

EFFECTS OF THE TREE SHAKER HARVEST SYSTEM
ON SUBSEQUENT CITRUS YIELDS

by

Scott L. Hedden
Agricultural Engineer
U.S.D.A., A.R.S.
University of Florida, I.F.A.S.
Citrus Experiment Station
Lake Alfred, Florida 33850

and

Glenn E. Coppock
Agricultural Engineer
Florida Citrus Commission
University of Florida, I.F.A.S.
Citrus Experiment Station
Lake Alfred, Florida 33850

ABSTRACT

Results of a 5-year study of tree shaker harvesting of citrus are presented. The same trees were shaken at approximately the same time each season to determine if this method of harvest had any effect on tree vigor or fruit yield in subsequent years. 'Hamlin' and 'Pineapple' oranges and 'Marsh' grapefruit showed no significant reduction in yields compared to handpicking methods. 'Valencia' oranges experienced a reduction in yield the succeeding year due to removal of the small immature fruit at the time of harvesting.

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INTRODUCTION

The tree shaker concept of harvesting citrus has been under development in Florida for the past 10 years. Progress reports on the various phases of this work have been presented to this Society on several occasions (1, 2, 3, and 4).

The tree shaker harvest system consists of an inertia-type tree shaker mounted on a trailer or on a catching frame. The fruit is either shaken onto the ground or caught and conveyed into a bulk container. The system used throughout most of these harvest trials is shown in Figure 1.

The Florida citrus industry has been reluctant to accept this method of harvest partly because of the questionable practice of shaking the tree. Many people have expressed fear of shaking the trees out of the ground and/or excessive leaf removal or root damage, thus destroying the tree and subsequent fruit crops.

A study was initiated in 1963 to determine experimentally the effects, if any, of tree shaking on fruit yields when trees are shaken season after season.

METHODS AND EQUIPMENT

The research work reported in this study extended over 5 complete harvest seasons in 'Hamlin,' 'Pineapple,' and 'Valencia' oranges and 'Marsh Seedless' grapefruit. It was conducted as an adjunct to the development of the tree shaker and catching frame harvest system for citrus.

Grove areas containing uniform-sized trees were selected and sixteen 2-tree plots were laid out in each variety block. These 16 plots were randomly organized into 4 replications on 4 harvest dates during the

respective fruit maturity or harvest period. On each harvest date, one tree in each of the 4 plots was mechanically shaken and the other was handpicked. The weight of fruit removed with the tree shaker was determined and the trees gleaned to obtain total fruit yield and percent fruit removal with the tree shaker. A hydraulic load cell in the loader boom, with the indicating scale next to the loader driver, provided an accurate, easy method of obtaining yield records for individual trees (Figure 2).

A normal pruning program of hedging alternate middles each year was maintained throughout the experiment in all but the 'Valencia' orange block. Tree skirts were raised when necessary to accommodate the catching frame.

The 'Hamlin' orange trees were approximately 30 years old, spaced 18 x 22 feet. The 'Valencia' orange and 'Marsh' grapefruit trees were 35 years old and spaced 25 x 30 feet. The 'Pineapple' orange block was 40 years old and spaced 25 x 35 feet in the row.

The tree shaker and catch frame were developed into a complete harvest system during the course of these experiments. The latest equipment available was used though the basic inertia-type tree shaker changed very little over the 5-season period.

RESULTS AND DISCUSSION

The net result of 4 years' mechanical harvesting with the tree shaker in 'Hamlin' oranges amounted to about 1% less fruit from the shaken trees (Figure 3). This small difference alone could have been due to split fruit graded out as the baskets were filled or missed the catching surface and not picked up after the harvest operation. This difference is not considered

significant. Harvest date made some difference in fruit removal with increased removal as the season progressed up to a maximum of about 95%.

Average figures for fruit removal are presented in Table 1.

'Pineapple' oranges reacted similar to 'Hamblins' over 4 seasons with less than 1% reduction in yield and an increase of about 4% in fruit removal as fruit maturity progressed.

