

Title: Development of Mechanical Harvesting for California Olives: 2007 - 2010

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Introduction:

The California table olive industry will need to develop mechanical harvesting if it is to survive. Development and research on the current picking head olive harvester and tree shaping from 1996 through 2002, and earlier research ethylene releasing compounds gave a base from which to reactivate the mechanical harvesting program in 2006. Data developed from October 1st through November 3rd, 2006 demonstrated the current picking head harvester can efficiently remove fruit if it is accessible to the picking rods. Simultaneous research from September 15th through November 10th, 2006 demonstrated Ethephon, and a new compound VBC 30069 can significantly lower fruit removal force. However, the problem of fruit bruising remains to be investigated. This research is now being conducted by Dr. Carlos Crisosto. Finally, the two major processing plants are cooperating by processing 119 identical (with Dr. Crisostos's sample set) samples through processing. Final results from these three simultaneous experimental projects, and the sample canning and cutting, should be available in February 2007

Preliminary analysis of the harvester data developed in October, 2005 demonstrates that the current picking head harvester can remove an average of 86.8% of the fruit from a standard, mature pruned Manzanillo olive tree if the fruit is accessible to the harvester's rods. Fruit removal is an average of 97.6% on the canopy extending into the row middle but as low as 35% on the in row canopy surface. This data reinforces the trees will be need to be trained for the mechanical harvester. Previous work by Ferguson indicates alternate row hedging on alternate years with topping is the most feasible mechanical pruning schedule.

Preliminary analysis of the ethylene releasing compounds by Burns demonstrated Ethphon above 1000 ppm and a new compound, VBC 30069 can drop fruit removal force

by 50%. Harvant, a commercial combination of monopotassium phosphate and Ethephon demonstrated no advantage over Ethephon alone.

The data on fruit bruising and processing ability will not be available until February 2007. However, a preliminary experiment demonstrated dead wood in the canopy and poorly trained canopies strongly harms olive processing quality.

A full report of analyzed data from the 2006 harvest season will be available in February, 2007. Some results will be presented at proposal review November 13th. However, the results thus far strongly suggest evaluation of the picking head operating parameters, olive abscission agents, and fruit bruising, should be expanded in 2007. The following project addresses these objectives.

This is a major, four year project and will require a four year funding commitment unless the objectives are not met.

2007 Objectives and Principal Investigator. Year 1 of a 4 year project: 2007

I. (Ferguson and Burns)

Evaluate the effect of harvester amplitude (CPMs) and harvester speed on mechanical harvester removal and efficiency, and processed olive quality.

II. (Ferguson and Burns)

Evaluate effect of tree pruning/preparation on mechanical harvester removal and efficiency, and processed olive quality.

III. (Burns and Ferguson)

Evaluate effect of chemical abscission agents on harvest removal and efficiency, and processed olive quality.

IV. (Crisosto)

Understanding the role of environmental conditions such as temperature, ethylene and antioxidants on olive blemishes.

Evaluate effect of mechanical harvester on fruit damage development postharvest.

Subprojects:

Kitrin Glozer, Willam Krueger, and Rich Rosecrance

a.: Effect of preharvest antioxidants and antitranspirants on postharvest damage development and processed fruit quality.

b.: Effect of immediate postharvest acetic acid/brine immersion on postharvest and processed fruit quality.

Materials and Methods:

- Objectives I-III: These experimental objectives will all require the commitment of:
- a. Well maintained commercial orchards that can be mechanically harvested, and in some cases mechanically pruned, and crop destruct.
 - b. Use of the most improved olive harvester available.
 - c. A field picking crew to strip the trees after mechanical harvest and hand harvest.
 - d. Commitment of both processors to processing samples, and separately if necessary, (unregistered compounds) through canning and cutting evaluation.

Objective I: (Ferguson and Burns)

Evaluate the effect of harvester amplitude (CPMs) and harvester speed on mechanical harvester removal and efficiency, and processed olive quality.

Experimental plot: 35 rows of 10 trees each in 5 blocks of 7 rows (350 trees)

Experimental design: 3 amplitudes X 2 speeds + hand harvest = 7 treatments
X 5 row (10 trees) replications = 350 trees

Randomized complete block design.

Treatments: 140 CPM, 180 CPM, 220 CPM amplitude
0.25 mph and .50 mph
hand harvested control

<u>Amplitude:</u>	<u>140</u>	<u>180</u>	<u>220</u>	<u>hand</u>
<u>Speed:</u>				<u>X</u>
0.25	140/0.25	180/0.25	220/0.25	
0.50	140/0.25	180/0.50	220/0.50	

Procedure:

Tree fruit count tagging for harvester efficiency evaluation.

