

Olive Work Group / Department of Plant Sciences

University of California
Division of Agricultural Sciences

PROJECT PLAN/RESEARCH GRANT PROPOSAL

Project Year: 2008 – 2009

Anticipated Duration of Project: year 2 of 4

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Title:

Developing of Mechanical Harvesting for California Olives: 2007-2010

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Keywords: Picking head harvester, trunk shaking harvester; abscission agent; tree training; tree pruning; anti oxidant; plant growth regulator; post harvest fruit evaluation; post processing evaluation; sensory evaluation; instrumental evaluation, consumer acceptance.

Problem and Significance:

The California table olive industry will need to develop mechanical harvesting if it is to survive economically. Hand harvesting costs are remaining above \$350.00/ton and the gross return per ton is sure to drop from the 2007 peak \$1050.00/ton price. Current immigration legislation suggests hand labor pools may decrease.

This proposal has four coordinated sections:

I.: Harvester Efficiency and Effects on Fruit Quality:

There are two components to successful mechanical harvesting. The first component is efficiently harvesting enough fruit in a short enough time to successfully compete with the cost of hand harvesting. The second component is delivering olives to the processor that can be successfully processed into a commercially acceptable quality product.

The 2006 and 2007 research results indicated we are making progress with the first major component of the project; efficient harvest removal and efficiency. Results from 2006 and 2007 demonstrated that, if the fruit was accessible to the tines of a 'picking head harvester', the fruit could be removed with 83-86% average efficiency. However, less accessible fruit, and inability to either place or keep all this fruit in the catch frame, decreased the final harvester efficiency to 73% in 2007. In a heavily cropped grove (8.5 tons/acre), spaced at 12 X 21 feet, the DSE 007 could potentially harvest 2 tons/hour at peak efficiency. However, tree shape strongly decreased efficiency.

The 2006 and 2007 results demonstrated the major impediment to efficient mechanical harvesting is tree shape. If the tree canopy is too high, wide, low, or dense, or has branches extending into the row middle the result will be poor harvest removal and final efficiency, and a damaged canopy. The results thus far strongly indicate the picking head harvester efficiency will not be significantly improved if the tree is not pruned for mechanical harvesting.

The above results, and preliminary observations of three different trunk shaking harvesters on hedgerow trees at Nickles Soils Laboratory, have resulted in a reorganization of this project.

First, the DSE 007 is still a prototype and not ready for harvest efficiency trials. Therefore further evaluation and improvement of this machine will be done by Dr. Uriel Rosa in cooperation with Dave Smith. Ferguson will assist with obtaining a suitable orchard, preparing the orchard, field support and obtaining samples for grading, processing and evaluation.

Ferguson and Krueger will evaluate four commercially available harvesters; OMC, Coe, and ENE trunk shakers, and a Spanish wraparound trunk shaker, in their hedgerow training trial at Nickles Soils Laboratory in Colusa County.

Ferguson and Krueger will also evaluate the Maqtec Colossus picking head harvester shaker in Argentina, in February 2009, after the improvements suggested by our February, 2008 trial have been incorporated.

In terms of the second major component of mechanical harvesting, fruit quality, 2006 results indicated a poor correlation of fruit grade at delivery with the final USDA grade of processed product. However, the 2006 mechanically harvested fruit was processed in small lots. Fruit harvested in 2007 was processed in the 5 and 10 ton samples requested by processors. The samples were extensively evaluated at delivery in October 2007, will be canned in March 2008, and will be evaluated by Drs. Barrett, Guinard, Yegge and Abdul Sigal, MS. This evaluation will have three components; instrumental, sensory and consumer acceptance. Using these three methods of evaluation the olive quality, as determined at the receiving stations, will be correlated with final processed quality. These results should be available in June 2008.

Though both factors discussed above are important, the second component, processed fruit quality, is the limiting factor; if the harvested olives cannot be successfully processed into a commercially acceptable product the decreased cost of harvesting is unimportant.

