Chill Accumulation in Peaches

Dr. Mercy Olmstead, Extension Stone Fruit Specialist
Why is Chill Accumulation Important?

- Leaf emergence
Why is Chill Accumulation Important?

- Low-chill peaches have a short *fruit developmental period* – 78-95 days
- Early leaf area is important for sugar development (carbohydrates)
Fruit Quality

• Poor leaf area early due to low chill accumulation = Bad Fruit Quality!
How Do We Accumulate Chill?

- Different varieties require different amounts of chill
- **Flower buds** need less cold weather than the **vegetative buds**

*In low chill accumulating years:*

- **Flower buds** break, bloom and set fruit
- **Vegetative buds** may be delayed in pushing out and creating mature leaves
The Two Levels of Chill: Ecodormancy

- Buds on the fruit or nut tree/bush/vine are dormant due to environment.
  - Water stress
  - Cold temperatures
  - Shortening of the daylength (photoperiod)
    - *Photoperiod* – length of light and dark periods affect plant processes

= Dormant

= Bud Break
The Two Levels of Chill: Endodormancy

- Buds are dormant due to internal physiological blocks
  - Despite ideal environmental conditions
  - Chilling conditions above freezing end physiological block

- Advantages:
  - Keeps plants dormant during fluctuating temperatures

- Subtropical climate and frequency of entering this stage?
Chilling requirements

• Measured based on different models
  • Standard method – chill hour
    • Anything less than 7.2°C = chill unit accumulation
  • 32-45°F Model
    • Used most commonly across multiple crops.
    • AgroClimate (http://agroclimate.org/tools/Chill-Hours-Calculator/)
  • Utah chill model (Richardson et al., 1987)
    • Temperatures between 1.6-12.5°C promote chill accumulation
    • 7°C is ideal (1 hr. @ 7°C = 1 chill unit)
    • Warmer temperatures negate (take away) chill
• Dynamic method – chill portion
  • e.g. 1 portion = 28 hours at 6°C
  • More recent, used with chemical rest-breaking agents such as hydrogen cyanamide (cherries in California)
## Utah Chill Model

- Allows for addition and subtraction of chill units accumulated over winter

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Chill Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 34.5°F</td>
<td>0.0</td>
</tr>
<tr>
<td>34.7 – 36.5°F</td>
<td>0.5</td>
</tr>
<tr>
<td>36.6 – 48.4°F</td>
<td>1.0</td>
</tr>
<tr>
<td>48.5 – 54.3°F</td>
<td>0.5</td>
</tr>
<tr>
<td>54.5 – 60.6°F</td>
<td>0.0</td>
</tr>
<tr>
<td>60.8 – 64.4°F</td>
<td>-0.5</td>
</tr>
<tr>
<td>&gt; 64.5°F</td>
<td>-1.0</td>
</tr>
</tbody>
</table>
Historical Chill Unit Accumulation

**Based on hours below 45°F received to Feb. 10th in 75% of the winters**
## 2013-14 Chill Accumulation

October 1, 2013 – February 28th, 2014

<table>
<thead>
<tr>
<th>Model</th>
<th>Citra</th>
<th>Fort Pierce</th>
<th>Lake Alfred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Chill (&lt;45°F)</td>
<td>417</td>
<td>97</td>
<td>85</td>
</tr>
<tr>
<td>AgroClimate (32-45°F)</td>
<td>382</td>
<td>72*</td>
<td>144</td>
</tr>
<tr>
<td>Utah Chill Model</td>
<td>-1027</td>
<td>-1828</td>
<td>-474</td>
</tr>
<tr>
<td>Dynamic Portion Model</td>
<td>20 chill portions</td>
<td>3 chill portions</td>
<td>2 chill portions</td>
</tr>
<tr>
<td><strong>Historical Average (FAWN)</strong></td>
<td>368</td>
<td>224*</td>
<td>209</td>
</tr>
</tbody>
</table>

*Sebring, FL is closest station*
Temperature: 32-45 °F - Polk County (FL)

Period [Oct 1, 2013 - Feb 28, 2014]:
- This season: 144 Hours
- Last season: 154 Hours
- Historic average: 209 Hours

Accumulated by 14 day periods:

- Current accumulation
- Historic Average
- Last season

Graph showing accumulated hours by 14-day periods.
Warm Winter Weather Impacts

• Cancellation of chill units accumulated
• How far back?
  • 2-3 days at most
  • Modified Utah Chill Model

• Phenological stage (Bud Break → Fruit Set)
  • Citra, FL
  • Bloom = February 6-7, 2014

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AgroClimate (32-45°F)</td>
<td>163</td>
<td>315</td>
<td>382</td>
</tr>
</tbody>
</table>
### Short-Term Historical Averages

