Final Report

WTFRC Project # PH-02-248

Project title: Identification of target and cull fruit pre- and post-harvest

PI: Carter Clary
Organization: Washington State University

CO-PI(s) and affiliation(s): Fran Pierce WSU-Prosser
Dana Faubion WSU Extension
John Fellman WSU-Pullman
Jim Durfey WSU-Pullman
Jim McFerson WTFRC

Cooperator(s): Brad Newman Olympic Fruit Company
Brent Milne McDougal and Sons
Steve Hull Occidental Orchards
Mark Hanrahan Olympic Fruit
John Verbrugge Valley Fruit

Objectives:
Cull fruit alone can account for as much as 15 - 25% of the crop. It has been suggested that it may be better to divert this fruit before it is delivered to the packinghouse. Assuming the cost to harvest, deliver, store and sort, and pack out a bin of apples is $165 - $174 per bin, and the bin contains 25% cull fruit, it costs $41 to $44 per bin to handle and store cull fruit. At 40 bins per acre, this amounts to at least $1640 per acre to handle and store fruit that will not be sold in the fresh market.

This project focused on the harvesting, handling and delivery system for apples to determine sites with potential for separating culls and other target fruit from fruit delivered to the packinghouse.

Long Term Objectives (future research):
1. Develop methods for removing cull and target fruit before it is delivered to the packinghouse.
2. Identify devices for early detection and separation of this fruit in the field.
3. Apply early detection and separation methods to practice in the orchard.

2002 Objectives:
Funding for the original project was reduced and the objectives were re-defined to:
1. Develop a way to handle and position harvested fruit so it can be evaluated in the field.
2. Arrange for testing of commercially available worker carrier system(s) for testing in Washington State.

Significant findings:
1. There are a number of worker carrier systems that are commercially available.
2. These systems have potential for providing a site to separate cull fruit in the field.
3. At the time this report is being submitted, an exploratory team is planning to evaluate eight manufacturers of worker carrier systems for potential application in Washington State.
4. These manufacturers have expressed interest in developing markets Washington State.

* A new proposal has been submitted to continue this work.
Methods:
In order to be able to identify the sites for separation of cull fruit from the harvesting and handling system, we met with growers and packers to better understand the system. Based on these discussions we made the following observations:

1. Before we could define methods of separating cull fruit before delivery to the packinghouse, we needed to identify a location in the harvesting and handling system where separation could take place.
2. The harvested fruit should be handled and positioned in a way that permits evaluation for separation of cull fruit in the field.
3. There is interest in reducing or eliminating the use of ladders and bags for harvesting.
4. There is interest in transporting yield mapping instrumentation through the orchard to monitor tree vigor, yield and other factors.
5. Some growers are already using carrier systems for pruning and thinning.
6. Mechanical platform systems are used in other countries and employ belts that may offer a site for separation of cull fruit.

The conclusion was to identify manufacturers of mechanical platform systems and select configurations that are compatible with Washington orchards. Platform systems have been evaluated in the past for efficiency and cost effectiveness. The results of these studies indicated that the cost of these harvest aid systems was not offset by improvement in efficiency. However, several things have changed in the past few years:

1. Labor for tree fruit production has historically been plentiful and inexpensive. With recent events, availability of labor has decreased.
2. The minimum wage in the state of Washington has increased to $7.01 per hour, which has had a significant impact on production and harvest costs.
3. Laws defining piece-rate pay have changed.
4. Safety regulations regarding working conditions have become more compulsory.
5. A mechanical carrier system will provide a site for culling fruit in the field, which will add the cost savings of removing culls before they reach the packinghouse.

These changes justify re-evaluation of worker carrier systems to improve the efficiency and safety of workers. At the same time, these systems will reduce or eliminate the use of ladders and bags, and they would provide a platform for sorting culls before they enter the bin. The proposed specifications of these systems include:

1. Bin carrying capability.
2. Gentle bin loading.
3. Carry and position workers with access to the tree canopy.
4. A site (like a belt) for sorting cull fruit before it enters the bin.
5. Possible collection of cull fruit (second bin).
6. Improved worker efficiency.

In addition to providing a site for sorting culls, the carrier system would serve as a platform for application of yield mapping technology. As the unit moves through the orchard, the location of the unit would be recorded as well as the weight of the bin. When the bin is full it is automatically discharged from the carrier and marked electronically so it can be tracked through the packinghouse.
Results and discussion:
Representatives of Washington State University and the tree fruit industry formed a team to evaluate worker carrier systems for application in Washington State. Manufactures of this equipment were located in The Netherlands and Northern Italy (Figures 1 - 3).

The objective of meeting with the manufacturers is to evaluate their equipment. It will be the goal of the team to demonstrate that there is a need for this equipment in Washington State. Manufacturers whose units exhibit potential for Washington State, will be asked to demonstrate their units in the state this season. The meetings with the European manufacturers are scheduled for June 21 through July 1, 2003.

