Evaluation and Demonstration of New Stone Fruit Systems
Goals of an “Ideal” System:

- Valuable Crop
  - Variety
  - Size and Quality
- Early yield & ROI
- Sustained High Marketable Yields
  - Light interception
  - Light distribution
- Labor efficient production
  - Minimal ladder use
  - Simple tasks
System Components

- Genetic
  - Variety
  - Rootstock
- Tree arrangement
- Tree spacing
- Training
- Pruning
### Missing Key: Dwarfing Rootstock

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Vigor (% of Lovell)</th>
<th>Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bailey</td>
<td>90%</td>
<td>Large tree</td>
</tr>
<tr>
<td>Empyrean®2 (Penta)</td>
<td>90%</td>
<td>Large tree</td>
</tr>
<tr>
<td>Empyrean®3 (Tetra)</td>
<td>90%</td>
<td>Large tree</td>
</tr>
<tr>
<td>Controller 9</td>
<td>90%</td>
<td>Large tree</td>
</tr>
<tr>
<td>Controller 6, 7, 8, 8.5</td>
<td>???</td>
<td>Too new</td>
</tr>
<tr>
<td>Controller 5</td>
<td>50%</td>
<td>Discontinued</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(anchorage)</td>
</tr>
</tbody>
</table>
### Missing Key: Dwarfing Rootstock

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Vigor (% of Lovell)</th>
<th>Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>American plum</td>
<td>70%</td>
<td>Rootsuckers</td>
</tr>
<tr>
<td>Fortuna</td>
<td>70%</td>
<td>Survival</td>
</tr>
<tr>
<td>Imperial California</td>
<td>90%</td>
<td>Survival</td>
</tr>
<tr>
<td>Ishtara</td>
<td>70%</td>
<td>Survival</td>
</tr>
<tr>
<td>Krymsk 1</td>
<td>75%</td>
<td>Survival</td>
</tr>
<tr>
<td>Krymsk 2</td>
<td>60%</td>
<td>Survival</td>
</tr>
</tbody>
</table>
## Missing Key: Dwarfing Rootstock Cumulative Mortality in Biglerville, 2013

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Year of Planting</th>
<th>Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fortuna</td>
<td>2009</td>
<td>38</td>
</tr>
<tr>
<td>Ishtara</td>
<td>2008</td>
<td>70</td>
</tr>
<tr>
<td>Krymsk 1</td>
<td>2008 &amp; 2009</td>
<td>40 &amp; 50</td>
</tr>
<tr>
<td>Krymsk 2</td>
<td>2008</td>
<td>40</td>
</tr>
<tr>
<td>Imperial California</td>
<td>2009</td>
<td>100</td>
</tr>
</tbody>
</table>
Missing Key: Dwarfing Rootstock

- Dwarfing stocks remain a long-term goal.
- Many are interspecific hybrids.
- When size control is achieved:
  - Tree often appears stressed (incompatibility)
  - Fewer and/or small fruit
  - No increase in biological efficiency
Objectives:
- Evaluate
- 4 training systems: 172 - 484 trees / Acre
- 2 peach varieties:
  - Loring (conventional growth habit)
  - Sweet-N-Up (upright growth habit)
Upright Variety: Sweet N Up
Cumulative Yield, 2009-2013:

Loring

Sweet N Up

Total yield (bu/acre)
Cumulative Yield, 2009-2013:

Loring

SweetNup

Bushels per acre

<2.25"  2.25 - 2.50"  2.50 - 2.75"  2.75 - 3.0"  >3.0"

OC14  HV10  QV7  PV5
Yield per tree by year, Loring

Yield per tree (bu)

- OC14
- HV10
- QV7
- PV5

Year:
- 2009
- 2010
- 2011
- 2012
- 2013
2013 Fruit Size Distribution, Loring

Yield in size category (bu / acre)

Peac(inches)

- PV5
- QV7
- HV10
- OC14
Cumulative trunk growth, 2007-13

- Perp. V (483 t/A) 83 cm²
- Quad V (346 t/A) 105 cm²
- Hex V (242 t/A) 130 cm²
- Open Center (173 t/A) 157 cm²

Trunk size correlates to tree spacing:

<table>
<thead>
<tr>
<th>Year</th>
<th>R² value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>0.999</td>
</tr>
<tr>
<td>2012</td>
<td>0.999</td>
</tr>
<tr>
<td>2011</td>
<td>0.999</td>
</tr>
<tr>
<td>2010</td>
<td>0.999</td>
</tr>
<tr>
<td>2009</td>
<td>0.989</td>
</tr>
<tr>
<td>2008</td>
<td>0.856</td>
</tr>
<tr>
<td>2007</td>
<td>0.792</td>
</tr>
</tbody>
</table>
Trunk Growth by Year

Trunk growth (cm$^2$)

