IFAS Citrus Initiative
Annual Research and Extension Progress Report 2006-07
Mechanical Harvesting and Abscission

Program: Loads and Allocations
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The "load and allocation" studies are an effort to incorporate concerns and issues which are important to the processing sector of the Florida Citrus industry. Woody debris and enhancing harvesting logistics are two mechanical harvesting related issues that connect the processing sector with the production and harvesting sectors. In the case of woody debris, processors argue that mechanical harvesting systems deliver more debris to processing plants than from hand harvested sites. If their argument is correct, the "extra" trash would impose higher costs through increased repairs to juice extraction equipment and time to handle a larger volume of waste material. Harvesting logistics involve daily trailer allocations and analyzing how mechanical systems could impact optimal harvesting schedules for both growers and processors. Mass harvesters have been shown to increase harvest labor productivity by 10-fold over hand harvesters. Consequently, mechanical systems require sufficient trailer allocation to operate through out the day. Cost efficiency plummets when mechanical systems are force to shut down due to limited daily trailer allocations. In addition to trailer allocations, the industry transition to mechanical harvesting will force a re-examination of optimal harvesting schedules that, hopefully, can increase economic returns to both growers and processors. While juice processors want to process as much pound-solids as possible, their other interests include acid levels, ratio, color, operational costs of the extraction process, and bulk-tank juice storage capacity.

Objectives pursued:

1. Characterize type of debris and estimate quantity of debris delivered to processing plants by harvest method.
2. Develop a resource allocation model that tracks the logistical movement of fruit and evaluates potential tradeoffs among pound-solids production, fruit harvesting, juice extraction and storage.

Objective 1. Characterize type of debris and estimate quantity of debris delivered to processing plants by harvest method. (Collaborating with Tim Spann.)

Accomplishments:

1. Met on three (3) occasions with representatives of a juice processing plant to identify and discuss how mechanical harvesting systems affect operations at a typical processing plant.
2. Develop protocol for data collection of woody debris at the processing plant's fruit collection station.
3. Built a prototype for an in-field data collection system that would allow data to be collected as goat dumped fruit into a bulk trailer.

4. Drafted a proposal for in-field data collection that will correlate debris delivered to the bulk trailer by harvest method, equipment operation, and grove condition.

Areas where progress exceeded expectations:

New initiative as of December 2006.

Areas where progress did not exceed expectations:

An initial plan to collect debris data at the processing plant proved to be cumbersome. Plant operations would have to be drastically altered, making the collection of debris data over an extended period of time unlikely. Further, collecting debris data at the processing plant would not allow for analysis of how equipment operation and grove conditions impact debris accumulation during harvesting.

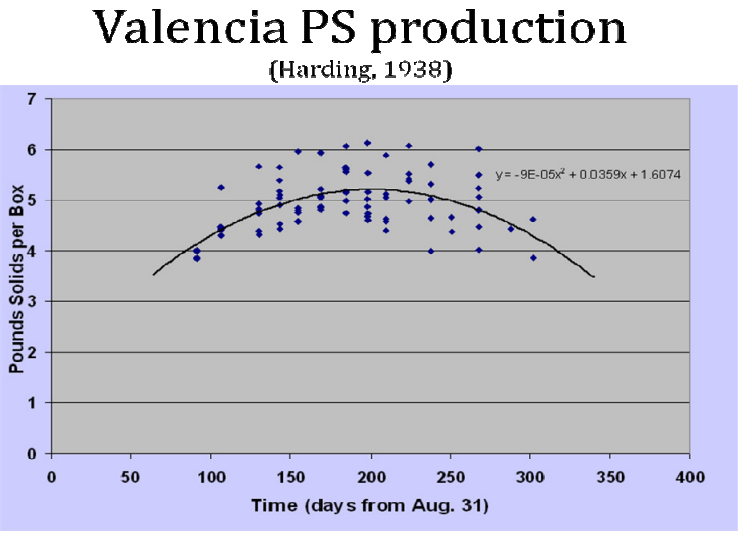
Impact of accomplishments:

A qualitative rating system of loads and limited data collected five years ago support the hypothesis that mechanical harvesting increases the volume of woody debris and sand delivered to a processing plant. An analysis of debris by harvest method, equipment operation, and tree condition could evolve into a series of "best operating practices" that capitalizes on the harvesting efficiencies of mechanical systems while at the very least, not impose higher costs on the processing plants.