II. Abscission Chemicals to Decrease Fruit Removal Force:

Table olives are harvested immature green at horticultural maturity but before physiological maturity. Harvest is done by hand labor over a period of approximately 2 months. Increased labor costs and low labor availability have intensified industry interest in mechanical harvesting. To ensure future economic stability for the olive grower and consistent product flow at the processing plant, the California table olive industry views the development of a successful mechanical harvesting system, that is, mechanical harvesting combined with abscission agent application, as high priority.

Mechanical harvesters were evaluated in the past but unable to harvest table olive fruit efficiently and without damage. Trunk-shaking and canopy-shaking mechanical harvesters are operating today in other fruit crops in California, and in some cases active machine development is ongoing for the purpose of harvesting table olives. Although acceptable fruit removal is being achieved (50 to 80%, depending on orchard conditions), it is widely believed that a fruit-specific abscission agent would allow for higher fruit

removal. Moreover, an abscission agent would enable lower mechanical forces to be applied during harvest, thus minimizing fruit damage. Fruit damage is an industry concern because bruising may compromise quality of the final canned product, although this remains to be tested.

Abscission agents were applied experimentally to olive canopies in the past to improve fruit removal by trunk-shaking mechanical harvesters. Recent work in Florida identified compounds that accelerated mature and immature fruit abscission when applied to citrus canopies in the field, and some of these were screened in California table olive orchards. Of those tested in 2006, only ethylene-releasing compounds (ERCs) such as ethephon (2-chloroethyl phosphonic acid) achieved consistent fruit loosening. ERC use in many crops including olive has been problematic due to attendant leaf loss coincident with fruit loosening. Some other compounds screened in 2007 were efficacious. These included metsulfuron-methyl and several dikegulac formulations. Like the ERC compounds, increased leaf abscission was associated with fruit loosening.

The purpose of this research is to 1) extend olive screening work done in 2006 and 2007 with 3rd tier compounds within the Florida abscission and harvesting compound library and refinement of application of 2nd tier compounds, 2) identify candidates useful for assessing the benefit of abscission agent application for machine harvest, and 3) work with the olive abscission and harvesting team to establish and execute field trials with abscission agent/machine harvest combinations.

III. Pre and Postharvest Treatments to Decrease Fruit Damage and Improve Fruit Quality; Assessment and Standardization of Fruit Quality

Damage to olives as a result of mechanical harvest includes cuts, indentations, bruises and softening, which may result in poor quality of a processed product. Fruit response to abscission agents, particularly ERCs, can result in accelerated fruit ripening, softening, and accentuated response to mechanical damage. Pre- and post harvest treatments that decrease these effects are desirable.

In 2006 and 2007 we had some success with postharvest application of ascorbic acid and 2 commercial products used to reduce postharvest disorders in pome fruit. We are working with the registrant of the commercial products to determine whether these products may be viable options to ameliorate damage in postharvest applications. Additionally, we intend testing pre- and post harvest application of 1-MCP, an ethylene binding inhibitor that has shown efficacy for improved fruit quality. SmartFresh (1-MCP) is now the standard treatment in controlled atmosphere to maintain apple quality in storage. ReTain (AVG; ethylene biosynthesis inhibitor, Valent) will also be tested preharvest for reduction of mechanical damage and increased firmness. There have been reports of some success with this product in preharvest applications in pear (Mitcham, unpublished results 2007), as well as in European plum subjected to simulated mechanical harvest (Lippert and Blanke, 2004). Increased firmness in prune, pear and cherry has been obtained with preharvest treatments of various plant growth regulators

(6-benzyl adenine, synthetic cytokinin CPPU, ethylene inhibitors; Glozer and other researchers, current research).

In 2008 we intend continuing to evaluate those treatments that have shown efficacy to-date in olive, and add other pre- and post harvest treatments for increased firmness, decreased bruising, and improved fruit handling methods post harvest. A post harvest strategy that removes fruit from the field to the receiving station with minimal time lapse, receiving station treatment (such as hydrocooling, drenches, cold storage), and minimal time in transit to the processing plants, will be considered with potential treatments described above, will be considered. We will work with the food technologists employed by the processors to develop these strategies. A mentioned in Objective I., improved methods of sensory evaluation to evaluate fruit quality will be developed in cooperation with processors. These improved fruit evaluation methods will also be used to evaluate the efficacy of the treatments applied in this portion of the experiment.

