Regional and harvest date relationships with storage quality of Honeycrisp apples

Chris Watkins and Jackie Nock
Department of Horticulture
Cornell University
Ithaca, NY 14850
Today’s presentation

• Background
• Maturity
• Fruit drop and yield
• Storage quality
• Storage disorders
• Conclusions
ReTain (aminoethoxyvinylglycine; AVG)
Honeycrisp – the profitable but difficult child!

1. Highly susceptible to a number of serious physiological problems in air storage
   - Bitter pit
   - Soft scald
   - Soggy breakdown
   - Senescent breakdown
   - Greasiness
   - Poorly understood, e.g. wrinkling
2. Fruit should be conditioned at 50F for 7 days to reduce risk of soft scald development. But, conditioning aggravates bitter pit in an already susceptible variety.
Regional and harvest date effects

- Two year trial (2009; 2010)
- Untreated, ReTain, Harvista
- 3 harvest dates (commercial pickers), but variable among regions because of color issues
- Plus and minus Smartfresh after conditioning (50°F for 7 days)
- Air (38°F) and CA (3% O₂, 1.5% CO₂) (38°F)
- 3 and 6 months storage plus 4 days at 68°F
AT HARVEST - MATURITY

EFFECTS OF REGION AND
PREHARVEST TREATMENT
Effect of preharvest treatment on the starch index [2010]

<table>
<thead>
<tr>
<th>Pre-harvest trt</th>
<th>HV</th>
<th>WNY</th>
<th>Champlain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>7.4</td>
<td>7.4</td>
<td>7.2</td>
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<tr>
<td>Harvista</td>
<td>7.2</td>
<td>5.8</td>
<td>6.4</td>
</tr>
<tr>
<td>ReTain</td>
<td>7.2</td>
<td>6.5</td>
<td>7.0</td>
</tr>
<tr>
<td>Significance</td>
<td>NS</td>
<td>***</td>
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Effect of preharvest treatment on acidity [2010]

<table>
<thead>
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<th>Champlain</th>
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<tbody>
<tr>
<td>Untreated</td>
<td>0.389</td>
<td>0.303</td>
<td>0.364</td>
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<tr>
<td>Harvista</td>
<td>0.347</td>
<td>0.328</td>
<td>0.355</td>
</tr>
<tr>
<td>ReTain</td>
<td>0.334</td>
<td>0.317</td>
<td>0.361</td>
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<tr>
<td>Significance</td>
<td>NS</td>
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</table>
Effect of preharvest treatment on firmness (lb-f) [2010]

<table>
<thead>
<tr>
<th>Pre-harvest trt</th>
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<th>WNY</th>
<th>Champlain</th>
</tr>
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<tbody>
<tr>
<td>Untreated</td>
<td>14.3</td>
<td>13.4</td>
<td>15.2</td>
</tr>
<tr>
<td>Harvista</td>
<td>14.3</td>
<td>14.0</td>
<td>15.5</td>
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<tr>
<td>ReTain</td>
<td>14.4</td>
<td>13.8</td>
<td>15.5</td>
</tr>
</tbody>
</table>

Significance: NS, *
Summary

• Harvista and ReTain inhibit ethylene production of Honeycrisp apples
  – sometimes starch
  – sometimes firmness

• Effects on other maturity indices are small or absent

• Many factors affecting acidity and starch that are not simply growing region related
AT HARVEST – YIELD AND DROP

EFFECTS OF REGION AND PREHARVEST TREATMENT
HUDSON VALLEY (2010)
Accumulated drop (%)
Summary

- Harvista and ReTain control drop of Honeycrisp apples, but can have undesirable effects on fruit color at the rates used.
- Seriousness of red color inhibition depends on growing climate.
- More work needed on ReTain rates.
STORAGE

EFFECTS OF PREHARVEST TREATMENT AND STORAGE TYPE ON FIRMNESS, SSC AND TA
WNY: Firmness (lb-f) in air storage
Effect of preharvest treatment

Storage time (months)

Firmness (lb-f)

Untrt
Harvista
ReTain
WNY: SSC (%) in air storage

Effect of preharvest treatment
WNY: Acidity (%) in air storage
Effect of preharvest treatment

![Graph showing the effect of preharvest treatment on acidity in air storage over time.]
WNY: Firmness (lb-f) in air storage

Effect of SmartFresh

Firmness (lb-f)

Storage time (months)
WNY: SSC (%) in air storage

Effect of SmartFresh

- SSC (%)
- Storage time (months)

Comparison of SSC (%) between Control and SmartFresh over 6 months of storage.

