FINAL PROJECT REPORTWTFRC
Project Number: TR-09-05

Project Title: Mobile linear asymmetric fruit transport systems

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Cooperators: Oxbo International Corporation, WTFRC, Familigia LLC, Washington State Growers Councils, Stemilt Growers, Washington Fruit, Oasis Farms

Other funding Sources

Agency Name: Picker Technologies, LLC, Oxbo International Corporation
Amount awarded:
Notes: WTFRC Grant represents < 5% of total R&D costs to date

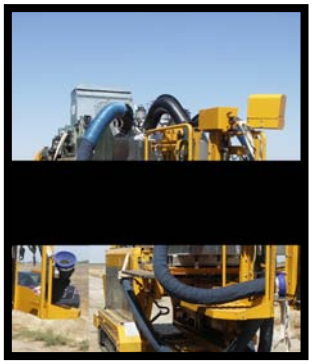
Total Project Funding: $200,000.00

Budget History:

Item	System	Scan	Dry Bin	Total
Salaries	$70,020.68	$14,916.68	$15,062.64	**$100,000.00**
Benefits	$20,110.09	$4,125.98	$3,763.93	**$28,000.00**
Wages	$21,776.58	$8,223.42	$ --	**$30,000.00**
Benefits	$1,500.00	$1,000.00	$500.00	**$3,000.00**
Equipment				
Supplies	$7,379.08	$6,620.92	$ --	**$14,000.00**
Travel	$20,773.32	$3,058.88	$1,167.80	**$25,000.00**
Miscellaneous				
Total	$141,559.75	$37,945.88	$20,49437	**$200,000.00**

Objectives:

1. Develop and test one (1) pilot fully integrated mobile fruit transport harvest system that increase the economic efficiency of harvest and post harvest, 2.5 to 6 times over traditional methods.



2. Develop and test an in-field cull sorter and bin storage (management) system (to decrease storage costs and increase revenue opportunities for the grower).

3. Develop and test a 'Dry Bin Filler' that minimizes damage to fruit while safely loading a bin in-field at a minimum of 8 apples per second (profitability).

Siginificant Findings:

Objective 1. Mechanical harvesting of apples works and is viable.

Objective 2. In-field Scanning/Sorting on a mobile Harvester is viable at a significantly lower cost point than delaying all fruit for Scanning/Sorting in a Packing House.

Objective 3. The bruise incidence for the Dry Bin Filler can be 0 to 4% depending on the Apple variety when the level-fill sensor and speed sensor are properly adjusted along with an even load balance for picking.

Results and Discussion:

Objective 1. After approximately 1000 hours of endurance testing, the pilot, integrated mobile fruit transport harvest system, which was developed is comprised of three main technology areas: 1. labor assist Picking Platforms; 2. fruit singulation for Scanning/Sorting; and 3. gentle Dry Bin filling. Testing and Orchard evaluations for the Harvester occurred in plantings of Vertical Axis; Slender Spindle; and V-Trellis which exhibited varying terrain, different degrees of pruning, and tree training. Several varieties of Apples: Gala, Golden Delicious, Red Delicious, Granny Smith, Fuji, Braeburn, and Pink Lady were harvested and each expressed its own unique characteristic during the Harvester development. Gala, Red Delicious, and Fuji were hardy varieties to mechanically harvest and showed the promise for the pilot system. Golden Delicious, Granny Smith, and Pink Lady acted like a spot light for specific areas within the pilot Harvester which needed the most attention and updates during the 2009 Fall Harvest. Pink Lady's for this year appeared to be the most sensitive to mechanical damage. With only 10 weeks of harvest time to perform the testing and in-field evaluation, improvements and design changes had to be done simply and quickly. There was a compromise made related to the ideal design changes needed and the ability to gather important information and orchard experience within the relative short season.

Objective 2. In-field Sorting and Scanning of cull defects occurred and was demonstrated to be effected in detecting sub-surface bruising along with cuts, stem puncture, limb rub, scars, depressions, hail, bin scuffing, Bitterpit, Lenticel breakdown, Russet, codling moth, and general decay. Some in-field challenges were discovered which showed the need to adjust lighting between the 'picking lanes'; sunlight penetration protection; fruit 'calming' to enable adequate scanning; software updates, and hardware configuration adjustments.

Objective 3. Several varieties of Apples: Gala, Golden Delicious, Red Delicious, Granny Smith, Fuji, and Pink Lady were harvested and each presented itself during their inherent times of maturity but not necessarily during

the optimal times of development and in sync with design improvements. This objective focused on the Dry Bin Filler and its ability to deliver fruit at 8 per second and with minimal bruise damage. The following table depicts the progression of improvement in bruise incidence associated with design improvements discovered in a variety of testing environments.

Table: Dry Bin Filler Bruise Assessment Tests

2009	Apple Variety	Qty Tested	Assessment	Comments
PREVIOUS TESTS				
March	Electronic IRD	8 Passes	Low Impacts	worst case drop
June	Golden Delicious	80 Apple Shop Test	10% out of grade	Wash Xtra Fanc
HARVEST 2009 TESTS				
August	Gala	~ 3 Bin: Orchard Test	no significant bruises indicated	
August	Red Delicious	~ 5 Bin: Orchard Test	no significant bruises indicated	
August	Golden Delicious	~ 5 Bin: Orchard Test	Some bruising indicated due to incorrect fill sensor calibration	3 different fill heights assessed for minimal damage
September	Granny Smith	~ 10 bin: Orchard test	Some bruising indicated due to incorrect speed calibration	Speed was faster than 8 Apples per second
September	Granny Smith	200 Apple: Shop Test	5% small impact bruising	deposited onto 3 layers of Apples
October	Fuji	25 Bin: Packing House – Packout Test	no significant bruises related to Dry Bin Filler noted. Sample from Pack-out: 3.88% Bruising 1.94% Cuts 1.55% Stem Puncture	Damage not necessarily attributed to Dry Bin Filler. Need to compare against 'hand harvest' for same time and block
October	Pink Lady	250 Apple: Orchard Test Sample	bruising related to even Dry Bin Filling was not detectable	28% of Apples on the trees within the Orchard exhibited pre-existing damage
October	Pink Lady	100 Apple: Shop Test	4% exhibited out of grade bruising	8 Apples per second fill rate