IV. Training Young Orchards for Mechanical Harvesting

A hedgerow 'Manzanillo' orchard was planted in 7/1/2001 at Nickles Soils Laboratory in Colusa County. Four training treatments; conventional, free standing espalier, an espalier woven through a trellis, and an espalier clipped to a trellis, all spaced at 12 X 18 feet, 202 trees to the acre have been evaluated for yield, value per ton and value per acre. The objective was to determine the effect of training trees for mechanical harvest on yield and fruit value. Thus far all treatments are yielding equally well with no significant differences in value per ton or acre. These evaluations will be continued until the mature yields plateau.

Preliminary trunk shaking efforts this year with three different shakers indicted removal with trunk shakers would be viable. Therefore a randomized replicated mechanical harvesting trial using four different trunk shakers will be conducted in this experimental orchard in October, 2008.

Objectives:

This project will have four major overall objectives. (PI directing research in parentheses)

- I. Evaluating existing harvesters on young trees; the Coe trunk shaker, ENE prune harvesters, and Spanish wraparound trunk shaker harvester for removal and final efficiency, and effects on fruit quality. (Ferguson) Also, improved methodology for assessing fruit quality (Barrett and Guinard)
- II. Screening and evaluating potential abscission compounds. (Burns)
- III. Evaluating pre and postharvest treatments and fruit handling strategies for reduced damage and improved fruit quality. (Glozer, Barrett and Guinard)
- IV. Evaluating the yield of hedgerow orchards. (Krueger)

Plans and Procedures:

Objective I:

Evaluation of OMC, Coe, ENE and Spanish Wraparound Mechanical Harvesters and

Evaluation of the MaqTec Colossus Harvester

**Trial # 1: Krueger and Ferguson ‘Manzanillo’ Olive Training Trial
Nickels Soils Laboratory, Colusa County**

Specific objective is to demonstrate effect of training method:

- Conventional
- Free standing Trellis
- Woven Trellis
- Clipped Trellis

On

- Harvester removal efficiency (total fruit removed/total fruit on tree)
- Final harvester efficiency (total fruit in bin/total fruit on tree)
- Fruit Value (as determined by receiving station)
- Fresh Olive Quality (as determined by Guinard, Barrett, Yegge and Sigal)
- Processed Olive Quality (as determined by Guinard, Barrett, Yegge and Sigal)

**Experimental Design: 5 X 4 Factorial with 5 Replications of 2 trees
(10 trees per combination)**

Tree Training Method

<u>Harvester</u>	Conventional	Free Espalier	Woven Espalier	Tied Espalier
Coe	5, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)
ENE	5, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)
Wraparound	5, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)
OMC	5, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)
Hand Harvested Control	5, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)	10, 2 tree, reps (10 trees)

OLIVES:
HEDGEROW
TRIAL

3	3	3	1	1	1	S	S	4	4	2	2	2
3	3H	3H	1W	1E	1C	S	4H	4H	4H	2C	2W	2
3	3W	3E	1W	1E	1C	S	4C	4E	4W	2C	2W	2
3	3W	3E	1C	1W	1E	S	4C	4E	4W	2E	2C	2
3	3C	3W	1C	1W	1E	S	4E	4W	4C	2E	2C	2
3	3C	3W	1E	1C	1W	S	4E	4W	4C	2W	2E	2
3	3H	3H	1E	1C	1W	S	4H	4H	4H	2W	2E	2
1	1H	1H	1H	1H	1H	S	3H	3H	3H	2H	2H	2
1	1H	1H	2C	2W	2E	S	3C	3W	3E	4H	4H	4
1	1W	1C	2C	2W	2E	S	3C	3W	3E	4C	4E	4
S	1W	1C	2W	2E	2C	S	S	3C	3W	4C	4E	4
1	1C	1E	2W	2E	2C	S	3E	3C	3W	4E	4C	4
1	1C	1E	2E	2C	2W	S	3W	3E	3C	4E	4C	4
1	1E	1W	2E	2C	2W	S	3W	3E	3C	4W	4W	4
1	1E	1W	2H	2H	2H	S	3H	3H	3H	4H	4H	4
2	2W	2C	4H	4H	4H	S	1H	1H	1H	3H	3H	3
2	2W	2C	4E	4W	4C	S	1H	1H	1H	3C	3W	3
2	2C	2E	4E	4W	4C	S	1C	1W	1C	3C	3W	3
2	2C	2E	4C	4E	4W	S	1C	1W	1C	3W	3E	3
2	2E	2W	4C	4E	4W	S	1W	1E	1W	3W	3E	3
S	2E	2W	4W	4C	4E	S	S	1E	1W	3E	3C	3
2	2H	2H	4W	4C	4E	S	1W	1C	1E	3E	3C	3
4	4H	4H	4H	4H	4H	S	2C	2W	2E	3H	3H	3
4	4C	4W	3H	3H	3H	S	2C	2W	2E	1H	1H	1
4	4C	4W	3E	3W	3C	S	2W	2E	2C	1E	1W	1
4	4E	4C	3E	3W	3C	S	2W	2E	2C	1E	1W	1
4	4E	4C	3C	3E	3W	S	2E	2C	2W	1C	1E	1
4	4W	4E	3C	3E	3W	S	2E	2C	2W	1C	1E	1
4	4H	4H	3H	3H	3H	S	2H	2H	2H	1W	1C	1
4	4	4	3	3	3	S	2	2	2	1	1	1