'Valencia' oranges present quite a different picture than the early and midseason varieties. The first and second harvest periods resulted in comparable yields to the handpicked trees; but as the season progressed and the small fruit representing the next season's crop became larger, so did the removal rate on the immature fruit. Removal of small immature fruit during the latter part of the season resulted in approximately a 30% to 40% reduction in fruit yield the following harvest season. Removal of mature fruit was about 84% over the whole season showing no increase with fruit maturity. The one exception to this trend was the 1968 season in which the trees shaken late in the 1967 season yielded 20% to 30% more fruit than the handpicked trees. A possible reason for this large increase is that the 'Valencia' grove was very dry and the trees wilted when they were shaken, causing them to put on a large crop of off-bloom fruit. Regression lines for the shaken tree yields in 1965-67 and the 1968 season are shown in Figure 4 with the handpicked tree yields as 100%.

'Valencia' oranges can be harvested satisfactorily with the tree shaker for the first 4 to 5 weeks of the 'Valencia' season without excessive loss to next year's crop.

'Marsh' grapefruit yields were very erratic over the entire test period, but the overall yield record resulted in about 3.5% less fruit from the

mechanically-harvested trees. Fruit removal averaged 94% overall with only a slight increase in removal as the season progressed.

Shaker harvesting of grapefruit by "hand" has been practiced for many years, and the mechanical tree shaker was very successful in these trials as might be expected.

No significant tree damage was experienced in any of these harvest trials though deadwood pruning was common the first season of the experiment. Again, the exception to this occurred in the latter half of the 'Valencia' season when the trees were in a full growth condition and the bark was succulent and easily scuffed or split. Other citrus varieties are harvested when the bark is hard and semidormant.

Table 1. Percent fruit removal with tree shaker harvest.*

Variety	Time of harvest			
	1	2	3	4
'Hamlin' oranges	89	89	91	92
'Pineapple' oranges	83	82	86	86
'Valencia' oranges	86	83	87	79
'Marsh' grapefruit	94	93	94	95

*Figures are a 4-season average.

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Fig. 1 The complete tree shaker catching frame harvest system used throughout most of the harvest trials.



Fig. 2 The fruit-weighing system used to keep records of individual tree yields employed a hydraulic load cell in the loader boom.