- Control: Steady SSC (%)
- SmartFresh: Slightly lower SSC (%) compared to Control
WNY: Acidity (%) in air storage
Effect of SmartFresh

![Graph showing the effect of SmartFresh on acidity in air storage. The graph plots TA (%) against storage time (months). The blue line represents Control, and the red line represents SmartFresh. The acidity decreases over time for both groups, with SmartFresh showing a slightly faster decrease than Control.]
## Champlain summary: Air vs CA

<table>
<thead>
<tr>
<th></th>
<th>3 months</th>
<th></th>
<th>6 months</th>
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<tr>
<td></td>
<td>Air</td>
<td>CA</td>
<td>Air</td>
<td>CA</td>
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<tr>
<td>Firmness (lb-f)</td>
<td>15.9</td>
<td>16.0</td>
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<td>SSC (%)</td>
<td>13.1</td>
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<tr>
<td>TA (%)</td>
<td>0.305</td>
<td>0.310</td>
<td>0.248</td>
<td>0.297***</td>
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# Champlain summary: Untrt vs SF (air)

<table>
<thead>
<tr>
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<th>SF</th>
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<tr>
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<td>3 mo</td>
<td>3 mo</td>
<td>6 mo</td>
<td>6 mo</td>
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<tr>
<td><strong>Firmness (lb-f)</strong></td>
<td>16.0</td>
<td>15.9</td>
<td>15.5</td>
<td>15.5</td>
</tr>
<tr>
<td><strong>SSC (%)</strong></td>
<td>13.0</td>
<td>13.2</td>
<td><strong>12.0</strong></td>
<td><strong>12.4</strong>*</td>
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<tr>
<td><strong>TA (%)</strong></td>
<td>0.291</td>
<td>0.318</td>
<td><strong>0.228</strong></td>
<td><strong>0.267</strong>***</td>
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# Champlain summary: Untrt vs SF (CA)

<table>
<thead>
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<th>SmartFresh</th>
<th>Untreated</th>
<th>SmartFresh</th>
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<tr>
<td>3 mo</td>
<td>16.0</td>
<td>16.0</td>
<td>15.6</td>
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<td>6 mo</td>
<td>13.2</td>
<td>13.1</td>
<td>12.7</td>
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<tr>
<td>Firmness (lb-f)</td>
<td>0.309</td>
<td>0.310</td>
<td>0.288</td>
<td>0.306</td>
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<tr>
<td>SSC (%)</td>
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<tr>
<td>TA (%)</td>
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</table>
Summary

- Little consistent effect of preharvest treatments on firmness, SSC and acidity
- CA superior to air storage, especially acidity
- Air plus SmartFresh is roughly equivalent to CA storage
- Little effect of SmartFresh in CA
STORAGE

EFFECTS OF PREHARVEST TREATMENT AND STORAGE TYPE ON DISORDERS
Bitter pit

Effect of preharvest trt (storage removals combined)

Air storage

CA storage

HV  WNY  Champlain

Untrt  Harvista  ReTain

HV  WNY  Champlain

Untrt  Harvista  ReTain
Soft scald (air)

- Champlain: affected by harvest date only: 0% at H1, 12% at H2 (despite conditioning)

- HV and WNY: negligible (<1%)
Greasiness in air storage
Effect of harvest date

3 months

6 months

Histograms showing the greasiness levels for different harvest dates (H1, H2, H3) and locations (HV, WNY, Champlain) after 3 and 6 months of storage.
Greasiness in air storage
Effect of SmartFresh

3 months

6 months

<table>
<thead>
<tr>
<th>Location</th>
<th>0</th>
<th>20</th>
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<table>
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<th>Location</th>
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<tr>
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</tr>
<tr>
<td>Champlain</td>
<td></td>
<td></td>
<td>80</td>
</tr>
</tbody>
</table>

Legend:
- Control
- Smartfresh
Greasiness in air storage

Effect of preharvest treatment

Often significantly lower in Harvista and ReTain trts, but not commercially meaningful in timeframes tested.

Lower incidence resulted in best SF effect (Champlain, H1 and 3 months air storage)
Greasiness in CA storage

Effect of harvest date

3 months

6 months
Greasiness in CA storage
Effect of SmartFresh

3 months
- Control
- Smartfresh

6 months
- Control
- Smartfresh

HV, WNY, Champlain
Internal CO$_2$ injury (CA only)
Effect of preharvest trt

![Graph showing the effect of preharvest treatments on internal CO$_2$ injury in HV, WNY, and Champlain varieties.](image-url)
Conclusions

• Regional effects on HC storage quality are high, and marketing plans should reflect this reality.
• More work is required on the effects of ReTain rates and timing, especially in southern regions.
• SmartFresh recommended for longer term air storage – can help maintain higher SSC and TA, and reduce greasiness for short term storage.
• CA can maintain TA, reduce pit and greasiness, but not recommended because of risk of carbon dioxide injury [Harvista and ReTain can aggravate].
The people and the funding

The people

- Mike Fargione
- Ron Jones
- Randi Wintamute
- Liza White

The growers

- JD Fowler
- Jeff Crist
- Seth Forrence

Visiting scholars and students

- Yanping Ma
- Inkyu Kang
- Yifan Cheng

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- NY Apple Research Development Program
- AgroFresh Inc.
- Valent BioSciences
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THANKS AND QUESTIONS