COLLECTING AND HANDLING OF MANI

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Abstract. An experimental harvesting system was evaluated, in cooperation with Congen Properties, Inc., to determine the feasibility of operating in a bedded citrus grove. 'Hamlin' oranges that were sprayed with abscission chemical and mechanically dropped to the ground with an air shaker were raked with a tractor-drawn citrus windrow rake and picked up with an offset pickup machine.

Down-the-row travel and speed of the rake and pickup machine was 0.5 to one mph, and fruit-recovery efficiency was 98 per cent. Fruit pickup and loading of the roadside trailer were limited by the round-trip travel time of the single, high-lift truck. That limitation reduced the field efficiency of the pickup machine to 60 per cent.

The cost of collection and loading fruit under these conditions was 40 cents per box of oranges.

Cooperative research by the U. S. Dept. of Agriculture (USDA); University of Florida, AREC, Lake Alfred; and State of Florida, Dept. of Citrus (FDOC).

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Equipment and methods for collecting, handling, and cleaning mechanically harvested citrus in the grove have been developed over the past decade (5). However, most of the efforts have been directed toward handling fruit harvested from trees 20 to 80 years old on loose sand, with relatively clean cultivation, in the "Ridge" area of Florida.

Approximately 16 per cent, or 106,000 acres, of Florida oranges are produced on bedded plantings (1). The beds vary from one to eight rows between ditches and have some

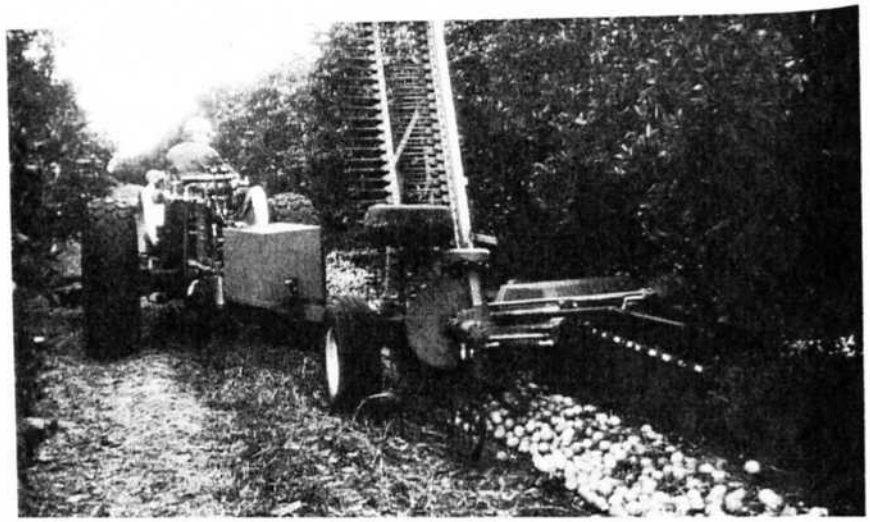

Fig. 1. Tractor-pulled windrow rake. This rake can be adjusted to form a center row or drip-line windrow of fruit.

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ground cover between tree rows. Trees are usually small and have dense foliage. Almost 30 per cent of the early and midseason oranges on beds are grown on four- to eight-row beds, slightly crowned, with adequate room between the outer row and the ditch bank for vehicle operation.

This study was conducted 1) to evaluate an experimental harvesting system (abscission chemical, air shaker, windrow rake, and pickup machine) to determine whether this system could be operated in bedded groves with little or no modification and 2) to determine the performance data of the system components for an economic analysis.

Materials and Methods

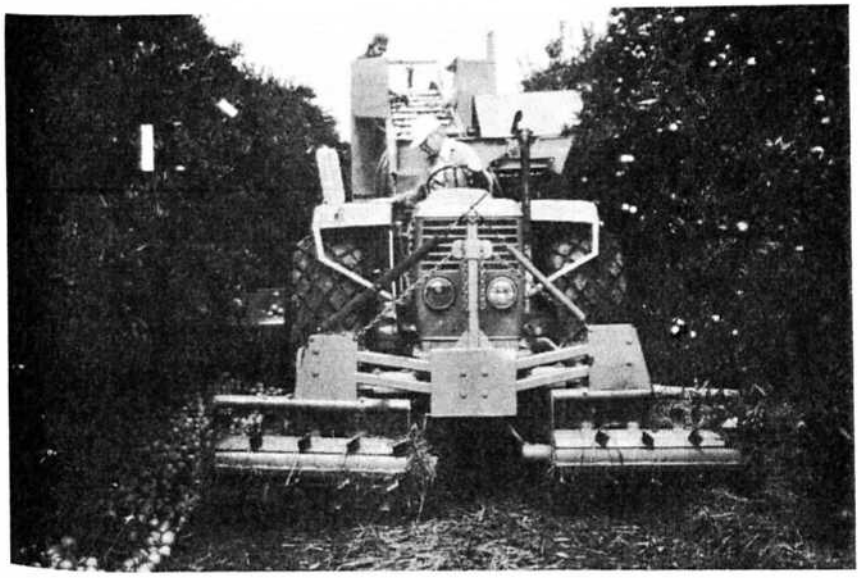
Fruit were sprayed with an abscission chemical and harvested at weekly intervals from Jan. 23 to Feb. 27, 1979 from an eight-row bed of 'Hamlin' orange trees comprising 11.5 acres approximately six miles west of LaBelle in cooperation with Congen Properties, Inc. The grove area had a uniform ground cover and few surface irregularities. The rows were 0.5 mile-long and 25 feet apart. The trees were spaced 15 feet apart in the rows and tree height was maintained at 13 feet. Estimated fruit yield was 3.5 boxes of oranges per tree. A 14 foot-wide strip of ground down the center of each tree row was treated with herbicide.