Note: Planted 7-8-01. Tree spacing =12'x18' or 202 trees/ac
 S = Sevillano (pollinators) center row budded to Sevillano 07-03
 The rest of the trees are Manzanillos
 Plot is located on Greenbay Avenue (Nickels Estate in Arbuckle).



MAP
KEY:

Bold, italics and underlined = border tree

H =
Hand
Harvest

O = OMC
Harvester

C = Coe Harvester

E = ENE Harvester

W = Wraparound Harvester

Treatments

1. Freestanding Traditional
2. Espalier - no trellis
3. Espalier - trellis, no tying
4. Espalier - trellis and tying

May, 2008:

Four training treatments (above) will be trained or pruned as per treatment, and thinned if necessary.

September / October 2008:

5, 2 tree hand harvested control samples (10 trees) will be harvested for yield and fruit quality.

Each harvester will trunk shake 5, 2 tree replications of 4 training treatments.

(Tarp will be placed under each 2 tree replication)

- catch frame will be cleaned
- fruit will be weighed in field using a bin scale
- fruit on tarp under tree will be collected and weighed in the field
- fruit remaining on tree will be hand harvested and weighed in the field
- mechanically harvested fruit in the bin will be sent to grading station for weight and grade after a sample has been collected for Barrett and Guinard
- trees will be evaluated on a four point scale for trunk damage, branch damage and leaf loss:
 - o 0 = no damage or loss
 - o 1 = mild
 - o 2 = moderate
 - o 3 = severe

Materials and Methods for Fresh and Processed Fruit Evaluation:

In April through May 2008 Drs. Diane Barrett and J.X. Guinard of the Department of Food Science and Technology, UC Davis will be cooperating with Dr. Jane Yegge of Bell Carter and Abdul Sigal MS of Musco Family Olives to develop instrumental, sensory, and consumer evaluations for processed olives. These methods will be used to evaluate the olives delivered to them fresh in fall 2008, and to be evaluated processed in spring, 2009.

They propose to compare processed fruit from mechanically and hand-harvested crops using a combination of analytical sensory and instrumental measures of sensory properties, quality ratings by industry experts and buyers, and liking and purchase intent ratings by consumers.

Sensory evaluation of appearance, flavor and texture (Dr.. Jean-Xavier Guinard)

A panel of users and likers of table olives will be assembled and trained in descriptive analysis. Using a terminology of descriptors of the sensory properties of table olives developed in the Sensory Science Laboratory of the Dept. of Food Science and Technology at UC Davis, the panel will evaluate the intensities of the sensory properties of appearance, flavor (aroma, taste, chemical irritation) and texture/mouthfeel of the olive samples in the design on 15-point intensity scales. Panel performance (e.g., ability to discriminate, reproducibility and consistency with the rest of the panel) will be assessed upon training using analysis of variance measures to ensure that the panel is ready to proceed with the actual descriptive analysis. A randomized complete block design with replications and accounting for order and contrast effects will be used for the actual descriptive analysis.

