Preharvest fruit drop – HLB relationships
2013-14 Season

L.G. Albrigo
Professor Emeritus
Citrus Research & Education Center
Preharvest fruit drop is known to vary from year to year

NASS (FASS) reported that 2012-13 was worst since 1969-70, then worst ever without freeze or hurricanes?
  - In the past
    - High or low drop year established before harvest season
    - Normally, drop rate increases 2-3 % per month during harvest

Some observations about HLB and fruit drop
Young bearing trees (8 to 12) appear to decline more rapidly than older trees and have more severe fruit drop (lack reserves of older trees?)

Dropping fruit often have necrosis and/or decay around button (Weakened fruit from low carbohydrate supply?)
2012-13 Season
Moderate declining tree with heavy fruit drop in March
2013-2014 season fruit drop

In September, most trees like one on left, but some heavy Sunburst crops had heavy drop. Canker affected trees had significant drop early. Split fruit common and some drop noticeable by late September.
2013-14 season

Drop increased from October on. Growers now reporting increased drop.

Some Valencia blocks severe, but in some blocks drop is just accelerating.
Background – Fruit Drop

- Fruit drop very high in 2012-13
- Weak trees (HLB?) more loss than healthy trees
- NASS reduced yield estimate more than 12% due to excess drop and small fruit size, overall drop was about 23-24%

- Fruit drop started slow & erratic in 2013-14
- NASS numbers now similar to last season
- Drop from Valencia trees in many cases delayed, late bloom & cool spring?
Summary of 2012-13 harvest season?

- Percentage drop – 24%
- Valued at about $150 million
- More drop on declining trees
Little previous experience with HLB effects on fruit drop

Last year was first year with significant numbers of HLB declining trees throughout the state?
### NASS Drop Statistics
#### Two Seasons

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>October 2012</th>
<th>March 2013</th>
<th>November 2013</th>
<th>March 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oranges – Early &amp; mids</td>
<td>12</td>
<td>18*</td>
<td>18*</td>
<td>23</td>
</tr>
<tr>
<td>Oranges - Late</td>
<td>17</td>
<td>22</td>
<td>18</td>
<td>26</td>
</tr>
<tr>
<td>Grapefruit - white</td>
<td>18</td>
<td>22</td>
<td>20</td>
<td>29</td>
</tr>
<tr>
<td>Grapefruit - colored</td>
<td>15</td>
<td>20</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

* Last drop count on Early-mid cultivars was in January
* No October data due to US government furlough
Fruit drop process
Stress induced fruit drop

Stress >>> Ethylene >>> Cell wall breakdown >>> Abscission
Fruit abscission zone

- Water stress - root loss
- Carbohydrate deficiency
- Clas produced toxin or signal
- Fruit peel senescence
- Herbicides?
- Nutrient imbalance

- HLB + additional stress
Abscission Zone & Drop
Preharvest herbicide tests - Valencia

Growers reporting less drop if fall herbicide avoided

Two tests on Valencia – Steve Futch and Gene Albrigo

Seven treatments applied 2/14 or 2/17

Glyphosate and Paraquat applied with and without trunk covers
<table>
<thead>
<tr>
<th>Herbicide applied</th>
<th>Site 1</th>
<th>Site 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>20.6</td>
<td>23.2</td>
</tr>
<tr>
<td>Glyphosate</td>
<td>21.1</td>
<td>21.2</td>
</tr>
<tr>
<td>Glyphosate w/ trunk covered</td>
<td>16.2</td>
<td>23.7</td>
</tr>
<tr>
<td>Paraquat</td>
<td>10.8</td>
<td>23.7</td>
</tr>
<tr>
<td>Paraquat w/ trunk covered</td>
<td>27.9</td>
<td>24.2</td>
</tr>
<tr>
<td>Saflufenacil</td>
<td>23.4</td>
<td>25.1</td>
</tr>
<tr>
<td>Sethoxydim</td>
<td>20.2</td>
<td>23.2</td>
</tr>
</tbody>
</table>

No consistent affect between sites for late winter application on Valencia fruit drop. Tests will be run again this Fall on Hamlin and Valencia trees.
Tests of 2, 4-D on preharvest drop of oranges in 2013

