

CMNP and mechanical harvesting

By Bob Ebel, Kelly Morgan
and Fritz Roka

The abscission agent, 5-chloro-3-methyl-4-nitro-1H-pyrazole (CMNP), has proven highly effective in loosening sweet oranges as an aid for mechanical harvesting, based on field studies conducted the last few years. With submission of an Experimental Use Permit (EUP) and Temporary Tolerance to the

Factors to consider in using the abscission agent to loosen oranges for mechanical harvesting

Environmental Protection Agency by AgroSource on behalf of the Florida Department of Citrus (FDOC) last December, there is much optimism that successful registration of CMNP

will provide the catalyst for expansion of mechanical harvesting throughout the industry.

Potential economic benefits of abscission have been addressed in a previous *Citrus Industry* article and published as a UF/IFAS EDIS paper found at <http://edis.ifas.ufl.edu/fe752>. Reviewing applications by EPA takes up to 18 months. Assuming the EPA grants the permit, CMNP will be available for application on a limited number of acres during the 2011/2012 harvest. AgroSource, the University of Florida-IFAS and FDOC are already preparing for the EUP.

Scheduling CMNP and fruit harvest will require careful timing to maximize fruit removal and meet the harvest quotas set by the processing plants. Several factors affect the rate of loosening by CMNP, and

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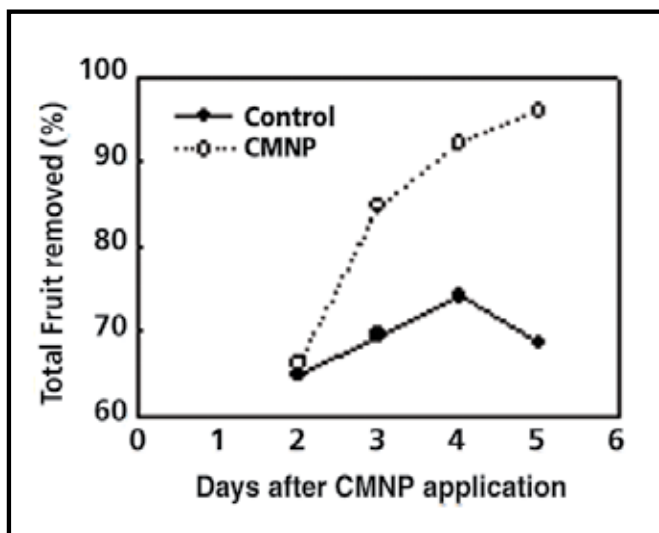


Figure 1. Efficacy of CMNP lasts up to five days after application. Shown is the percent of fruit removed by a canopy shaker system.

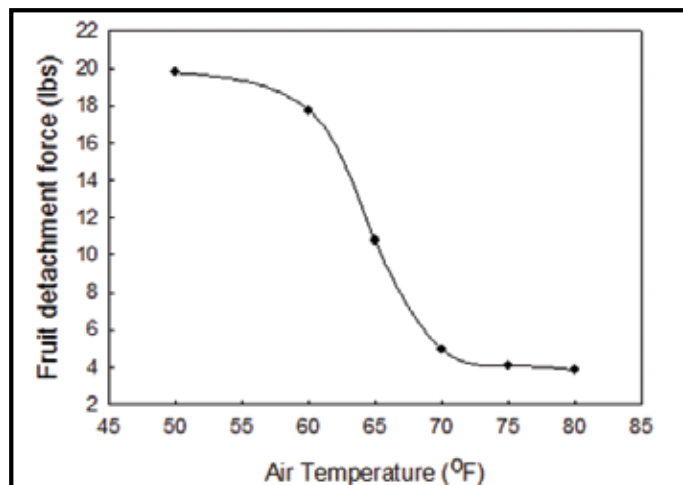


Figure 2. Results of a study of potted citrus trees held in an environmental growth chamber at constant temperatures for five days, showing that the rate of loosening decreases below 70°F. The rate of loosening on field-grown trees will vary as temperatures rise and fall.

harvesting managers must understand these factors if CMNP is to be used successfully. The principal factors affecting CMNP efficacy include coverage, concentration, rain and air temperature.