- PV5
- QV7
- HV10
- OC14

Crop + Water stress
2013 Yield Efficiency

Yield per unit trunk area

- OC14
- HV10
- QV7
- PV5

- 2009
- 2010
- 2011
- 2012
- 2013
Blush coverage (%), Loring 2012

Blush side of fruit

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>OC14</td>
<td>b</td>
</tr>
<tr>
<td>HV10</td>
<td>a</td>
</tr>
<tr>
<td>QV7</td>
<td>a</td>
</tr>
<tr>
<td>PV5</td>
<td>a</td>
</tr>
</tbody>
</table>

Background side

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>OC14</td>
<td>b</td>
</tr>
<tr>
<td>HV10</td>
<td>a</td>
</tr>
<tr>
<td>QV7</td>
<td>a</td>
</tr>
<tr>
<td>PV5</td>
<td>a</td>
</tr>
</tbody>
</table>
## Income over specified costs / A

### Sweet N Up

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>OC14</td>
<td>$1,741</td>
<td>$ 633</td>
<td>$ 2,014</td>
<td>$ 4,575</td>
<td>$ 6,953</td>
<td>$ 15,916</td>
</tr>
<tr>
<td>HV10</td>
<td>$2,938</td>
<td>$ 2,283</td>
<td>$ 4,534</td>
<td>$ 9,930</td>
<td>$ 8,241</td>
<td>$ 27,927</td>
</tr>
<tr>
<td>QV7</td>
<td>$2,556</td>
<td>$ 240</td>
<td>$ 4,255</td>
<td>$ 9,628</td>
<td>$ 9,551</td>
<td>$ 26,231</td>
</tr>
<tr>
<td>PV5</td>
<td>$2,809</td>
<td>$(162)</td>
<td>$ 2,169</td>
<td>$ 5,871</td>
<td>$ 6,072</td>
<td>$ 16,795</td>
</tr>
</tbody>
</table>
# Income over specified costs / A

## Loring

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OC14</strong></td>
<td>$1,246</td>
<td>$1,764</td>
<td>$3,880</td>
<td>$7,455</td>
<td>$6,625</td>
<td>$20,970</td>
</tr>
<tr>
<td><strong>HV10</strong></td>
<td>$1,647</td>
<td>$3,311</td>
<td>$6,277</td>
<td>$15,886</td>
<td>$10,218</td>
<td>$37,338</td>
</tr>
<tr>
<td><strong>QV7</strong></td>
<td>$3,911</td>
<td>$436</td>
<td>$5,861</td>
<td>$15,677</td>
<td>$11,095</td>
<td>$36,981</td>
</tr>
<tr>
<td><strong>PV5</strong></td>
<td>$1,855</td>
<td>$226</td>
<td>$4,546</td>
<td>$11,952</td>
<td>$9,304</td>
<td>$28,077</td>
</tr>
</tbody>
</table>
Why do V systems perform better?

- More linear bearing surface per acre
- Better light interception
- Training compatible with natural growth
- Less aggressive, ‘retaliatory’ growth
- They don’t shade themselves excessively
Summary - Variety

- Similar tree size for both
  - Sweet N Up trees were taller (con)
  - Loring Trees were wider (pro)
- Loring pulling away on cumulative yield
  - Sweet n Up had highest yield in 2009
  - Loring has been yielding more since 2010
- Advantage: standard spreading habit
Future Missing Key?

- Who will test future peach varieties?
- Trend to private breeding programs
- Trend to California varieties
- Loss of Extension personnel
- Answer: YOU WILL!
Summary

- **V systems**
  - Higher yield / A
  - Redder fruit color
  - More economic value
  - More efficient use of land
  - More bearing surface per acre
  - More large fruit, more small fruit, **more fruit**

- **Open center systems**
  - Very slight savings on labor
  - Larger average fruit size
  - Less fruit, also less large fruit (per acre)
  - More wood
Take Home Message.
2012 & 2013 2014:

- Hex V at 10 x 18 & Quad V at 7 x 18

- Quad:
  - Easier to get 4 good scaffolds
  - Earlier Bu. / A = best system for high value crops

- Hex:
  - Similar performance to Quad V with less initial investment
  - Scheduled replacement of declining peach blocks
Questions Remain (2013/ 2014)

- Can we maintain higher yields in V systems as trees become mature?
  - Especially in lower canopy?
- Yields of all systems have continued to increase through 2013
  - PV5 is “catching up” to QV7 and HV10
  - Shoot vigor has migrated up in all systems,
  - Shoots in lower canopy of V trees still Ok.
Questions Remain (2013/2014)

- Can we achieve an optimal balance between high yield and fruit size?
- Yes! 2013 V system Loring yields > 600 BPA and large fruit size (with irrigation for final swell)
Peach Facts