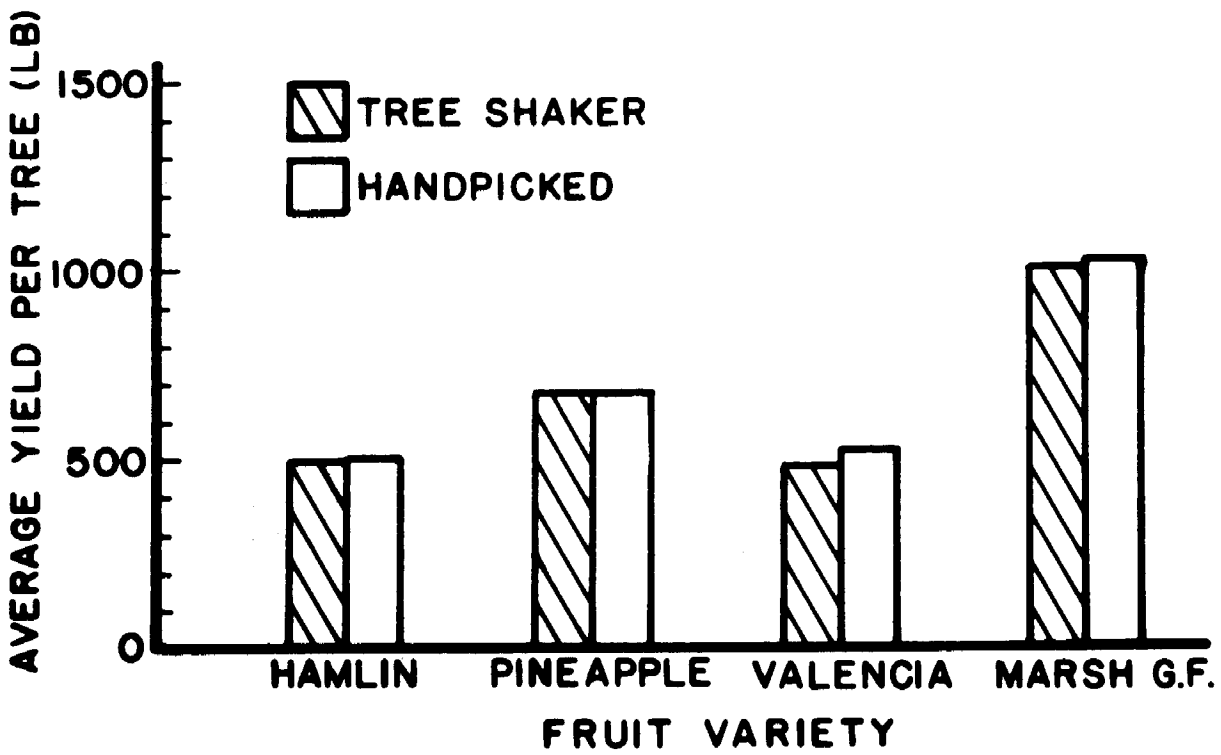


Fig. 3 Comparative fruit yields over 4 harvest seasons.

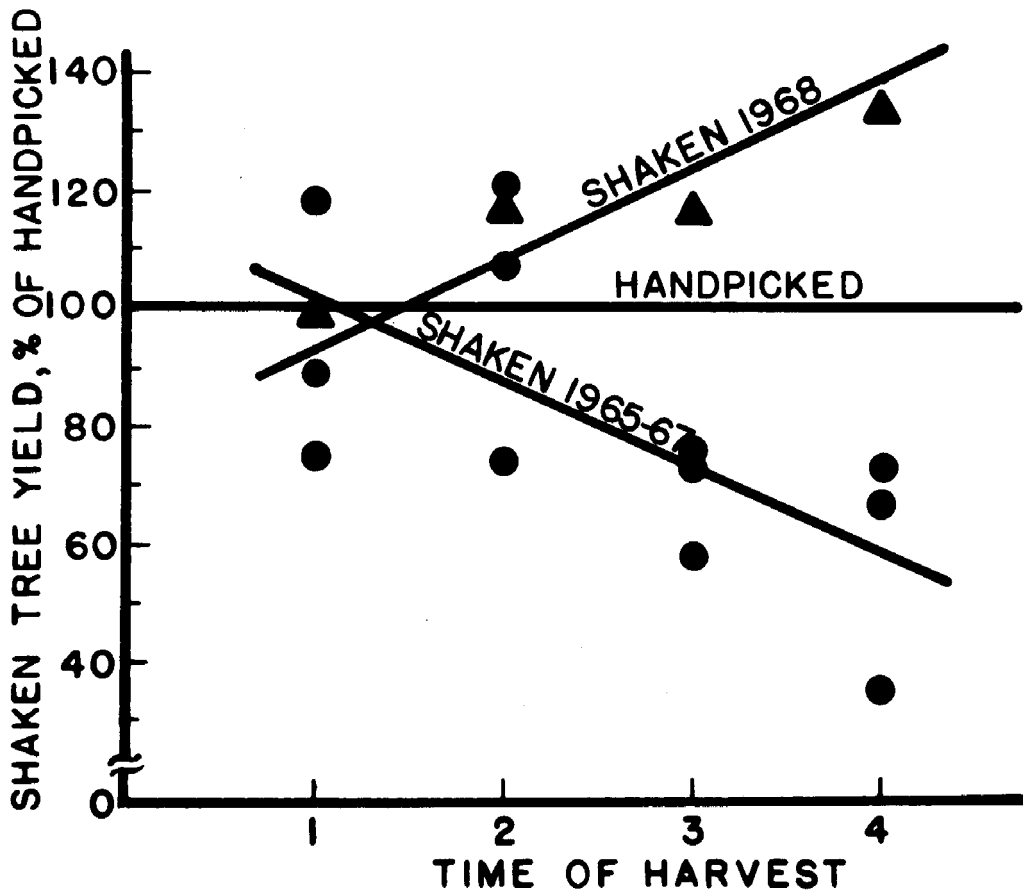


Fig. 4 Effect of tree shaker harvest on subsequent fruit yields ('Valencia' oranges).