CMNP has been shown to require direct contact with the fruit peel, especially near the stem. Application methods must achieve good coverage over the entire canopy. Coverage near the top of the canopy will be especially important because the force required to remove those fruit tends to be higher than is required for the rest of the canopy. Also, mature trees are often higher than the uppermost set of tines for canopy shaker systems, so the force applied there is reduced.

Research studies in the last few years have shown that traditional air-blast sprayers have not been as effective as directional multi-head airblast sprayers to ensure adequate coverage.

The rate of fruit loosening is proportional to CMNP concentration. Loosening begins approximately two days after application and CMNP is active for several days after application (Figure 1). When conditions are favorable, loosening occurs uniformly among all fruit within the canopy. However, there can be substantial variation in detachment force among fruit throughout the canopy that persists through harvest.

The variation in fruit detachment force is less of a concern for harvest machines that drop fruit to the ground. Harvest can occur any time after sufficient loosening has occurred. Variation in fruit detachment force is a concern for mechanical harvesters

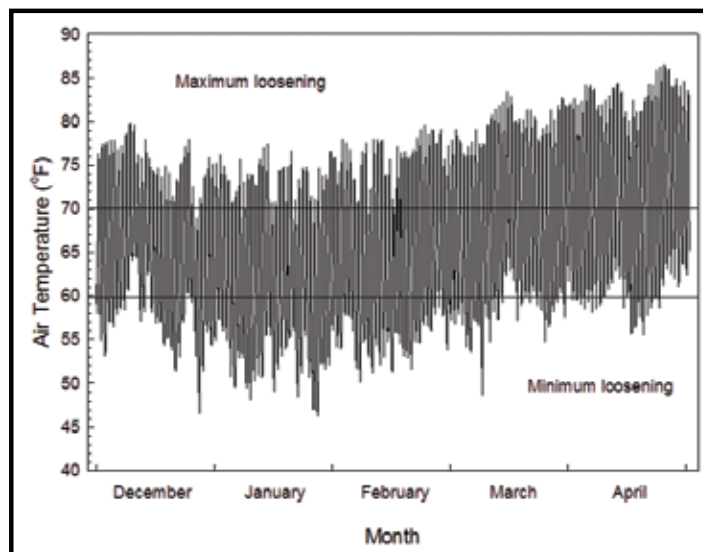
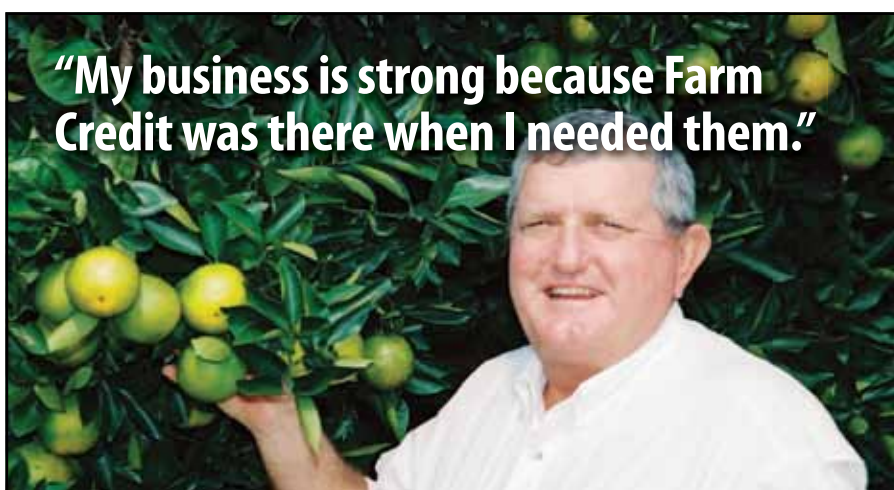


Figure 3. Average hourly air temperatures from the Florida Agricultural Weather Network (FAWN) for the 10-year period from 1999 through 2009. The horizontal lines at 60°F and 70°F show the critical temperatures that affect fruit loosening by CMNP.



