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 shaker catches 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 skirt 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 the type of equipment used. 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, grow 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.
Trunk Shake Mechanical Harvester Contractors

<table>
<thead>
<tr>
<th>Company</th>
<th>City</th>
<th>Contact</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coe-Collier</td>
<td>Immokalee</td>
<td>Will Elliot</td>
<td>239-658-6074</td>
</tr>
<tr>
<td>FMC FoodTech</td>
<td>Lakeland</td>
<td>John Crum</td>
<td>863-499-1823</td>
</tr>
<tr>
<td>Stackhouse Harvesting</td>
<td>Hickman, CA</td>
<td>Matt Craven</td>
<td>863-441-0911</td>
</tr>
</tbody>
</table>

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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