The ground cover, consisting of bahia grass, torpedo grass, and various woody-type weeds two to three feet high, was mowed approximately two weeks prior to harvest. Several methods for removing the large amount of grass material were tried, including single and double windrowing the mass of cut grass away from the row being harvested. The grass, hedge cuttings, small rocks, and vines were preraked in all eight tree rows.

After the fruit had been removed from the trees with an air shaker (6), they were windrowed to the drip-line of the trees near the edge of the strip of ground treated with herbicide.

The windrow rake used in these trials was a tractor-pulled unit developed by the U. S. Dept. of Agriculture (USDA) for this purpose (Fig. 1). A 50-horsepower tractor powered the rake, and one operator was required. Windrowed fruit was picked up

Figure 2. Offset pickup machine, with stations for manual fruit-sorting. Machine loads fruit directly into high-lift truck pulled behind machine.



with an offset pickup machine with a double-belt trash eliminator and locations for two people to do manual fruit-sorting (Fig. 2). This equipment was developed by the USDA and the Florida Dept. of Citrus (FDOC) and has been operated successfully in the "Ridge" area of Florida.

A 60-horsepower, low-speed tractor pulled the pickup machine and the accompanying high-lift truck that received the cleaned and sorted fruit at the discharge conveyor. One tractor driver and two fruit sorters made up the crew of the fruit-pickup operation.

One of the two sorters also operated the conveyors of the pickup machine and the speed and discharge height of the loading conveyor. The other sorter was also the operator of the 80-box-capacity high-lift truck that transported the fruit from the pickup machine to the roadside semitrailer.

Fruit recovery was determined by randomly selecting 20 trees in each row (170 trees) and counting the fruit left on these trees and on the ground after harvest. The fruit left on the tree was attributed to the fruit removal method and was not included in the efficiency of raking or picking-up operations.

Overall fruit production was determined by dividing the weight of fruit harvested from each tree row (170 trees) by 90 pounds per box and multiplying by 250 fruit per box. Fruit losses from 20 trees were counted in an adjoining bed that was handpicked by a commercial harvesting crew for comparison with the mechanically harvested treatment.

Results and Discussion

The mass of cut grass and weeds left after mowing posed a problem that was never completely solved. Preraking the herbicide-treated area under the trees was helpful by removing vines, small stones, dead limbs, and other ground trash from the fruit-drop area, but large stones had to be removed manually to prevent equipment damage. Also, vines became entwined in the rake bearings and had to be cut out. Vine strippers were attached to the rake drive shafts, and they greatly reduced the vine problem.

The rake section that covered the middle, sodded portion of the drive row during preraking gathered torpedo grass runners in long sections and rolled the mass into a tight windrow that was unmanageable at times. A rotary mower would not cut this windrow of grass, and when the mass of grass was left in place during the air-shaker operation, some fruit became entangled in the mass and were lost over the trash removal belt during the pickup operation.

Another method of preharvest trash removal used was double windrowing to move the material as close to the adjoining row of trees as possible so it would not be encountered when the fruit was later harvested. This method worked well, but was time consuming, and the windrowed trash had to be raked back in the other direction before fruit from the second row of trees were harvested. Mowing more frequently and closer to the ground in the future would keep the weed material in shorter pieces and less likely to entangle the fruit as they are picked up.

The windrow rake was operated at 0.5 to one mph with a field efficiency of approximately 80 per cent. The remaining 20 per cent of the time, the rake was idle while dead limbs, rocks, and other trash were being removed from the raking path and vines and grass runners entwined in the rake bars and bearings were being removed. Fruit recovery averaged 99 per cent; a few fruit were lost around tree trunks, due to tree sprouts and in an occasional ground burrow that entrapped the fruit.

Overall, the rake was dependable, and few repairs were required. However, replacement of rake tines that bent or broke when they struck rocks and exposed roots was a continuing repair item.

The pickup machine operated at 0.5 to one mph, depending on the amount of trash in the windrow. Field efficiency of the pickup operation was only 60 per cent. A large percentage of time was spent in waiting on the