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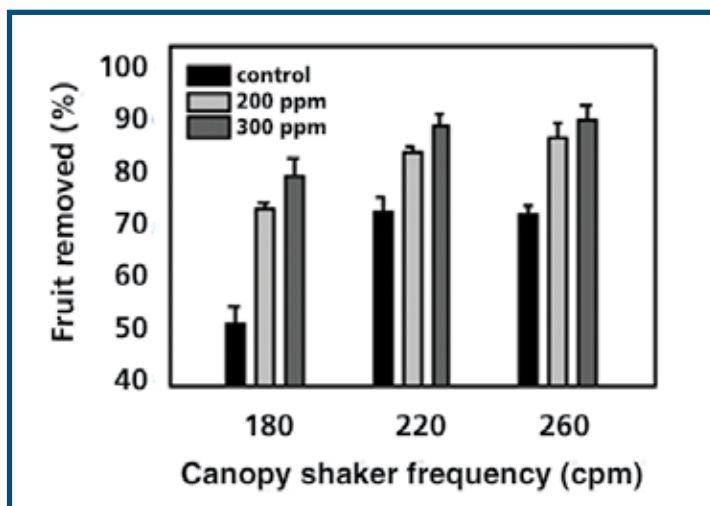
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Figure 4. Interaction of CMNP concentration and canopy shaker frequency (in cycles per minute) for Valencia. CMNP will allow lower canopy shaker frequencies and thus reduce tree injury.



with catch-frames. Harvest managers scheduling CMNP application and mechanical harvest will have to consider the amount of fruit drop and the extent of loosening to optimize the proportion of the crop caught by the catch-frame. Excessive fruit drop is not desirable, as dropped fruit diminishes the economic advantages from mechanical systems that utilize catch-frames.

The most important environmental variables that will affect CMNP efficacy are rain and low air temperature. Rain within the first 24 hours after application, and especially within the first eight hours after application, can reduce efficacy. Since most sweet orange harvest occurs during the dry season, rain should not be a major problem. However, the El Niño climate pattern that brings more rain and cooler temperatures, such as the one experienced during 2010, could pose challenges to CMNP application.

Air temperature is another matter. CMNP is very sensitive to low air temperatures with the rate of loosening slowing when air temperatures drop below 70°F (Figure 2, page 7), which occurs frequently during winter, especially at night (Figure 3, page 7). The rate of loosening increases and decreases as temperature rises and falls below 70°F. During colder spells, harvest managers will have to allow more time between CMNP application and mechanical harvest or apply CMNP at higher concentrations to offset the colder temperatures.

There is limited information on plant-based factors that may affect the rate of loosening by CMNP, but it appears that differences in cultivar and rootstocks will likely be small. Research on Hamlin has occurred during a cooler time of year than Valencia, so we've not been able to separate cultivar differences from temperature effects so far. We've also not been able to conduct tests to directly compare rootstock effects on the rate of loosening by CMNP due to the limit on the number of acres to which we can apply experimental CMNP for research purposes (Limit: 10 acres per 12-month period). Nevertheless, many studies over the years with CMNP have shown good loosening regardless of rootstock. It appears any rootstock effects, if any, will be small.

Another factor that might affect the rate of fruit loosening by CMNP is tree stress. Drought stress appears to



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have little effect on the rate of loosening, but we don't know how diseases may affect CMNP efficacy.

TREE HEALTH CONCERNS

Grove managers continually strive to maintain healthy groves, and research has shown that mechanical harvesting of healthy trees has no long-term impact on tree mortality or yield. Still, growers remain concerned about mechanical harvesters impacting tree health. One advantage of CMNP will be that by loosening fruit, harvester settings can be reduced to limit tree injury while allowing a high level of fruit removal (Figure 4, page 8).

It is our hope that the EPA will award an EUP for CMNP because we believe it will be the catalyst for expanding sweet orange acreage that's mechanically harvested. Until then, we are continuing our research to develop recommendations for scheduling CMNP and harvest. Stay tuned.

Bob Ebel, Kelly Morgan and Fritz Roka are all associate professors at the Southwest Florida Research and Education Center, Immokalee.

WHAT'S SHAKIN'

UF/IFAS team reports progress on machine harvesting

The University of Florida-IFAS Citrus Mechanical Harvesting and Abscission Team met May 26 with an advisory committee in Southwest Florida to report on the progress made during the 2009-2010 citrus season.

Reza Ehsani, a mechanical engineer at the Citrus Research and Education Center, reported that he has been developing a piece of equipment that removes debris prior to the fruit being loaded into road trailers. The equipment, which is being used primarily for research purposes, consists of a pinch cleaner, blowers and extended de-stemmers. Preliminary tests showed that the detrasher eliminates all the trash from the load, leaving a clean load of fruit.

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