- An peach fruit is ~89% water by weight.
- ~10% by weight is carbohydrate.
  \[6\text{CO}_2 + 12\text{H}_2\text{O} + \text{light} = \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}\]
- ~1% is mineral moved to the fruit by water.
- Fruit growth occurs by water pressure (turgor).
- Deficits during final swell reduce size.
- Irrigation is water insurance!
Questions Remain (2013/2014)

- Do Open Vase trees ever catch up, if so when?
- OC14 yield per tree = to HV10 in 2013
- No evidence that OC14 yield/acre will ever catch up as of 2013, 7th yr/5th crop
- Do we still care?
Goals of an “Ideal” System:

- Valuable Crop
  - Variety
  - Size and Quality. Edge: HV / QV
- Early yield & ROI. Edge: HV / QV
- Sustained High Marketable Yields
  - Edge: HV / QV
- Labor efficient production
  - Minimal ladder use. Edge: OC
  - Simple tasks. Edge: V systems
Thanks For Your Support!

- Hoffman Foundation
- Pennsylvania Peach & Nectarine Board
- SHAP
Feedback From Growers

“I liked your talk, and I’m going to plant Hex V, but I’m going to keep them short”
Peach Trees Want to Be Trees!

- Natural growth habit: Acrotonic
  - Vigorous growth is at the periphery
  - Secondary buds near base of limbs are weak
- Species is INTOLERANT of shade
  - Shaded apple limbs will limp along for years
  - Shaded peach limbs DIE!
Other Methods of Restricting Tree Height

“Dilute” vigor between multiple scaffolds

- Two scaffold V: 14.4 ft;
- Six scaffold V: 13.9 ft. (3.5%)
- Not effective in peach
Pruning for Restricting V Tree Height

Heading of V-systems:
- in the upper half of a vigorous scaffold,
- upright branching angle,
- favorable light environment...

Severing apical dominance stimulates regrowth

Result: Shorter tree with more branches and worse shading than if it had been left tall

Summer shearing/ Dormant heading cuts no help
A Common Challenge:
Bearing surface migrates up
Loss of Productivity in Lower Canopy

- Bearing surface migrates up
  - Shading partly responsible
  - Summer pruning/shearing to prevent shading?
- Renewal pruning not as successful as apple
  - Peach growth habit: acrotonic
  - Secondary buds at base of lateral are weak/unlikely to grow out as new shoots
Pruning Goals: Fruit Size and Quality
Sunlight and quality of Fruiting Laterals

 Eliminate excess fruiting laterals
  • Reduce crop density and shading
 Space fruiting laterals evenly up / down & radially on scaffold
  • Eliminate shade from limb crowding
 Eliminate long fruiting laterals
  • Reduce shading
 Eliminate small fruiting laterals
  • Promote higher Leaf : Fruit ratio
Std. Open Vase Peach System

Open Vase Canopy

- Short height for ease of labor access
- Heavy pruning stimulates branch renewal
- Well-understood

Creates challenges:
- Reduced yield and fruit color (low light interception / penetration)
- Less compatible with mechanization
Intensive Peach Systems

Tall Narrow V Canopy

- Canopy split into 2 narrow tree walls
- Increased yield and fruit color
- Facilitates mechanization

Creates challenges:
- Tall tree + labor-intensive crop
- Renewal pruning not as successful as apple
Pruning for Peach Crop Goals

Open Vase orchard

350 bushel / A of large (3”) fruit

= 35,000 peaches per A

140 trees/A = 250 peaches/ tree

5 scaffolds / tree = 50 peaches/ scaffold

At 3 peaches per fruiting lateral = 17 laterals

20% “safety margin” =

20 fruiting laterals / scaffold
Pruning for Peach Crop Goals
Perpendicular V orchard

600 bushel / A of large (3”) fruit
  = 60,000 peaches per A
400 trees/A = 150 peaches/ tree
2 scaffolds / tree = 75 peaches/ scaffold
At 3 peaches per fruiting lateral = 25 laterals
20% “safety margin” =
30 fruiting laterals / scaffold
Open Vase Pruning
Thin out Upright & Pendant Secondary Limbs
Bench Cuts & Thin Laterals
Heading Cut in Open Vase: The Bench Cut

Essential to low headed open vase system
Slows ascent of canopy (+)
Contributes to a loss in productivity (+)
Increases risk of canker infection (-)
Stimulates vigorous regrowth in canopy
  Stimulates renewal shoots (+)
  Shades lower canopy, with loss in productivity/quality (-)
Pruning Perpendicular V
Reduce / Thin Out Secondary Limbs
Renewal: 2ndary Limbs Cut Back to 1ˢᵗ Strong Fruiting Lateral
Pruning Fruiting Laterals

- Dormant heading releases lateral buds from apical dominance
- Dormant heading leaves basal buds to set crop (not the best).
- Summer shearing = many heading cuts
Peach Pruning Demo

- 6 Feb (Next Thursday)
- Rich Marini
- Jim Schupp
- V and OC systems
- Hands on!