At harvest the mechanical harvester will harvest each of the 7 mechanical harvest treatments (6 treatments X 5 replications) + 5 hand harvested rows.

From the 35 mechanically harvested rows a total harvested row bin weight, dropped fruit bin weight, and hand stripping bin weights will be taken.

Samples will be sent the two major processors, and Carlos Crisosto for evaluation.

Objective II: (Ferguson and Burns)

Evaluate effect of tree pruning/preparation on mechanical harvester removal and efficiency, and processed olive quality

Experimental Plot: 25 rows of 10 trees, in 5 blocks of 5 rows (250 trees).

Experimental: 2 pruning treatments and hand pruned control, all skirted.

Treatments:

Hand pruned control

Hedged and topped 2007 and 2009

Hedged 2007, & 9, and topped 2007, 8, 9, 10.

Randomized complete block design

Experimental Procedure:

Trees will be mechanically pruned in May.

Tree tagging for harvester fruit removal efficiency evaluation.

All rows will be mechanically harvested rows with row bin weights, dropped fruit bin weight, and hand stripping weights. Samples will be sent for processing

Objective III: (Burns and Ferguson)

Evaluate effect of chemical abscission agents on harvest removal and efficiency, and processed olive quality.

Experimental plot: 30 rows of 10 trees each in 3 blocks of 10 rows (300 trees)

Experimental design: 4 chemicals (10 different treatments) X 3, 10 row replications = 300 trees

Randomized complete block design.

Treatments: Ethephon: 1000, 1500 and 2000 ppm +/- MCP

VBC 300390
Harvant
Unsprayed control

Procedure:

Prior to harvest apply chemical treatments.

Fruit removal tests will be done 3, 7, 10 days after application to determine harvest time.

Tree tagging for fruit removal efficiency evaluation.

Mechanical harvest of all rows with a total harvested row bin weight, dropped fruit bin weight, and hand stripping bin weights.

Samples will be sent the two major processors and Carlos Crisosto for evaluation.

Crop destruct of all fruit.

Objective IV. (Crisosto)

Understanding the role of environmental conditions such as temperature, ethylene and antioxidants on olive blemishes.

Materials and Methods

- ! Blemishes evaluation will be carried out on samples from field mechanical and hand harvesting as done in 2006. A separate test will be designed to evaluate blemishing evolution over time period. In this test olive samples will be evaluated immediately after collection and daily for a week period.
- 2a **Influences of temperature management on olive blemishes.** To accomplish it, olives will be stored at field temperature, room temperature, 50F and 41F prior to blemish percentage evaluation.
- 2b **Influences of Plant Growth Regulators (Ethylene, MCP, Antioxidants) on olive blemish development.** Mechanically harvested olives will be immediately after harvest exposed to different treatments while store at room temperature conditions and blemishes evaluated daily:
 - 1 Exposed to Air
 - 2 Exposed to ethylene (10ppm)

- 3 Exposed to ethylene (10ppm) after being dipped in 1000nl·l⁻¹ 1-MCP (ethylene action blocker).
- 4 Exposed to air after being dipped in 1000nl·l⁻¹ 1-MCP (ethylene action blocker).
- 5 Exposed to air after being dipped in a strong antioxidant
- 6 Exposed to ethylene (10ppm) after being dipped in a strong antioxidant

Budget:

Ferguson:

SRA support: 4 months @ 55,000 + 28% benefits = 23,466.00
(Kitrin Glozer; Ph.D.)

Travel and operating expenses for SRA: = 8,000.00
Truck, travel, mobile phone.

Travel support for Ferguson = 3,000.00

Chemicals, spraying costs, field supplies = 7,500.00

Mechanical pruning = 1,500.00

Hand harvesting crews = 15,000.00

Mechanical harvester use and transportation:
(900 trees) @ 3 locations X 3 days @ 500/hour
and transportation @ 2,500 X 3 plots = 43,500.00

Crop destruct on 250 tree production = 5,000.00

Burns:

Travel, housing and vehicle support for 6 weeks = 12,000.00
(Professorial reassignment at no salary cost to us)

Crisosto:

Laboratory technical support: = 10,000.00

Laboratory supplies: = 2,500.00

Visiting Scientist for 3 months: = 8,400.00

Krueger = 5,000.00

Rosencrance = 5,000.00

Total = 149,866.00

This is the first of a four year experiment: 2007 - 2010