

Impact of mechanical harvesting on tree health and debris

By James P. Syvertsen
Juan Carlos Melgar
and Timothy M. Spann

Despite abundant research to the contrary, some citrus growers and managers still believe that mechanical harvesting (MH) will harm their trees. This is an update and review of MH and tree health.

Only about 7 percent of Florida citrus is mechanically harvested. Worry about potential tree injuries caused by MH machines has been a major concern hampering the widespread adoption of mechanical harvesting. Visible injuries from MH often include leaf drop, twig loss, scuffing of the bark on trunk and branches, limb breakage, removal of flowers and young green fruit and exposure of shallow roots at the soil surface. We still hear comments like, “I made up my mind years ago that those machines tear trees up.”

Despite appearances, the bottom line is that there is no historical evidence that mechanical harvesting causes any tree mortality or loss of yield in healthy, well-managed trees except in late season Valencia. So, if that’s true, how important are visible injuries? Does MH really hurt citrus trees?

Recent tree health studies have focused on the physiological responses of MH trees. Tree water use, growth and yield of healthy, well-managed and well-prepared citrus trees has not been measurably affected by MH — even after trees were mechanically harvested annually for several consecutive years. The removal of a few healthy leaves by MH has no long-term effect on trees, and in some cases, can even be beneficial to light penetration, growth and yield. Any visible root exposure after trunk shaking does not measurably affect water or nutrient uptake by roots relative to hand-harvested trees. Thus, there is no long-term physiological stress caused by mechanical harvesting. Irrigated, well-managed trees are not measurably harmed by normal MH.

What about knocking off flowers? Mechanical harvesting of Valencia trees during peak bloom (~March) can remove some flowers — about the same number as ladders do during hand harvesting — but this does not diminish fruit set. During late season MH of Valencia, as long as the diameter of young green Valencia fruit is less than about one inch, mechanical harvesting does not reduce yields the following year. Once the young fruitlets exceed this size, however, aggressive MH will likely harvest large green fruit and can depress the following year’s yield by as much as 25 percent. Such a yield loss does not always happen, however, as healthy trees can compensate for the loss of many green fruit by reducing the fruit drop of remaining fruit.

We have used winter time drought during December through early March followed by good irrigation in late March to delay Valencia flowering and fruit development two to three weeks. Such young fruit, less than 1” in diameter, are not affected by MH in June and July. Delayed fruit growth and quality catch up so yields in the following year are not affected. The temporary drought stress does not affect yield or juice quality of the current crop either. In some years, the winter drought can increase bloom and fruit set. So, turning off the irrigation in winter can be a viable tactic for trees that are anticipated to be harvested as late as July. Such late harvesting can reduce yield the following year, however, even in hand-harvested trees. MH can additionally

stress severely droughted or debilitated trees, but such stress can occur in weakened trees from hand-harvesting, too.

DEBRIS

Although the loss of some leaves and twigs does not harm the health or yield of mechanically harvested trees, it can impact fruit processing if those leaves and twigs make their way into the loads of harvested fruit delivered to the processing plant. During the 2008 and 2009 harvest seasons, we studied the impact of mechanical harvesting systems on the amount of debris in harvested loads of fruit. On average, the total amount of debris in a trailer of mechanically harvested fruit is double what is found in a hand-harvested load.

While much of this debris can be removed with existing equipment in the processing plant, mechanical harvesting has introduced a new class of debris — large diameter stems. These are stems that are finger size in diameter or larger. The mechanical harvester does not necessarily break these stems from the tree, but may simply shake free any dead or loose branches caught in the canopy from the last hedging/topping. Regardless of their source, there is currently no equipment in the processing plant to remove these large stems, which have the potential to cause serious damage to processing equipment. Additionally, all of the leaf and twig debris that is removed at the processing plant must be disposed of in some way, either through the feedmill or to a landfill. Thus, even if no equipment breakdown occurs, there is a measurable increase in processing costs associated with mechanical harvesting from handling and disposing of debris. Engineers are working on machine improvements to leave more of this debris in the grove.

Fortunately for growers, harvesters and processors, the abscission agent CMNP, which is currently being registered for use in citrus, should help considerably with both debris and tree health concerns. Using CMNP to selectively loosen only mature fruit will allow the mechanical harvesters to operate less aggressively and still remove a high percentage of fruit. Less aggressive shaking will not only reduce visible tree injury (bark scuffing, leaf removal, etc.), but will also help overcome the Valencia late-season harvest problem. Additionally, CMNP can reduce the amount of debris in loads to levels equal to or even below that of hand-harvesting.

SUMMARY

Despite some leaf and twig removal and bark scuffing, multi-year studies have shown that mechanical harvesting does not have any negative effects on long-term health of well-managed, irrigated citrus trees. The leaves and twigs removed can pose a problem for processors in the form of debris that must be removed and disposed of at the processing plant. However, the abscission agent CMNP, in addition to improving fruit removal efficiency, should have the added benefit of reducing tree injury and debris.

James P. Syvertsen is professor, Juan Carlos Melgar is post-doctoral associate, and Timothy M. Spann is assistant professor, all at the University of Florida-IFAS Citrus Research and Education Center, Lake Alfred.