  - Crop Load
  - Environment

- **Application Factors**
  - Timing
  - Rate
  - Coverage
  - Application Conditions
  - Tank-mix partners
  - Split Applications

Orchard Factors Influencing Response

- **Cultivar**
  - Differences in sensitivity among varieties
  - Self-fertile cultivars
    - May need a higher dose (heavier crop loads)
    - May benefit from split applications (longer stage II & longer stage III)

- **Tree Vigor**
  - Weak trees with poor growth = reduced response
  - Stressed trees = reduced response
  - Young fruiting wood is more responsive
Orchard Factors Influencing Response

- **Environment**
  - Temperature & wind
    - Early season – Winter Freeze / Spring Frost / Extended Bloom Period
    - Growing Season
      - Cool growing season delays maturity, maintains turgor pressure; optimum response
      - Hot, windy growing season stresses tree; diminished response

- **Crop Load**
  - Leaf : fruit ratios
  - Firmness effect influenced by soluble solids
  - Soluble solids (and fruit size) correlated to crop load
  - Over-cropped trees = poor or no response
  - Lightly cropped trees = best response
    - Also greatest risk of over-dosing
  - Moderately cropped trees
    - Best balance between response and over-dosing risk

Application Factors Influencing Response

- **Timing**
  - Three Stages of Cherry Fruit Growth
    - Stage 1 – Cell Division
      - Rapid Growth
    - Stage 2 – Pit Hardening
      - Little or no growth (lag phase)
      - Later-maturing varieties have a longer stage 2
    - Stage 3 – Cell Enlargement
      - Rapid Growth
      - Later-maturing varieties have a longer stage 3
Application Factors Influencing Response

**Timing**

- Maximum effect on all attributes – firmness, size, maturity delay – at END of pit-hardening (stage 2)
- Pit-hardening is a process that occurs over time (~2 – 3 weeks), not a fixed point in time

![Diagram of cherry fruit growth stages](image)

**Fig. 2.** The growth pattern of a cherry fruit. From Tukey and Young, 1939. The Botanical Gazette 100(6):745.
PGRs to Improve Fruit Quality
2019 WSU/OSU Cherry Fruit School

Application Factors Influencing Response – Timing

- Broader window than once thought
- Adjust timing (not rate) for desired effect
  - Impact on maturity diminishes closer to harvest
  - Impact on size diminishes closer to harvest
  - Impact on firmness greatest at end of stage 2
    - Still some impact with later applications
  - Longer stage 2 duration for later-maturing varieties
    - May not always coincide with straw color
  - Longer stage 3 duration for later-maturing varieties
    - Does not correlate well with maturity

Benefit from Split Applications

Duration of Growth Stages

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Growing Degree Hours (GDH)</th>
<th>Duration of Stages</th>
<th>End of Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>Cristalina</td>
<td></td>
<td>4,422 d</td>
<td>5,276 b</td>
</tr>
<tr>
<td>Bing</td>
<td></td>
<td>5,450 c</td>
<td>4,966 b</td>
</tr>
<tr>
<td>Sandra Rose</td>
<td></td>
<td>3,121 e</td>
<td>5,837 b</td>
</tr>
<tr>
<td>Sonata</td>
<td></td>
<td>5,877 c</td>
<td>8,696 a</td>
</tr>
<tr>
<td>Regina</td>
<td></td>
<td>5,591 c</td>
<td>5,815 b</td>
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<tr>
<td>Sweetheart</td>
<td></td>
<td>7,770 b</td>
<td>8,598 a</td>
</tr>
<tr>
<td>Symphony</td>
<td></td>
<td>10,824 a</td>
<td>9,119 a</td>
</tr>
</tbody>
</table>

Means separation within columns with the Waller-Duncan MSD, α = 0.05, k-ratio = 100

Application Factors Influencing Response – Timing

- **Split Applications**
  - Can help when maturity is staggered
  - Can cover multiple responsive stages to maximize and/or prolong effect
  - Work well on late-maturing varieties
  - Have improved response on Chelans

![Packinghouse Firmtech Readings](image)

<table>
<thead>
<tr>
<th>Fruit Firmness (g/mm)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>340</td>
<td>Bing 32 gm x 1</td>
</tr>
<tr>
<td>384</td>
<td>Bing 16 gm x 2</td>
</tr>
<tr>
<td>482</td>
<td>Lapins 48 gm x 1</td>
</tr>
<tr>
<td>678</td>
<td>Lapins 24 gm x 2</td>
</tr>
</tbody>
</table>

From: 2010BPHIL087GAD • 2010 • Malaga, WA

Application Factors Influencing Response - Rate

- **Dose (rate per acre) vs Concentration (ppm solution strength)**
  - Linear relationship between dose and response
  - Label rate range of 16 – 48 grams a.i. **per acre**
  - Match rate to variety and crop load (adjust timing for response)

**As long as coverage is optimum, the DOSE (rate per acre) is more important to results than the concentration (ppm)**
Application Factors Influencing Response - Rate

- Full dilute sprays (400 GPA – spray to run-off)
  - Ensured uniform coverage on older systems
  - Reduced potential for over-dosing
  - Prolonged drying time and absorption period

- Lower water volumes (80 – 200 GPA)
  - More use on newer higher-density plantings
  - Increased potential for over-dosing
  - Higher concentrations increase potential impact on return bloom

Rainiers treated with 12 grams GA$_3$ per acre in 100 GPA volume (30 ppm). Peaked on 8 ½ row; average firmness at receiving 486 on Firmtech.

Coverage

- Thorough coverage of fruit is critical
  - Response is localized
  - Applied GA$_3$ is not translocated throughout the tree
  - Limited movement from spur leaves to fruit

- Match application volume to canopy
- High volume air shear nozzles
- Travel speed no faster than 2 mph
Application Factors Influencing Response

**Application Conditions**
- Influence drying time and absorption
- Slow drying to maximize response
  - Temperature
    - Absorption occurs at 60°F - 90°F, but optimum at 70°F - 80°F
    - Cuticle change impacting absorption at 68°F
  - Humidity
    - Humidity > 40% slows drying time
    - Early morning applications when humidity is highest
  - Wind
    - Reduces drying time, absorption, & response
  - Rain
    - 2 hours after application will reduce absorption

**Tank-mix partners**
- Conflicting drying conditions?
- Effect on spray tank pH?

**Buffers / Acidifiers / Surfactants**
- Spray tank pH 6.0 – 7.0
- Surfactants
  - Will help with coverage
  - Can help with absorption
  - Some can cause fruit marking (tip rigs) or buckskin tips

**NEVER USE A SILICONE SURFACTANT WITH GA₃ ON CHERRIES**
Calcium

- Increases firmness
  - Binds with pectins to increase structural rigidity of cell walls
  - High concentrations can reduce plasticity of cell walls, reducing cell elongation
  - Potential adverse impact on fruit size

- Intracellular regulator with direct role in GA₃ transport
  - Can improve GA₃ response

Source

- CaCl₂ – rates > 0.15% burn leaves
- CaNO₃ – 6 weekly applications 0.3% - 0.6% from PH to 1 WBH or 1 app with GA₃
- Calcium Chelate, Calcium Citrate, Calcium Oxide

Take-Home Messages

- GA₃ is NOT a substitute for good farming & harvest practices
- Match the dose (rate per acre) to the variety and crop load
- Adjust timing for desired response
- Thorough coverage is critical
- Optimum absorption occurs at 70°F - 80°F
- Split applications can be helpful
  - Chelans
  - Staggered bloom period resulting in staggered maturity
  - Late-maturing varieties