

**IFAS Citrus Initiative**  
**Annual Research and Extension Progress Report, 2008-09**  
**Mechanical Harvesting & Abscission**  
**June 2009**

**Program:** Economic Studies (formerly titled “Loads and Allocations”)

**Investigator:** Fritz Roka

**Other Contributors:** Tom Spreen, Jake Searcy, German Blanco, Jackie Burns

A southwest Florida grower advisory committee rated Economic studies a “medium” priority and specifically rated a study of Loads and Allocations as “low” priority during a meeting on September 2, 2005.

Economic studies attempt to address questions related to machine and worker productivity, crop yields, harvesting costs, and valuing the costs and benefits of incorporating abscission as part of the overall harvesting system. A “load allocation” study addresses efficiency of harvesting equipment, but also includes broader interests of juice processors, such as juice quality, optimal harvest timing, and trade offs between length of harvest season and bulk-tank juice storage capacity.

**Objectives:**

1. Conduct “case-study” analysis of a large grower who harvests fruit with both hand crews and mechanical systems. Objective of study will be to test whether harvest method (hand vs. mechanical) has any significant impact on crop yield. This study will be contrasted with “shot-gun” approach of previous commercial yield study. “Case-study” will allow for more careful collection of data including annual yields, harvest method, tree counts, and management practices by block.
2. Estimate cost of handling harvest debris at the processing plant.
3. Harvest Scheduling Model. This work is the basis of Jacob Searcy’s Ph.D. dissertation. This research is developing a programming model that integrates biological characteristics of fruit maturity in the grove with the logistical constraints involved in fruit harvesting and juice processing. Objective of research is to assess whether mechanical harvesting can alter “efficient” (i.e. least cost) logistical movement of fruit from the tree through the juice plant, and ultimately into a juice carton.

**Objective 1. Case-study analysis of a large grower who harvests fruit with both hand crews and mechanical systems.**

Accomplishments during 2008-09:

1. Earlier “shot-gun” data summarized and described in a SWFREC Station Report.
2. A masters-level student was recruited in Aug 2008 for work on the case study project.
3. A grower-cooperator was recruited to share 15-years of block level production data.
4. Status of project is “on-hold” because the student recruited for this project decided to quit the FRE graduate program in Oct 2008. No other students were

immediately available. A second student has been interviewed and expressed interest in the project. She could start on the project during the Fall 2009 semester, possible even during the second summer session.

Areas where progress exceeded expectations: n/a

Areas where progress did not exceed expectations:  
No data as yet collected from grower-cooperator.

Impact of accomplishments:

Many growers remained concerned over whether the stress of mechanical harvesting negatively affects long-term fruit production from their trees.

Presentations: none

Publications: none

Next steps:

1. Develop work/study plan with new student.
2. Initiate data collection process.

**Objective 2. Estimate cost of handling harvest debris at the processing plant.**

Accomplishments during 2008-09:

1. As of June 1<sup>st</sup>, 5 processing plants have been visited and interviews conducted with personnel involved with fruit receiving and processing operations.
2. From the interviews, a survey has been developed for individual plants to provide cost information on equipment repairs and downtime associated with harvesting debris. The survey has been submitted to UF/IRB for approval. Six plants are being recruited to provide confidential cost information and associated seasonal production data. First survey will be initiated in mid to late June 2009, and hopefully be completed by early Sep. Since only 6 plants are targeted for the survey, we anticipate at least two iterations per plant to follow-up with phone calls to clarify and ensure that survey responses are consistent across all plants.
3. During late March 2009, Tom Visser, an operator of mechanical harvesting equipment, approached us with an opportunity to collect harvesting debris data. Dr. T. Spann has developed a sampling procedure to estimate weight of harvesting debris by trailer load. Mr. Visser offered the use of a cleaning machine he developed as a way of measuring total harvesting debris by trailer load. Mr Visser's cleaning machine receives fruit from goats and runs the fruit across brushes and de-stemmers before conveying the fruit into the bulk fruit trailer. From early April through the middle of May, IFAS personnel collected fresh weight data on the total debris removed by the cleaning machine. Post-cleaned fruit was sampled to estimate the amount of leaf and stem material still being conveyed into the trailer. In addition, fruit samples were washed and filter by cheesecloth to estimate the amount of sand and other frit material removed by the cleaning procedure.

Areas where progress exceeded expectations:

Availability of cleaning machine not anticipated at the beginning of the harvest season.

Areas where progress did not exceed expectations:

Developing a procedure to collect cost data from processing plants proved to be more difficult than anticipated, in large part to the perceived sensitive nature of the data. Cooperators in this study want complete assurance that their individual data not be shared with other processing companies.

Impact of accomplishments:

Cost of handling harvesting debris could be a sizable number. At best, knowledge of this cost could stimulate discussion across the industry (grower + harvester + processor) to figure out the least cost solution to remove all harvesting debris prior to juice extraction. At the very least, knowledge of this cost could facilitate a change in mechanical harvesting so that debris from mechanically harvested systems dramatically decreases, and mechanically picked loads actually become preferred to hand harvested loads.

Presentations:

Roka, F.M. 2009. Cost of Harvesting Debris. Mechanical Harvesting Field Day and Workshop, Immokalee, FL, 22 April 2009. (70 industry representatives, 11 IFAS).

