Mechanical harvester for fresh-market plums

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Trials with an in-tree collector-decelerator catch frame have demonstrated the practicability of harvesting fresh-market plums mechanically. Fruit quality was competitive with that obtained by hand harvest and exceeded that from an under-tree catch frame.

Starting in about 1969, research at the University of California, Davis, was directed toward developing a system to harvest pears mechanically. In 1973 this effort resulted in the construction of a special catch-frame referred to as an in-tree collector-decelerator (*California Agriculture*, June, 1974). The unit is a large panel (8.5 feet high and 10 feet long) with eight levels of protruding, air-inflated (3 to 5 psi), 5-foot-long, tapered flexible tines. The tines, made of rubber-covered nylon, have a 4-inch-diameter base and 1½-inch-diameter tip and are attached to a vertical "padded wall" with 8 inches of vertical clearance between levels. The tines are staggered on 8-inch horizontal centers and have a 40° upward slope.

Harvested fruits pass through openings in the padded wall and collect in four conveyors, which extend the length of the panel at every other tine level. A strip of padded material resting on top of the tine layer and positioned below the opening aids in fruit collection at each conveyor level. A complete system would be about the size of existing two-piece soft fruit harvesters with a panel of tines on both sides of the tree row.

Because of the flat panel, the system is best suited to hedgerow-trained trees less than 8 feet thick. This permits uniform coverage of the fruiting area with the opposing panels each collecting fruit from approximately one-half of the hedgerow thickness. With a trunk shaker on each side of the tree row (one on each machine half) and tree spacings of about 12 feet or less, two trees could be harvested at once to achieve a high harvest rate.

The machine is moved from tree to tree with the panel retracted in a lowered position and with the tips of the inflated tines nearly touching the periphery of the tree. When in position at a tree, the panel assembly is advanced toward the tree on the 40° slope until the flexible, inflated tines penetrate approximately one-half of the tree thickness. Alignment of the tines was nearly always excellent in the trials with only a few tines severely buckled or deflected in any tree. The damping effect of the pneumatic tubes did not prevent good fruit removal.

Harvested fruits trickle down through the maze of sloping tines, which decelerate and divert them to the outer surface of the tree and into the collection conveyors. By gently moving the fruit to the periphery of the tree, exposure to long drops and numerous tree parts is avoided.

For the 1976 plum trials, a commercial, wrap-around, under-tree harvester was used to shake the tree and to collect fruits outside the bounds of the experimental collector-decelerator panel. Fruit samples from the two varieties harvested, Laroda and Queen Ann, were transported to Davis, stored 30 days at 36° and then evaluated for mechanical damage. The samples were sorted into six categories: sound, slight bruise, severe bruise, stem puncture, cuts and splits, and rot. Sound and slight-bruise categories were considered marketable as fresh fruit.

The percentage of marketable Queen Ann fruits was 89.7 for hand harvested, 84.6 for the collector-decelerator, and 68.5 for the under-tree catch frame. For Laroda, the percentage of marketable fruits was 93.7 for hand harvest, 74.0 for the collector-decelerator, and 55.5 for the under-tree catch frame. A 1975 test using only the under-tree catch frame on Queen Ann had yielded 64.7 percent marketable.

In 1976 a light crop, especially on the Laroda variety, made it necessary to harvest several trees per sample. Consequently, the Laroda fruit received a significant amount of handling in filling the container. It should also be noted that the hand-picked samples were not from a commercial picking crew.

Results for the Queen Ann variety are probably more representative of a normal situation than those for Laroda, because yield of the test trees was higher. The advantage of protecting the fruit as it falls and diverting it out of the tree through fewer substantial tree parts is apparent.

Performance of the collector-decelerator was consistent with prior results with both pears and apples. Consequently, it is estimated that comparisons of the collector-decelerator with commercial hand harvest under more normal yield conditions would reveal no significant difference in fruit quality. As with any harvest operation, yield, fruit losses, fruit quality, harvest rate, and machine costs interact to determine harvest costs. Since this trial was limited, harvest costs were not determined, although estimates based on experience with pears indicates a very favorable situation.

As a result of this research, an improved harvest method is known, but it is not now commercially available. Therefore, attempts to use existing commercially available machinery should include tree modifications to reduce the exposure of falling fruit to parts of the tree structure. The combined percentages of severely bruised and cut or split fruit indicate, to a large degree, the damage caused by the tree, as follows: Queen Ann—hand 2.9 percent, collector-decelerator 7.5 percent, under-tree catch frame 21.0 percent; Laroda—hand 1.6 percent, collector-decelerator 14.6 percent, and the under-tree catch frame 27.8 percent.

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