Orchard Mechanization in Washington State

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Causes of Injury

Total of 13,068 Claims 1996-2001
Ladders - $20M (time/med)
Simple, Narrow, Accessible and Productive Canopies

Random or organized / narrow = accessible

Uniform Canopy/ Uniform Crop

High Early Yields

High Mature Yields

High Quality Fruit (Target)
Scott McDougall

“We have invested in and succeeded with high density narrow systems. We now need the engineering solutions to optimize the horticultural system and our investment”
Investment in Technologies MUST make you money

*Increased productivity* that results in a lower per unit cost

Or

*Increased quality* that results in a greater return
• Proven reliability
Local parts and service
Safe
Simple
Scalable
Multi purpose
Positive ROI (not just $$)

Lease? Contract?
For Success: Right fit for block, people, machine and task and..

Desire to make it work
1-1.5 mph  35 acres/day  
1.5-3 km/h  14 ha / day
For Success:
Orchard canopy must be uniform height and density

Red = tall trees

yellow = short trees
Efficiencies
Apple – high density, tall, narrow systems

• Tree Training +40-60%
• Bloom Thinning +25-45%
• Green Fruit Thinning +35-45%
• Pheromone Placement +75%
• String Tying +65-116%
• Trellis Construction +15-20%
APPLE
Mechanical Pruning
Gillison Center Mount
LaGasse Hedger
Dormant to bloom hedging sets the “box” for harvest assist
Detailed hand pruning to manage bud load and fruit quality
Orchard system is based on short, stiff, horizontal fruiting units, with 2-4 buds
Pretty Scary
## Apple trials: Fuji – treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dormant pruning</th>
<th>Summer pruning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hand</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Mechanical</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Hand</td>
<td>Mech. 12-15 leaves</td>
</tr>
<tr>
<td>4</td>
<td>Mechanical</td>
<td>Mech. 12-15 leaves</td>
</tr>
<tr>
<td>5</td>
<td>Hand</td>
<td>Mech. 20 leaves</td>
</tr>
</tbody>
</table>
June 2, 2014 10-12 leaves – Fuji/M9
Results

Hand pruning

Mechanical pruning
Wood Removal

![Graph showing wood removal data for different species: MP, HP, MSP12, MWS12, MSP20. The y-axis represents weight wood removed per TCSA (Kg/cm²), and the x-axis represents different species. The data shows a higher wood removal for MSP20 compared to MP, HP, MSP12, and MWS12.]
Summer pruning

Max 3.5% damaged fruit/tree before green thinning
<table>
<thead>
<tr>
<th>TREATMENT</th>
<th>Current season shoot length/tree (cm)</th>
<th>st error</th>
<th>Number current season shoots/tree</th>
<th>st error</th>
<th>Shoot length/T CSA</th>
<th>st error</th>
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</thead>
<tbody>
<tr>
<td>MP</td>
<td>1637.33</td>
<td>a</td>
<td>96.33</td>
<td>a</td>
<td>143.51</td>
<td>28.35</td>
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<td>HP</td>
<td>1481.00</td>
<td>ab</td>
<td>92.33</td>
<td>ab</td>
<td>136.67</td>
<td>18.07</td>
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<tr>
<td>MSP12</td>
<td>1176.78</td>
<td>ab</td>
<td>72.33</td>
<td>b</td>
<td>107.31</td>
<td>18.19</td>
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<tr>
<td>MWS12</td>
<td>1051.11</td>
<td>b</td>
<td>77.22</td>
<td>ab</td>
<td>97.36</td>
<td>13.03</td>
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<tr>
<td>MSP20</td>
<td>1223.11</td>
<td>ab</td>
<td>75.22</td>
<td>b</td>
<td>119.25</td>
<td>19.17</td>
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<tr>
<td>p-value</td>
<td>0.027</td>
<td></td>
<td>0.011</td>
<td></td>
<td>0.1458</td>
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</table>
Fuji Results

• The number fruit/tree from dormant mechanical was 31% higher than number fruit/tree from dormant hand/summer mechanical, with an average of 70.2 apples/tree.

• Apples from dormant hand treatment had 10% lower °Brix than those from dormant hand/summer mechanical with an average of 12.4 °Brix.

• Apples from dormant mechanical/summer mechanical had 46% more sunburn than the apples from dormant mechanical, with an average of 7.6 apples with some degree of sunburn per tree.
Pink Lady 2014: fruit size distribution at harvest (9 trees per trt)

- winter pruning
- summer pruning
- control

<table>
<thead>
<tr>
<th>fruit class size (mm)</th>
<th>≤55</th>
<th>60</th>
<th>65</th>
<th>70</th>
<th>75</th>
<th>80</th>
<th>85</th>
<th>≥90</th>
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<tbody>
<tr>
<td>%</td>
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<td>0.0</td>
<td>0.3</td>
<td>1.8</td>
<td>5.5</td>
<td>11.6</td>
<td>22.5</td>
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<td>0.0</td>
<td>3.1</td>
<td>5.5</td>
<td>11.1</td>
<td>11.1</td>
<td>24.6</td>
<td>34.6</td>
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<td>0.0</td>
<td>0.0</td>
<td>5.5</td>
<td>8.4</td>
<td>12.6</td>
<td>32.1</td>
<td>31.3</td>
<td>18.3</td>
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<tr>
<td></td>
<td>0.0</td>
<td>0.0</td>
<td>5.5</td>
<td>8.4</td>
<td>12.6</td>
<td>32.1</td>
<td>31.3</td>
<td>16.3</td>
</tr>
</tbody>
</table>
Effects of mechanical pruning on fruit ripeness/maturity

Starch index

Winter: 5.3  
Control: 5.8  
Summer: 6.4

Brix

Control: Winter: Summer:

Titratable acidity

Control: Winter: Summer:
Cripps Pink

- Trees mechanically pruned in summer and winter + summer only showed had same pruning weight.
- Trees that were mechanically pruned in summer had higher yields than trees pruned in winter by hand or machine and those that were mechanically pruned in winter and summer.
- At harvest, the number of fruit per tree, net weight of fruit, and yield efficiency was significantly lower in the control than the other treatments. However, the weight of the fruit in the control was significantly higher than other treatments.