Instrumental measures of appearance, flavor and texture (Dr. Diane Barrett)

We will use a combination of color (L,a,b), flavor (Gas-Chromatography & Mass Spectrometry), and texture (TA.XT2 Texture Analyzer) measures, along with basic chemical measures of fruit composition to compare mechanically and hand-harvested processed fruit.

Quality evaluation with industry experts and buyers (Dr. Jean-Xavier Guinard)

Samples will be assessed for overall quality by industry experts and buyers at one or more table olive industry events (e.g., annual convention, food show).

Consumer testing (Dr. Jean-Xavier Guinard)

A set of about 200-300 consumers screened and selected to provide a representative sample of the table olive consuming public will be asked to assess the samples for liking and purchase intent among other measures. Demographic and psychographic data will

also be collected in an exit survey, and used to characterize potential preference segments among the consumer sample.

Data analysis (Drs. Jean-Xavier Guinard and Diane Barrett)

Data from each of the four protocols above will be analyzed with parametric univariate (analysis of variance and multiple mean comparisons) and multivariate statistics (principal component analysis and cluster analysis) to document the sensory properties, quality and consumer acceptance of mechanically-harvested vs. hand-picked processed fruit. The relationships among the four data sets will then be investigated using multivariate analysis methods (PLS regression and External Preference or Quality Mapping) to identify sensory drivers of quality and of acceptance.

**Trial # 2: Evaluation of MaqTec Colossus and ‘Manzanillo’ Table Olives
Finca La Bella, Poman, Catamarca, Argentina**

Ferguson, Krueger and Paul Vossen will cooperate with the local INTA in evaluating the improved MaqTec Colossus harvester on hedgerow ‘Manzanillo’ table olives.

The specific objective is to determine the efficiency of the MaqTec Harvester on hedgerow ‘Manzanillo’ trees and its effects on processed green and processed black table olive quality.

February, 2009:

Experimental Design: Two rows, divided into 2 blocks, each containing 1 replication of
- 10 hand harvested control trees
- 10 machine harvested trees (with Ethephon treatment in 2/2008, will not apply in 2009)
- 10 Machine harvested trees (no Ethephon in 2008 or 2009)
(8 replications of 10 trees each with 2 harvested border trees between each 10 tree replication and at the ends of both rows)

If it was not done in the spring, all trees to be mechanically harvested will be skirted at 1m prior to harvest, the fruit removed, and weighed.

Hand harvested control:

- 4, 10 tree, replications will be harvested, weighed and samples taken for green and black processing the day before machine harvest.

Mechanically harvested fruit:

MaqTec harvester will:

- Harvest each 8, 10 tree replication, while being timed for total time for 10 trees.
- Stop at harvested border trees to clean catch frame for total weight of mechanically harvested and caught fruit.
- Fruit under the 8, 10 tree replications will be hand harvested, weighed and discarded
- Fruit remaining on tree will be hand harvested and weighed, and discarded
- 3, 30 kg samples of each 10 tree replicate will be processed black
- 3, 30 kg samples of each 10 tree replicate will be processed green
- 3, 100 fruit samples, from each 10 tree replication will be visually evaluated for fresh fruit damage.
- trees will be evaluated on a four point scale for trunk damage, branch damage and leaf loss:
 - o 0 = no damage or loss
 - o 1 = mild
 - o 2 = moderate
 - o 3 = severe

Objective II: Evaluating Potential Abscission Agents

In all cases, ANOVA or t-tests will be performed and means separated. Percentage data will be transformed, if necessary, to stabilize variance.

Manzanillo cultivar will be used.

- 1) Screen experimental abscission compounds in at least two olive growing sites in California. Olive branches will be tagged and fruit number recorded. Proprietary experimental abscission compounds and an adjuvant-sprayed control will be applied to branches to run-off. At least 1 branch with at least 10 fruit on four replicate trees will be used. Fruit detachment force and leaf drop will be assessed 10 to 12 days after application. Phytotoxicity will be visually evaluated.
- 2) Make decisions on compound(s) to use with machine harvesting field trials. Decisions will be based on efficacy, selectivity, and phytotoxicity measured in 2006-2008 seasons. Grower risks will be identified and communicated.
- 3) Apply selected abscission compound based on the above-mentioned criteria. Compound(s) will be applied to plots using either a hand gun or air-blast sprayer. Work with the research team to set up plots and execute measurements for determination of the potential of abscission agent application for increase machine harvesting efficiency.