The evaluation team consists of:

- Carter Clary  WSU Pullman
- Dana Faubion   WSU Extension
- Brad Newman  Olympic Fruit Company
- Brent Milne  McDougal and Sons

A final report summarizing the results of the trip will be submitted to WTFRC by July 24, 2003.

Justification:
It is evident that a significant proportion of apples produced for the fresh market are impacted with fruit that does not meet standards for retail sale and consumption. Sources indicate that cull fruit alone can account for as much as 15 - 25% of the crop. In addition, there are grades of fruit that are not marketable all the time. It may be better to divert this fruit to other uses before it is delivered to the packinghouse.

Identifying and sorting cull fruit will be the focus of this project. In the long term, there may be ways to expand the capacity of field sorting systems to identify and sort target fruit.

Although cull fruit is a reality in tree fruit production, most other tree fruit crops are not held in CA storage for extended periods. In some cases, fruit is pre-sorted at the packinghouse, but costs could be reduced if this was done earlier in the system. When culls are picked with marketable apples and are transported and stored, they reduce the efficiency of the system. How many culls being sorted on this line (picture) just prior to boxing?

Even if cull fruit has value for juice or other uses, for each step in the system that cull fruit remains with marketable fruit, there is an added cost. If we could eliminate culls at harvest by sorting in the field, we would save the cost of harvest, delivery, storage and sorting, and packing. Dropping the fruit or diverting the fruit to another use would include the expense for harvesting but would save the cost of handling culls through the rest of the system.

Based on discussions with several growers and packers, the following table describes the costs. Assumining the cost to harvest, deliver, store and sort, and pack out a bin of apples is $165 - $174 per bin, and the bin contains 25% cull fruit, it costs $41 to $44 per bin to handle fruit that will not be sold. At 40 bins per acre, this adds at least $1640 per acre to handle fruit that will not be sold in the fresh
market. Targeting particular sizes, color or grade and separating it in the field may further increase profitability.

**How Much Does a Cull Cost?**

<table>
<thead>
<tr>
<th>CULL</th>
<th>COST</th>
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<tbody>
<tr>
<td>Leave on the Tree</td>
<td>Cost of Production ($65/bin)</td>
</tr>
<tr>
<td>Pick</td>
<td>$15-20 per bin</td>
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<tr>
<td>Deliver</td>
<td>$4.8 per bin</td>
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<tr>
<td>In-charge &amp; Store</td>
<td>$26 per bin</td>
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<tr>
<td>Sort &amp; Pack</td>
<td>$120 per bin + Lost Market</td>
</tr>
</tbody>
</table>

Post Harvest Cost = $165 - $174/bin or $6.60 - $6.96/box

Cull Handling Cost:
Assuming 25% Culls = $41 - $44/bin
or $41/bin x 40 bin/acre = $1640/acre

If successful methods are developed for identifying and sorting cull fruit from the harvest system, it may be possible to expand the capability of in-field sorting systems to target specific grades, sizes or color of fruit and separate it before delivery. It is evident prices and demand for specific grades change. The fruit targeted for field sorting would also change.

**Literature review:** Good Fruit Grower (June, 2002) describes the benefit and cost savings of leaving cull in the field. A preliminary review of other literature has indicated that most research has focused on the costs of the harvesting, handling and packing of fresh market apples.
Budget:
Identification of target and cull fruit pre- and post-harvest
Carter Clary
Project duration: 2002
Current year: 2002
Project total (1 year): $19,916
Current year request: $19,916

<table>
<thead>
<tr>
<th>Item*</th>
<th>Year 1 (2002)</th>
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<tr>
<td>Salaries</td>
<td>7,111</td>
</tr>
<tr>
<td>Benefits (27%)</td>
<td>1,920</td>
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<tr>
<td>Wages</td>
<td>2,000</td>
</tr>
<tr>
<td>Benefits (16%)</td>
<td>320</td>
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<tr>
<td>Equipment</td>
<td>2,500</td>
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<td>Supplies</td>
<td>3,300</td>
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<td>Travel</td>
<td>2,765</td>
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<tr>
<td>Miscellaneous</td>
<td>0</td>
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<td><strong>Total</strong></td>
<td>19,916</td>
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Explanation of Budget Items

Year 1

Salaries: PI for 1 month (PI is on a 9 month appointment)
Wages: Graduate student- 6 months
Equipment: Field scales and other equipment (re-allocated for travel)
Supplies: Buy-out for apples (re-allocated for travel)
Travel: Funds for equipment and supplies were re-allocated to support a team to travel to Europe to make contact with platform manufacturers and arrange field-testing the platforms in Washington orchards.
Figure 1. Manufacturers of worker carrier and harvest aid systems