Presentations and publications: None.

Next steps:

1. Complete the design and build a mobile in-field data collection system that would allow debris data to be collected from the bulk trailer.
2. Complete the experimental design that would collect debris data along with data on equipment operation and grove/tree condition.



Objective 2. Develop a resource allocation model that evaluates any potential tradeoffs within the logistical movement of fruit or potential changes of overall juice and/or fruit quality.

Accomplishments:

1. Based on research data from the late 1930s, we have developed a basic model of pound-solids accumulation in the tree over the course of a harvest season. Using a time-dependent "production function" of pound-solids and harvest costs, one can determine the "optimal" window of harvest from the grower's perspective.

2. Developed a conceptual model linking the grower's optimal harvest window with a processor's optimal combination of extraction schedule and storage capacity.
3. Established a working relationship with a processor who has already shared data on fruit maturity over the season.
4. Continued to gather relevant information on processing issues through a series of 13 industry interview. Key insight from these interviews are that FCOJ plants would seek to operate their plant more intensively for fewer number of days, while NFC plants would seek to stretch their extraction schedule for as long as fruit could be stored on the trees.

Areas where progress exceeded expectations:

Interest in this project among processor representatives and fruit buyers is higher than expected. The issue of daily trailer allocations has proved harder than the fruit buyers we interviewed initially thought and believe that our IFAS project may yield beneficial results.

Areas where progress did not exceed expectations:

The development of a conceptual model has proved more time consuming than originally anticipated. By this time we had hoped to be working toward an empirical or simulation model.

Impact of accomplishments:

Sufficient trailer allocations are a necessary condition for cost efficient operation of mechanical harvesting equipment. Daily trailer allocations, however, are a function of cost efficiencies at the processing plant. A plant seeks to process the most pound-solids as possible, but subject to operational capacities, storage costs, and its 12-month distribution schedule of juice to its buying customers. For mechanical harvesting can be adopted across the entire citrus industry, all sectors of the industry, including the processing sector, must be fully aware and cognoscente of any and all costs mechanical harvesting may likely impose. An optimal resource allocation model can become a decision-aid tool for growers, harvesters, and/or processors to evaluate how best to employ MH systems.

Presentations:

1. Searcy. Optimal Harvest Time of Florida Valencia Oranges to Maximize Grower Returns. Class presentation Food and Resource Economics Class AEB 6592 Mathematical Programming, Dr. Donna Lee. Gainesville, FL, December 2006.
2. Searcy. Optimal Harvest Time of Florida Valencia Oranges to Maximize Grower Returns of fruit or potential changes of overall juice and/or fruit quality. Annual meeting of the Southern Agricultural Economics Association, Mobile, AL, Feb. 2, 2007.
3. Searcy. Coordination Issues Hindering the Adoption of Mechanical Citrus Harvesters by the Florida Citrus Industry. IFAS Graduate Research Symposium, Gainesville, FL, March 21, 2007.
4. Searcy. Reconciling Grower and Processor Objectives when Deciding to Harvest Juice Oranges. Annual meeting of the Florida State Horticultural Society, West Palm Beach, FL, June 4, 2007.

Publications:

1. Searcy, Roka, and Spreen. 2007. Optimal Harvest Time of Florida Valencia Oranges to Maximize Grower Returns of fruit or potential changes of overall juice and/or fruit quality. Selected paper and published abstract, Journal of Applied Economics, forthcoming.
2. Searcy, J., F. Roka, and T. Spreen. 2008. Reconciling Grower and Processor Objectives when Deciding to Harvest Juice Oranges. Proceedings of the Florida State Horticultural Society, Vol 120, forthcoming.

Papers in progress

1. Coordination of Citrus Fruit to the Processing Plant and Coordination Issues Presented by Mechanical Harvesting.
2. Mathematical modeling of Grower and Processor Objectives when deciding to Harvest Juice Oranges in Florida.
3. Literature review and bibliography of industry data on juice quality aspects of Florida oranges.
4. Dissertation Proposal: Coordination Issues Hindering the Adoption of Mechanical Citrus Harvesters by the Florida Citrus Industry

Next steps:

Invite a select group of fruit buyers/processors (no more than 6 people) to a meeting and present the 2007 FSHS Searcy talk. The objective is to have these individuals react to our FSHS presentation with questions and guidance on how to collect the needed storage and extraction cost data, as well as complete any data on juice quality.

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