Publications:

Roka, F.M. and B.H. Hyman. 2009. Survey of costs associated with harvesting debris at citrus processing plants. Immokalee, FL.

Next steps:

1. Initiate formal cost survey and collect data from 6 plants.
2. Summarize data collected from T. Visser's cleaning machine.

**Objective 3. Harvest Scheduling Model.**

Accomplishments during 2008-09:

1. Mr. Searcy successfully passed his "field exam" in Sep 2008. Exam based on a literature review and analysis of previous optimal control and operations research papers involving agricultural production and harvesting topics.
2. Mr. Searcy completed draft of his dissertation including a chapter on fruit maturity dynamics that is manuscript ready for submission to a hort-science journal.

Areas where progress exceeded expectations: n/a

Areas where progress did not exceed expectations:

Mr. Searcy was expected to have completed his dissertation paper and Ph.D requirements.

Impact of accomplishments:

Integrating the biological dynamics of fruit maturity with the logistics of fruit harvesting and juice processing allows for an analysis of the complete system. Identifying areas of potential economic trade-offs could help suggest strategies to remove costs and thereby enhance the economic efficiency of the entire process of converting whole fruit into consumer ready juice products.

Presentations: none

Publications: none

Next steps:

1. Complete Mr. Searcy's Ph.D requirements by Aug 2009.
2. Solicit involvement of Dr. Gene Albrigo as an author to revise and ultimately submit fruit maturity manuscript to appropriate hort-science journal.
3. Draft and submit manuscript on harvest logistic programming model to appropriate operations research journal.

**Other Accomplishments during 2008-09:**

1. ***Mr. German Blanco completed and defended his MS thesis entitled "Cost/Benefit Analysis of Public Investment into CMNP Registration and Development for Citrus Harvesting."***

Impact of accomplishment:

Mr. Blanco's financial analysis of expected benefits from solely advancing "late-season" mechanical harvesting with CMNP indicates that the net present value of expenditures on registration and development since 1995 could be recouped within 6 years after securing an EUP for 25,000 acres. Financial pay-back period could be shortened with more treated acreage and a wider savings differential between hand and mechanical harvesting systems.

Presentations:

Blanco, GL. *Cost/Benefit Analysis of Public Investment into CMNP Registration and Development for Citrus Harvesting*. Thesis defense seminar on October 9, 2008, Gainesville, FL.

Blanco, GL, FM Roka, JK Burns, and RL Kilmer. *Cost/Benefit Analysis of Abscission Registration for Citrus Mechanical Harvesting*. Selected paper presented at the 2009 Annual meeting of the Southern Agricultural Economics Association, Atlanta, GA, on Feb. 2, 2009.

Roka, FM. *Summary of German Blanco's thesis on the NPV of mechanical harvesting during the late season with CMNP*. Presentation to the DOC Harvest Research Council, Lake Wales, Mar 10, 2009. (Presentation also cited in the Education and Outreach final report.)

Publications:

Manuscript submitted to the J. of Agricultural and Applied Econ (Mar 2009).

**2. *Measuring the labor productivity of harvest gleaners.***

Impact of accomplishment:

Data collected from an additional 30 'Valencia' blocks harvested between Apr – Jun 2008 strengthened productivity relationship developed in a draft of the Gleaner Productivity paper. Estimating gleaner productivity is important in order to estimate an implied piece rate, or unit cost, to harvest the remaining fruit crop after mechanical systems have finished. Less available fruit is hypothesized to lower gleaner productivity, and hence, increase the piece rate in order to attain a targeted hourly earnings for the harvest workers.

Presentations:

Roka, FM and BR Hyman. *Gleaning after Citrus Mechanical Harvesting – Labor Productivity*. Selected oral presentation at the 44<sup>th</sup> Annual Meeting of the Caribbean Food Crops Society, Miami, FL, July 17, 2008.

Roka, FM. *Productivity of Citrus Gleaners after Mechanical Harvesting*. Presentation to the DOC Harvest Research Council, Lake Wales, June 2, 2009. (Presentation also cited in the Education and Outreach final report.)

Publications:

Manuscript submitted to the J. of Agricultural and Applied Econ (June 2009).

**3. *At the request of AgroSource, Inc, a white paper was written to summarize the production, harvesting, and economic arguments of why an abscission agent was necessary to advance citrus mechanical harvesting.***

Impact of accomplishment:

White paper will become part of the USEPA CMNP registration package for submission in late June/ early July 2009.

Publications:

Roka, FM, JK Burns, JP Syvertsen, TM Spann, and BR Hyman. 2009. *Improving the Economic Viability of Florida Citrus by Enhancing Mechanical Harvesting with the Abscission Agent CMNP*. White paper written for submission package to USEPA for CMNP registration. (Paper also listed in the Education and Outreach Final Report.)

**4. *Worked with J. Burns and R. Ebel to help plan and organize abscission field trials for the 2008/09 season.*** My role was to acquire an initial grove site in southwest Florida and help coordinate the various cooperators to provide need equipment and harvesting labor. I participated in the Dec 08 and May 26, 2009 field trials. Barb Hyman and other personnel from the SWFREC Economic program provided field labor for four other field trials.