Figure 1. *A self-propelled canopy shaker equipped with a catch frame is currently being used to harvest Florida's sweet orange crop.*

CMNP and mechanical harvesting of Valencias

By Bob Ebel, Tim Spann and Fritz Roka

Valencia oranges harvested in late May and early June are high-quality fruit that are valuable to juice plant operations. All fruit harvested during this late-season period is hand-picked, and historically growers have faced challenges securing harvesting labor during this time. A higher Florida minimum wage ($7.31), pressure to adopt immigration reform policies and increased competition for labor from other crops will exacerbate these challenges.

Labor availability was especially difficult late in the 2010-11 harvest season. Some labor was obtained through the H2A (foreign guest worker) program, but H2A workers are expensive and cumbersome to

administer. As calls for E-verify push forward, H2A workers may be the only source of harvesting labor.

Higher labor costs, heightened regulations and uncertainty about labor availability have renewed interest in mechanical harvesting. The citrus industry supported mechanical harvesting research and commercial efforts the last few decades to reduce the overall cost of harvesting. Various types of mechanical harvesters and abscission agents were evaluated from the 1960s through the 1980s, but commercial interest waned as severe freezes reduced the Florida crop and eased labor availability pressure.

A number of mechanical harvesting machines were developed and tested for their ability to efficiently remove fruit. The mechanical harvester that evolved from the earlier research and that is used commercially is the self-propelled canopy shaker system equipped with a catch frame (See Figure 1, page 22). The harvest mechanism contains whirls of tines, each of which rotate independently on an axis. Pairs of machines operate together, with the catch frames maneuvered to meet under the canopy, forming a solid platform for catching fruit. The shaking mechanisms are moved manually into the canopy at a depth that maximizes fruit removal throughout the canopy.

Fruit removal is affected by machine settings, with tractor speed and frequency of the tine rotation the two most important adjustments operators can make. Speed and shaker frequency are adjusted to maximize fruit removal. In general, commercial harvesters operate between 1.0 to 2.0 mph through the groves and set tine frequency between 220 to 260 cycles per minute (cpm). Commercial operators report that they can achieve 80 percent to 90 percent removal.

In order to successfully harvest the late-season Valencia crop, tine frequency should be reduced so that removal of young green fruit is reduced and next year's yield is not affected. Removal of the newly developing crop becomes an increasing concern as the season proceeds through May and June because machine harvesting is not selective. When the mass of growing green fruit approaches that of mature fruit, they may be removed also. Today, mechanical harvesters operate in groves until the newly developing crop reaches about 1 inch in diameter, which typically occurs by early May.

An abscission agent that would aid mechanical harvesting throughout the harvest season has been a long-term goal of the industry. One abscission agent, CMNP, selectively loosens mature fruit. Importantly, studies with Valencia trees sprayed with CMNP and harvested with trunk shakers indicated that we can harvest later in the Valencia harvest season without impacting next year's yield. Research is under way to determine if the same will be true when self-propelled canopy shakers are used.

We are following young fruit diameter and mature fruit removal in trials from early May to mid-June to determine the advantage that CMNP brings to late-season harvesting. We demonstrated that up to 20 percent more fruit removal and fruit recovery can be achieved when CMNP is used with machines operated at lower tine frequency harvesting settings. The determinant of success will be demonstrating that next year's yield will not be impacted. These trials are continuing for concurrent seasons.

An application for registration has been applied to the Environmental Protection Agency for use of CMNP as an abscission agent as an aid for mechanical harvesting of sweet oranges in Florida. CMNP will provide harvest managers with a powerful tool

to aid mechanical harvesting. CMNP is expected to facilitate improved performance of the existing canopy harvesting equipment throughout the entire harvest season, and not just during the late-season Valencia period. By reducing machine forces with CMNP, less tree damage will occur and thereby lessen grower concerns about health impacts to their trees. Harvesting equipment will be able to operate faster down the row and increase harvesting capacity while at the same time decrease the boxes of fruit that need to be gleaned.

Finally, CMNP has been shown to reduce overall debris that is delivered to juice processing plants from mechanical systems, which is generally more than what hand-harvesting crews deliver. Extending the harvest season for mechanical systems, enhancing overall harvesting capacity, and lowering concerns about tree damage among growers and excessive debris among processors are the primary benefits of CMNP that will increase adoption of mechanical harvesting and lower the net cost of harvesting juice oranges in Florida.

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CRDF Support for Research on Asian Citrus Psyllid

By Harold Browning

Without populations of the Asian Citrus Psyllid (ACP), there would be no field spread of HLB, and thus ACP management is by far the most important component of response to HLB in Florida. Since psyllid management will remain a challenge into the future, we need to look beyond currently available strategies. CRDF is making significant investments in ACP research, spending more than $4 million in the current fiscal year. In this article, we provide an overview of 5 major areas of ACP research, each with the goal to contribute to ACP population reduction in both managed groves and residential or abandoned citrus.

• **Understanding the Dynamics of HLB Transmission:** Projects in this section look at how the insect and pathogen interact and how ACP acquires the bacterium from infected trees and then inoculates healthy trees. Results here will assist growers in managing disease spread and will clarify critical timing for ACP control and inoculation reduction actions (4 projects).

• **ACP Biology and Ecology:** While pesticides currently are our main tools to reduce ACP populations, research is focusing on aspects of ACP biology and ecology which can be exploited, providing windows into novel approaches for management. Exploring the behaviors of ACP, researchers are looking at chemicals which ACP uses to communicate, such as mating signals and attraction/repellency related to host plants. Results of this area of research can lead to improved understanding of how psyllids are infecting citrus, with outcomes of better monitoring tools. Information derived from these studies also will contribute to development of management strategies for the ACP/HLB system (6 projects).

• **ACP Suppression with Pesticides:** A major emphasis in the short term is optimizing the use of existing and emerging new insecticidal materials to suppress ACP populations. Included in this research are means to alter timing of applications and application methods, ranging from application to young trees to aerial application within Citrus Health Management Areas (CHMAs) (9 projects).

• **Non-Pesticidal Suppression:** This area of research focuses on exploiting ACP behaviors for improved population suppression. Examples are: 1) developing application methods for chemicals applied to disrupt ACP behavior; 2) targeting ACP feeding mechanisms to disrupt feeding on citrus; 3) use of guava-based and other repellents; and 4) use of biological control organisms, particularly parasitoids, which attack and kill ACP (9 projects).

• **RNAi Strategies to Disrupt ACP Populations:** Projects are focused on a novel approach to introduce small RNAi molecules which affect critical psyllid functions such as feeding or reproduction. Progress in other fields has made this approach a possibility, as has the recent successful completion of ACP genome sequencing. In addition to the regularly funded projects in this area, CRDF also is conducting a contest to attract broad participation in identifying specific RNAi molecules which have potential to fit into an ACP control strategy (4 projects).

Results of research on ACP are being readily delivered to growers through Florida Citrus Health Management Areas, another activity supported by CRDF. These results have directly informed the improved management practices that have already been successfully adopted by many growers within local CHMAs. Progress reports on this work can be found at www.citrusrdf.org

Harold Browning is Chief Operations Officer of CRDF. The foundation is charged with funding citrus research and getting the results of that research to use in the grove.

CRDF Citrus Research and Development Foundation, Inc.

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