Objective III: Pre and Postharvest Treatments to Decrease Fruit Damage and Improve Fruit Quality; Standardization of Methods and Sensory Analysis

Appropriate statistical methods will be used to evaluate treatment effects.

Manzanillo cultivar will be used, with multiple testing sites, as needed. Preharvest treatments will be crop-destruct and in large scale applications (whole tree applications), crop compensation must be covered. Post harvest applications will be done in small scale tests primarily. If large scale tests are warranted, fruit for testing will be obtained from the processors as part of cooperative development.

- 1) Screen plant growth regulators (PGRs) in preharvest applications for improved fruit firmness: cytokinins MaxCel (6-BA) and CPPU (2-chloro-4-pyridyl)-N=phenylurea; labeled as Prestige, Valent BioSciences), and ethylene synthesis/binding/activity inhibitors ReTain and 1-MCP (SmartFresh) will be tested as whole tree applications in replicated trials.
 - a. Cytokinins are plant growth regulators that increase cell division, but also have positive effects on cell enlargement. They have shown benefit in increasing firmness and regulating fruit maturity in various crops, with effective applications periods throughout early, mid- and late fruit development, depending on crop. Applications will be made to whole trees by mistblower or handgun, at varying concentrations and application timings from post-bloom until 1 month prior to harvest. Fruit size and firmness are the main quality measures that may be affected, however, fruit removal force may also be affected as a function of maturity timing change. These measures will be assessed on fruit sampled from treated trees at an early harvest timing. Mechanical damage simulating mechanical harvest will be applied to a sample of fruit, and fruit responses as a function of PGR treatments will be evaluated, with firmness and bruising as the main components of quality.
 - b. 1-MCP is an ethylene binding inhibitor that has shown some efficacy preharvest in reducing deleterious effects of ethylene, including prior to simulated mechanical harvest, thus, this product should be applied within the last few days prior to harvest. ReTain, an ethylene synthesis inhibitor, is typically applied 3 to 4 weeks prior to harvest for prevention of preharvest fruit drop, however, application closer to harvest to ameliorate damage from mechanical harvest is the appropriate timing for this project. Interactions with abscission agents (especially ERCs) are an important evaluation as well, so trials will include treatments with 1-MCP and ReTain, with and without ethephon application. Fruit firmness, removal force and response to mechanical damage will be evaluated post-treatment until harvest timing. Whole tree applications will be made and individual olive branches will be tagged and fruit number recorded for observations of preharvest drop and leaf drop. Fruit removal force and firmness

will be evaluated as a function of treatment and any phytotoxic symptoms recorded.

- c. As potential candidates for abscission agents are developed in associated trials, these agents will also be tested with PGRs for interactions and combined efficacy, however, it is likely that this work will be carried over into 2009.
- 2) Test antioxidants and 1-MCP in post harvest application for reduction of mechanical damage and improved fruit quality. Develop fruit handling strategies that include these applications and physical means of reducing damage in cooperation with processors and their food technology specialists.
- a. Test the best candidates from 2006 and 2007 trials, and any new candidates for post harvest treatment (drenches, controlled atmosphere) in cooperation with processors. Fruit from hand- and mechanically-harvested trees will be tested in small lots first, to screen available technologies, and then in large lots to develop and overall fruit handling strategy. Physical methods of maintaining fruit quality, such as hydrocooling, cold storage, and rapid movement of fruit from harvest to processing plant will be developed.
 - b. Fruit quality measures will be coordinated among Glozer, Barrett, Yegge and Sigal, for uniformity. Firmness and bruising will be important measures evaluated; means of evaluating and instrumentation for standardization will be determined jointly. Sensory evaluation of the processed fruit will be conducted to determine degree of difference between hand and mechanical harvesting, and descriptive analysis will point out specific differences.

