



FMC

Trunk SHAKER



Stackhouse

Mechanical harvesting systems

By Stephen H. Futch and Fritz M. Roka

As discussed in recent articles in Citrus Industry Magazine on mechanical harvesting, Florida citrus growers must adopt technologies which reduce harvesting costs

to compete with low-wage countries in a global juice marketplace. Trunk shaking systems are a viable mechanical harvesting system which growers should consider in an effort to lower harvesting costs, increase fruit returns and remain competitive.

These mechanical harvesting systems have been used commercially for more than 10 years and have been extensively studied in Florida citrus groves since the 1970s.

Trunk shake systems are of two basic types, those which operate with a catch frame system (trunk shake and catch) or systems without the catch frame (monoboom). Each system offers different advantages and cost savings for mechanically harvesting citrus fruit.

The trunk shaker and catch system utilizes two self-propelled units. On one side of the tree row, a trunk shaker and a fruit deflector are combined into a single unit. In bedded groves, the shaking unit operates in the swale, or water furrow middle. The shaking unit clamps the tree trunk above the bud union and below the first scaffold limbs. A specially designed clamping pad shakes the tree with a straight-line linear motion. This linear shaking action is preferred to a multi-direction or circular shaking system used in the past.

Actual shaking time varies from five to 12 seconds depending upon the time of year and variety of fruit. Early in the season, when the fruit pull-force required to separate fruit from the tree is high, shake times that exceed 10 seconds may be required.

After shaking the tree, removed fruit is deflected to the receiving unit located on the opposite side of the tree. The receiving unit separates leaves and twigs and conveys fruit to a trailing cart. The cart holds between 80 to 100 boxes before offloading to a field goat. This harvesting system removes 94 to 97 percent of the fruit, and recovers between 88 and 95 percent of the available fruit.

For optimal harvesting equipment

efficiency, tree trunk spacing needs to be uniform down the row with clear trunk heights of at least 15 inches above the bud union. This required skirting also improves harvest fruit removal and recovery. Low hanging fruit that rides on the fruit deflectors may remain attached to the tree or be raked off the deflectors. Tree canopy skirts should be at least 36 inches above the ground, measured on the bed and at the drip line, to allow the catch frame to easily slip under the tree canopy.

The trunk shake and catch system is limited to trees with a trunk diameter less than nine to 11 inches. It is recommended that tree heights do not exceed 16 to 18 feet to minimize fruit splitting from a long drop to the catch frame.

One trunk shaker and catch system can harvest between 90 and 140 trees per hour. Harvesting and roadside costs vary between \$1.10 and \$1.60 per field box

depending upon tree preparation, yield, and gleaning requirements. In many cases, growers who are using this system have saved between 20 and 50 cents per box compared to conventional harvesting systems. In years with low fruit prices, gleaning operations may not be economically feasible or justified.

The monoboom trunk shake system operates without a catch frame. The monoboom mechanical harvesting system has greater flexibility for operating in groves where the trunk shake and catch systems are not well suited due to large trunk size, grove design or low hanging limbs. The monoboom system is well suited for older groves with trees having short trunks or trunks which have a diameter of greater than nine inches. The monoboom can clamp onto larger scaffold limbs if necessary.

Trees as high as 25 feet have been harvested with monoboom trunk shakers. When shaking large trees, it is recommended that the grove floor be disked to cushion falling fruit and minimize splitting. The monoboom system operates in the drive middle and alternately shakes trees on both the right and left side of the machine as it travels the row middle.

Since the machine does not utilize a catch frame, the fruit is allowed to drop to the ground where a hand crew picks up the fruit and gleans fruit from lower branches. This system has the flexibility of shaking individual limbs,

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Coe-Collier shaker, above, and receiver



thereby allow harvesting to occur on older, larger trees. Under these conditions, the monoboom can shake up to 30 trees per hour. Under the same grove conditions suitable for the trunk-shake and catch systems, the monoboom can harvest up to 140 trees per hour.

Harvesting cost savings are generally not as great as compared to the trunk shake and catch system because hand labor is required to pick the fruit from the ground. Hand labor efficiency is increased because fruit gathered on the ground per hour per worker is faster than fruit harvested by hand from the tree.

Groves harvested for 10 or more years show no evidence of shortened tree life or reduced yields. Bark damage to the tree trunk has been noted in some cases when the tree's cambium is actively growing.

Growers should consider other factors to enhance harvesting efficiencies when utilizing trunk shakers. To avoid irrigation system damage, microjet emitters should be low to the ground, within the trunk line of the row, and mid-way between adjacent trees. As mentioned

above, skirting the trees to a height of 36 inches allows for the catch frame to easily move under the tree canopy and minimizes tree damage.

From research conducted by the University of Florida, United States Department of Agriculture, Florida Department of Citrus and harvesting companies, groves harvested for 10 or more years show no evidence of shortened tree life or reduced yields. Bark damage to the tree trunk has been noted in some cases when the tree's cambium is actively growing. Damage can be minimized with proper operator training as well as proper operation of equipment.

Trunk Shake Mechanical Harvester Contractors			
Company	City	Contact	Phone Number
Coe-Collier	Immokalee	Will Elliot	239-658-6074
FMC FoodTech	Lakeland	John Crum	863-499-1823
Stackhouse Harvesting	Hickman, CA	Matt Craven	863-441-0911

Specific effects of mechanical harvesting on tree health will be the subject of a future article in this series.

At the present time, the main operator of these trunk shake systems is Coe-Collier Citrus Harvesting of Immokalee. Additionally, FMC Food Tech is actively developing and operating trunk shaker equipment in south Florida. In previous years, the monoboom trunk shaker operated in the state but has not operated in the 2003-04 season.

Mechanical harvesting systems have successfully operated in Florida citrus, providing viable options for grower utilization. There is no doubt that when these systems are used, harvesting costs are

reduced. Mechanical harvesting is an important tool enabling the Florida citrus industry to remain competitive in a global juice market.

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