<table>
<thead>
<tr>
<th>Company</th>
<th>Address</th>
<th>Contact</th>
<th>Phone Numbers</th>
<th>Country</th>
<th>Zip Code</th>
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<tr>
<td>Munckhof</td>
<td>Meterikseweg 115</td>
<td><a href="mailto:info@munckhof.org">info@munckhof.org</a></td>
<td>31-77-398-1001 31-77-398-6485</td>
<td>NL</td>
<td>5961CV</td>
</tr>
<tr>
<td>C.A.T. sas of Peponi Naional G&amp;c</td>
<td>Nazionale 100</td>
<td><a href="mailto:superclimber@superclimber.it">superclimber@superclimber.it</a></td>
<td>0461-864278 0461-864278</td>
<td>IT</td>
<td>38010</td>
</tr>
<tr>
<td>Meccanica Zucal</td>
<td>Via della Palustela, 10</td>
<td><a href="mailto:ohz.agrar@wlz.de">ohz.agrar@wlz.de</a></td>
<td>39-0463-875300 39-0463-875544</td>
<td>IT</td>
<td>38010</td>
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<tr>
<td>BerMarTEC d. Pfattner B&amp;M snc</td>
<td>Via Arciduca Eugenio</td>
<td><a href="mailto:info@bermartec.com">info@bermartec.com</a></td>
<td>39-0473-55025 39-0473-554673</td>
<td>IT</td>
<td>39011</td>
</tr>
<tr>
<td>N.Blosi</td>
<td>Via G. di Vittorio n. 18</td>
<td><a href="mailto:info@nblosi.com">info@nblosi.com</a></td>
<td>39-0544-583473 39-0544-582845</td>
<td>IT</td>
<td>48026</td>
</tr>
<tr>
<td>Babini Giorgio Costruzione</td>
<td>Via Castiglione 3/D</td>
<td><a href="mailto:gbabi@tin.it">gbabi@tin.it</a></td>
<td>39-0532-806357 39-0532-806891</td>
<td>IT</td>
<td>44014</td>
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<tr>
<td>F.LLI Festi</td>
<td>Via Nazionale 162</td>
<td><a href="http://www.cermac/festi">www.cermac/festi</a></td>
<td>39-0532-820017 39-0532-820524</td>
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<tr>
<td>Pomac s.r.l.</td>
<td>44043 Mirabello</td>
<td><a href="mailto:info@pomac.it">info@pomac.it</a></td>
<td>39-0532-846735 39-0532-845379</td>
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<td>44043</td>
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</table>
Figure 2.

BerMarTec

C.A.T. Superclimber

Munckhof Pluk-o-trak

Pomac

Zucal

Blosi

Bambini

Festi
<table>
<thead>
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<td></td>
<td>Home</td>
<td>air</td>
<td>Near Greefa</td>
<td>travelling</td>
<td>Bolzano</td>
<td>Bolzano</td>
<td>Ferrara</td>
<td>Ferrara</td>
<td>travelling</td>
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<td>Amsterdam</td>
<td>North of Amsterdam</td>
<td>Amsterdam</td>
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<tr>
<td><strong>Morning</strong></td>
<td>Leave For Amsterdam</td>
<td>Arrive in Amsterdam 9:20AM</td>
<td>Meet w/ Greefa folks at hotel - 8:00AM</td>
<td>Drive to Italy</td>
<td><strong>Bolzano</strong>  <strong>Zucal</strong></td>
<td><strong>Ferraro</strong>  <strong>Pomac</strong></td>
<td>Harvest machines/packing houses in route</td>
<td>Drive to NL</td>
<td>Horst</td>
<td>Munckhof</td>
<td>Meet with Aweta group</td>
<td>Pannekeet Machine Teck</td>
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<td><strong>Afternoon</strong></td>
<td></td>
<td>Tour Amsterdam</td>
<td>Packing facility w/ Greefa</td>
<td>Drive to Italy</td>
<td><strong>Bolzano</strong>  <strong>Orchards</strong>  <strong>with Martin Thomann and Walter Rass</strong></td>
<td><strong>Zucal</strong>  <strong>Kurmark Cocea</strong></td>
<td><strong>Ferraro</strong>  <strong>Babini</strong></td>
<td>Drive to NL</td>
<td>Down time</td>
<td>Horst</td>
<td>Orchard visits</td>
<td>Meet with Aweta group</td>
<td>Pannekeet Machine Teck</td>
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<td><strong>Evening</strong></td>
<td></td>
<td>Drive south towards Greefa. Hotel made</td>
<td>Dinner with Greefa?</td>
<td>Dinner with Zucal?</td>
<td>Drive to Ferrara</td>
<td>Drive to NL</td>
<td>Dinner with Munckhof?</td>
<td>Dinner with Aweta?</td>
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<td><strong>PM Location</strong></td>
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<td>Near Greefa</td>
<td>traveling</td>
<td>Bolzano</td>
<td>Bolzano</td>
<td>Ferrara</td>
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<td>Delft</td>
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Figure 3 – Itinerary for review of European worker carrier systems and sorting equipment