Objective IV: Evaluating Yield of Hedgerow Orchards

This is a continuing trial evaluating the yield of olives trained four different ways:

- conventionally trained
- free standing espalier
- trellised woven espalier
- trellised tied espalier

The specific objective is to determine if olives trained for mechanical harvesting can yield as well as conventionally trained olives.

OLI VE:
HEDGEROW
TRIAL

S	3	3	1	1	1	S	S	4	4	2	2	2
3	3	3	1	1	1	S	4	4	4	2	2	2
3	3	3	1	1	1	S	4	4	4	2	2	2
3	3	3	1	1	1	S	4	4	4	2	2	2
3	3	3	1	1	1	S	4	4	4	2	2	2
3	3	3	1	1	1	S	4	4	4	2	2	2
3	3	3	1	1	1	S	4	4	4	2	2	2
1	1	1	1	1	1	S	3	3	3	2	2	2
1	1	1	2	2	2	S	3	3	3	4	4	4
1	1	1	2	2	2	S	3	3	3	4	4	4
S	1	1	2	2	2	S	S	3	3	4	4	4
1	1	1	2	2	2	S	3	3	3	4	4	4
1	1	1	2	2	2	S	3	3	3	4	4	4
1	1	1	2	2	2	S	3	3	3	4	4	4
1	1	1	2	2	2	S	3	3	3	4	4	4
2	2	2	4	4	4	S	1	1	1	3	3	3
2	2	2	4	4	4	S	1	1	1	3	3	3
2	2	2	4	4	4	S	1	1	1	3	3	3
2	2	2	4	4	4	S	1	1	1	3	3	3
2	2	2	4	4	4	S	1	1	1	3	4	3
S	2	2	4	4	4	S	S	1	1	3	3	3
2	2	2	4	4	4	S	1	1	1	3	3	3
4	4	4	4	4	4	S	2	2	2	3	3	3
4	4	4	3	3	3	S	2	2	2	1	1	1
4	4	4	3	3	3	S	2	2	2	1	1	1
4	4	4	3	3	3	S	2	2	2	1	1	1
4	4	4	3	3	3	S	2	2	2	1	1	1
4	4	4	3	3	3	S	2	2	2	1	1	1
4	4	4	3	3	3	S	2	2	2	1	1	1
4	4	4	3	3	3	S	2	2	2	1	1	1

Note: Planted 7-8-01. Tree spacing =12'x18' or 202 trees/ac
S = Sevillano (pollinators) center row budded to Sevillano 07-03

The rest of the trees are Manzanillos

Plot is located on Greenbay Avenue (Nickels Estate in Arbuckle).



Treatments

1. Freestanding Traditional
2. Espalier - no trellis
3. Espalier - trellis, no tying
4. Espalier - trellis and tying

Planted 7/8/01: 12' X 18', N-S, 202 trees/acre @ Nickles Soils Laboratory in Colusa County

- 4, 3 row replications
 - containing 7 or 8 trees of each of 4 training treatments
 - each treatment repeated once within each row
 - 90 of each training method

Annual hand harvest for yield, value/ton and calculated value/acre:

- tree weights and receiving station grade from the 5, 2 tree, hand harvested replications of each treatment collected during the mechanical harvester evaluation, detailed in Objective 1; Trial #1, will be used to obtain per tree yield, fruit value and calculate value per ton and per acre for each training treatment.

Budget:

Ferguson:

APS support: 3 months @ 67,000 + 35% benefits (Kitren Glozer; Ph.D.)	=	22,612.00
Travel and operating expenses for APS: Truck, travel, mobile phone, materials.	=	8,000.00
Crop compensation for preharvest applications of test materials.	=	5,000.00
Travel for Ferguson: (California research and meetings, off season research in Argentina, Spain to see OXBO harvester)	=	15,000.00
Harvesting supplies; tarps, bags, tapes:	=	2,000.00
2 Imada Pull Testers, field scale, computers	=	8,200.00
Hand harvesting crews @ Nickles (To be contracted and negotiated at time of harvest)	=	3,000.00
Mechanical harvester use and transportation: ENE 1 location X 3 days @ 8 hours/day @ 500 hour and transportation @ 2,500.	=	14,500.00
Mechanical harvester use and transportation: Coe 1 location X 3 days @ 8 hours/day @ 500 hour and transportation @ 2,500.	=	14,500.00
Mechanical harvester use and transportation: Wraparound 1 location X 3 days @ 8 hours/day @ 500 hour and transportation @ 2,500.	=	14,500.00
Mechanical harvester use and transportation: OMC 1 location X 3 days @ 8 hours/day @ 500 hour and transportation @ 2,500.	=	14,500.00
Burns: Travel, housing and vehicle support for 2 weeks (Professorial reassignment at no salary cost to us)	=	4,000.00