- Three tests reported – late applications
- No positive results
- Expand tests – earlier & more chemicals
  - Cooperation and support of Valent Biosciences
Test plant growth regulators

2, 4-D – inhibits up-regulation of cell wall dissolving enzymes, reduces abscission

NAA – another auxin substitute, but traditionally used for fruit thinning

Gibberellic acid – delays peel color change & retains firmness (delays senescence?), blocks some phases of ethylene production from drought

ABA – anti-gibberellin, slows growth

AVG – reduces early apple drop, anti-ethylene

MCP-1 – Blocks ethylene action

Cytokinins – cell division, essential for flowers
Fall applications of PGRs

- Treated Pineapple, Valencia, Grapefruit and Murcott
- Two applications September and October
- Used Citrus Fix (2, 4-D), ProMaxa (NAA), ProGibb (GA) in all combinations +Kinetic
## Fall PGR Tests - % Drop

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pineapple</th>
<th>Grapefruit</th>
<th>Murcott</th>
<th>Valencia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>10.5</td>
<td>23.0</td>
<td>37.5</td>
<td>31.8</td>
</tr>
<tr>
<td>ProGibb</td>
<td>12.3</td>
<td>27.3</td>
<td>47.6</td>
<td>31.3</td>
</tr>
<tr>
<td>Citrus Fix</td>
<td>7.7</td>
<td>19.9</td>
<td>38.3</td>
<td>28.5</td>
</tr>
<tr>
<td>ProMaxa</td>
<td>13.1</td>
<td>22.8</td>
<td>42.0</td>
<td>28.9</td>
</tr>
<tr>
<td>Citrus Fix + ProMaxa</td>
<td>7.6</td>
<td>23.5</td>
<td>41.3</td>
<td>24.5</td>
</tr>
<tr>
<td>ProGibb + Citrus Fix</td>
<td>8.4</td>
<td>17.8</td>
<td>26.0</td>
<td>22.4</td>
</tr>
<tr>
<td>ProGibb + ProMaxa</td>
<td>9.0</td>
<td>22.5</td>
<td>37.4</td>
<td>26.8</td>
</tr>
<tr>
<td>ProGibb + Citrus Fix + ProMaxa</td>
<td>9.8</td>
<td>22.8</td>
<td>32.1</td>
<td>29.5</td>
</tr>
</tbody>
</table>

Data not statistically analyzed nor is tree decline ratings of trees considered
Fall Applications to Valencia

- ProGibb, Citrus Fix and combined-2 sites
- GA in two formulations, S-ABA, Retain (AVG), ProGibb + Retain, ProGibb + Citrus Fix
- All treatments applied twice, 45 days apart
A grower trial has reported a reduction in fruit drop of Hamlin oranges with the application of ProGibb in the fall.
Additional PGR tests

- Winter applications of PGRs
  - ProGibb, Citrus Fix, Retain, 1-MCP – 2 sites
  - Citrus Fix, Retain and combined – 4 sites
  - Data not summarized yet

- Low concentration – auxin-cytokininin-GA season long test (grower & research trials)

- Repeat & expansion of fall and winter applications (Grower and research trials)
Important observations

- Almost all blocks receiving enhanced foliar program
- Not all blocks have high fruit drop
  - Is it ingredients in foliar program?
  - More likely additional stress factors
- Root loss early = water stress, hormones
- Carbohydrates to fruit limited = stress
- Need more attention to additional stresses in each grove
Additional Stresses

- Poor root systems = water stress
  - January bloom evidence of general water stress
  - Can we alleviate by irrigating more frequently?
  - Need cooperators to run irrigation trials, split blocks

- Stresses in your blocks?
  - Water quality and soil pH (not in many blocks)
  - Minor element deficiencies (some Fe cases?)

- What else?
Trial Plans

Are herbicides in Fall contributing?
  – We will expand those trials into early cultivars

Can PGRs reduce preharvest drop?
  – These trials are expanding

How much is HLB induced water stress contributing to preharvest drop?
  – Plan to set up comparison trials of different irrigation frequencies

What else should we do?
  – Grower interviews
Summary

- SCRI Block Grant for 2 year study of preharvest drop associated with HLB
- Characteristics of normal drop – baseline
- Continue survey of growers
- What stresses are operative?
- Effects of production practices
- PGR tests
- CRDF Grant support for several PGR trials