- **Low chill accumulation – past 2-3 years**

<table>
<thead>
<tr>
<th>Year</th>
<th>Tallahassee</th>
<th>Jacksonville (Monticello)</th>
<th>Macclenny</th>
<th>Alachua</th>
<th>Lake Alfred</th>
<th>Fort Pierce</th>
<th>Immokalee</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-01</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td>582</td>
<td>314</td>
<td>210</td>
<td>202</td>
</tr>
<tr>
<td>2001-02</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td>391</td>
<td>134</td>
<td>88</td>
<td>86</td>
</tr>
<tr>
<td>2002-03</td>
<td>NA</td>
<td>714</td>
<td>712</td>
<td>517</td>
<td>192</td>
<td>253</td>
<td>247</td>
</tr>
<tr>
<td>2003-04</td>
<td>647</td>
<td>490</td>
<td>716</td>
<td>391</td>
<td>170</td>
<td>103</td>
<td>177</td>
</tr>
<tr>
<td>2004-05</td>
<td>571</td>
<td>510</td>
<td>495</td>
<td>391</td>
<td>170</td>
<td>129</td>
<td>174</td>
</tr>
<tr>
<td>2005-06</td>
<td>570</td>
<td>529</td>
<td>530</td>
<td>714</td>
<td>193</td>
<td>147</td>
<td>184</td>
</tr>
<tr>
<td>2006-07</td>
<td>540</td>
<td>442</td>
<td>419</td>
<td>391</td>
<td>193</td>
<td>64</td>
<td>66</td>
</tr>
<tr>
<td>2007-08</td>
<td>512</td>
<td>440</td>
<td>385</td>
<td>512</td>
<td>123</td>
<td>49</td>
<td>66</td>
</tr>
<tr>
<td>2008-09</td>
<td>517</td>
<td>505</td>
<td>490</td>
<td>512</td>
<td>246</td>
<td>138</td>
<td>196</td>
</tr>
<tr>
<td>2009-10</td>
<td>664</td>
<td>519</td>
<td>503</td>
<td>517</td>
<td>246</td>
<td>235</td>
<td>237</td>
</tr>
<tr>
<td>2010-11</td>
<td>778</td>
<td>679</td>
<td>646</td>
<td>664</td>
<td>371</td>
<td>223</td>
<td>227</td>
</tr>
<tr>
<td>2011-12</td>
<td>452</td>
<td>333</td>
<td>343</td>
<td>452</td>
<td>115</td>
<td>86</td>
<td>94</td>
</tr>
</tbody>
</table>
Change in Prosser, WA-1924-2005
Dealing with Low Chill Accumulation

- What can be done?

- Variety selection
  - Choose variety with a chill unit requirement that is 75% of historical average
    - 350 chill units = 262 chill units
    - Gulfkong → UFO1e

- Evaporative cooling of buds
  - Desert climate (Israel)
  - Need low daytime relative humidity to allow for evaporative cooling
  - Wet conditions may increase root diseases

- Can you replace chill with chemicals?
Replacing Chill?

- Hydrogen cyanamide
  - Rest-breaking chemical
  - Helps leaves to break bud sooner

- Used in Florida blueberry production frequently
  - Use low volumes
    - 0.75 to 1.0%
  - Flower bud damage can occur with higher rates
    - Timing is critical
Hydrogen Cyanamide in Peaches

• Research at Auburn University (Dr. Powell)
  • Different rates:
    • 0.5% to 2.0%
    • Over 2.0% = overthinning of flower buds due to bud damage
  • Can replace up to 250 to 290 chill hours
    • Tests done on ‘Ruston Red’ = 850 chill unit requirement
    • Will that be less if we use lower chill peaches? When are the buds receptive?

• Can cause early bloom

• Question for FL:
  • How much chill can be replaced?
  • What rates should be used?
  • When to apply?
Hydrogen Cyanamide in Florida Peaches

- ‘UFSun’ and ‘UFOne’
- Vero Beach, FL
- Dormex® application (v/v)**
  - 2%
  - 3%
  - Used Silwet L-77 Surfactant
  - Sprayed at 125 gpa
- Application = December 17, 2013
  - 3 weeks before anticipated budbreak
- Timing is important – look at pollen grains

**BudPro also will be tested in 2014-15; did not apply before bloom
HC on ‘UFSun’

![Graph showing Lateral Budbreak (%) against Hydrogen Cyanamide Rate (%).]

- Lateral Budbreak at 0% Hydrogen Cyanamide Rate: 38.1%
- Lateral Budbreak at 2% Hydrogen Cyanamide Rate: 73.1%
- Lateral Budbreak at 3% Hydrogen Cyanamide Rate: 69.2%
HC on ‘UFOOne’

Lateral Budbreak (%)

<table>
<thead>
<tr>
<th>Hydrogen Cyanamide Rate (%)</th>
<th>Lateral Budbreak (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>54.4</td>
</tr>
</tbody>
</table>
HC on Florida Peaches

February 17, 2014, courtesy of Ryan Atwood.
HC in Florida Peaches

- Data is encouraging
- Need further research
  - Grower cooperators
  - Different formulations
  - Different rates and timing

**CAUTION!!!**
- HC is a toxic chemical and there are many restrictions for application and worker protection
- Buds can be severely damaged if flower buds are swelling
- Don’t spray oil within 2 weeks of HC application
Summary

- Chill is accumulated using several models
  - Low chill peaches don’t fit one particular model
  - Warm, humid nights and high disease pressure
- Climate is getting warmer
  - Night temperatures have large impact on acid retention
  - Flavor compounds
Summary

- Cultural techniques aren’t perfect to deal with low chill accumulation
  - Variety selection, good frost protection is key
- Chemical alternatives are still open for research
  - *Make sure to have a control for comparison!*
UF Stone Fruit Resources

• Web Page
  • http://hos.ufl.edu/extension/stonefruit

• Stone Fruit Growers ListServ
  • Contact Mercy for addition to list
  • Be sure to add address to “safe” list

• Just Peachy Blog
  • http://ufstonefruit.wordpress.com/

• EDIS
  • Extension documents
  • http://edis.ifas.ufl.edu/