Abscission Compounds, shipping, spray materials, application costs, grower compensation if needed.	= 10,000.00
<i>Guinard and Barrett: (Budget breakdown in italics)</i>	
<i>Graduate Student Research (GSR) assistantship for 1 academic year</i>	\$19,980
<i>GSR benefits</i>	\$ 560
<i>Supplies for descriptive analysis</i>	\$ 1,700
<i>Supplies and maintenance for instrumental measurements</i>	\$ 3,800
<i>Quality assessment with industry experts and buyers</i>	\$ 2,100
<i>Consumer testing</i>	\$ 4,200
<i>Sensory data collection software (maintenance contract)</i>	\$ 540
<i>SAS license (statistics)</i>	\$ 300
<i>Travel to plants, meetings with industry and to harvest</i>	\$ 2,820
<u>Total</u>	= 36,000.00
Krueger: Field assistance and travel	= 10,000.00
Neil O'Connell: Field Assistance and travel	= 5,000.00
<u>Total</u>	= 186,812.00

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

Originator's Signature

Date

Department Chair:

Date

UC COC Liaison Officer

Date

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Scope of Work: This section is required by UC Davis Sponsored Research Office

Louise Ferguson: Project Co-Director:

Responsible for designing all aspects of the project with co-director and cooperator, obtaining industry cooperators, and negotiating contracts with independent contractors, (harvester rental, harvester hauling, picking crews, equipment rental and crop loss compensation to industry cooperators). Responsible for directing execution of the experiments, delivering the samples to industry processor cooperators, collecting the data from same, submitting data for analysis, and collating all reports into final form for approval of Project Overseer, Steven T. Sibbett and COC) when requested.

Responsible for determining exact details of Objectives I through IV above in cooperation with all project cooperators.

Jackie Burns: Project Co-director:

Responsible for designing and, with assistance, executing Objective II above. Will analyze data and submit a final report to Project Overseer by requested date.

Diane Barrett: Project Co-director

And

Jean Xavier Guinard: Project Co-director

Fruit quality evaluation, sensory evaluation, standardization of methodology participating in execution of Objective III at UC Davis and in cooperation with processors' food technology personnel. Funds are to cover costs of student and laboratory costs.

Kitren Glozer: Cooperator:

Will assist project co-directors and other cooperators in designing, preparing and executing objectives I-III; analyze data, write reports, produce posters and reports as requested. Will design and execute preliminary trials on preharvest and postharvest treatments in preparation for determining which compounds to use in larger trials. Funding is to cover her time, travel costs and miscellaneous expenses.

William H. Krueger: Glenn County Farm Advisor Cooperator

Local Farm Advisor participating in execution of field work of Objective IV in Glenn County; estimated at 4 weeks time. Funds are to cover his time, travel costs and miscellaneous expenses.

Neil O'Connell: Tulare County Farm Advisor Cooperator

Local Farm Advisor participating in execution of field work of Objective I in Tulare County; estimated at 4 weeks time. Funds are to cover his time, travel costs and miscellaneous expenses.

Paul Vossen: Sonoma County Farm Advisor Cooperator:

Local Farm Advisor participating in execution of field work of Objective I in Argentina. estimated at 2 weeks time. Funds are to cover his time, travel costs and miscellaneous expenses.

Contractors: harvester hauling, rental, operation, support and hand harvesting of olives.

Harvesting Contractors: to be negotiated

Sebastian Coe: Coe Harvesting

Eric Nielsen: ENE

Don Mayo: OMC

Martine Bonadeo: MaqTec

Dennis Burreson: Burreson Farms