

INCREASING THE EFFICIENCY OF AVOCADO HARVESTING

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INTRODUCTION

Harvesting avocados differs from a packing house operation in many ways. First, operational conditions are not fixed as in a packing house and, second, the crew must go to the crop instead of vice versa; both factors create operational and fruit handling problems. The crew must adapt itself to constantly changing orchard conditions. This means that the approaches used to increase the efficiencies of the harvesting operation must differ somewhat from those which have proven so successful in packing houses.

If one is to realize success in improving the efficiency of avocado harvesting, the first step is to make a thorough analysis of the harvest operation. The purpose of the analysis is to locate areas where improvements can be realized. This would require collecting, in the field by skilled observers, time data on all phases of the harvest operation under a range of orchard and operating conditions. The next step is to isolate, classify, and measure the effect on efficiency of all important orchard variables that influence any phase of the harvest operation. The harvest operation itself should be separated into operational components based upon the nature or the way these orchard variables influence their times of performance. No really extensive and systematic analysis of this nature has been made as described above, but I have made limited observations in testing a man-positioning device for picking avocados. This paper is based on these observations and reinforced by much more extensive analyses that have been made in citrus harvesting.

WHAT DAILY PRODUCTION RECORDS OF CREWS SHOW

An examination of the daily production of crews in avocados shows a wide daily fluctuation in average rates of pick by the crew members. An actual example of an individual crew's average daily picking rates in boxes per man hour on different days in orchards with about 18 foot high trees, 3 to 4 boxes of fruit per tree, and 65 to 85 fruit per box are 3.8, 7.7, 5.2, 4.4, 5.9, 8.7, 12.5, 11.1, 11.3, 11.2, 7.8, and 7.4. Here the average rate of pick is 8.1 boxes per hour and the standard deviation is plus or minus 2.92 boxes per hour or 36% of the average. This is probably a little less variation than normal. Notice that the crew's fastest rate of pick is 3.3 times that of its slowest. It appears that when measured in standard deviations, there is about three times as much variation in production rates in avocados as in citrus, even when comparisons are limited to orchards of similar tree heights, volume of fruit per tree, and fruit size. Under these conditions the crew's standard deviation from its average on different days was about plus or minus 40%. This means that on 68% of the days the average production

in boxes per hour of crew members will be within plus or minus 40% of its over-all average in the given orchard conditions and on 32% of the days the crew's production will vary even more than this 40%. When one attempts to determine the effect of tree size, or fruit per tree, or fruit size on the rate of pick, the comparisons become inconsistent. Sometimes there appears to be strong relationships between these factors and rates of pick and again sometimes there appear to be no relationships at all. While it is reasonable to assume that tree height, volume of fruit per tree, and fruit size have some effect upon average rates of pick, the wide variations in rates of pick even when these factors are similar and the apparent inconsistency of the effects of these factors indicate that other orchard factors may be more important in their influence on picking rates.

FRUIT REMOVAL FROM THE TREE

In ladder and bag picking the function of the ladder is to enable the picker to position himself in the tree to pick the fruit. In orange picking the ladder is a very effective and fast man-positioning device. The pickers are able to reposition the ladder to a new picking route in about 1/3 minute and they experience no real difficulty in positioning the ladder to reach almost all of the fruit. The pickers are able to move rapidly up and down the ladder with little fear of the ladder's losing its support in the tree. The above is not the case in avocado picking. The picker experiences difficulty in setting the ladder in the tree, particularly the extension ladder which takes him about one minute to set. Even after the ladder is placed in the tree the picker frequently moves cautiously up the ladder for fear of the ladder's losing support in the tree. This whole operation of setting and climbing ladders appears in many cases to take three to four times longer in avocados than in oranges. This setting and climbing ladders may become serious in low yields where considerable tree area must be covered to pick the fruit. In addition, the picker frequently cannot place the ladder to reach the remote fruit which means he has to pick some with a picking pole.

With a pole his rate of pick is not more than about 1/3 that of non-pole picking. Even without the pole the picker must do considerable reaching because of the difficulty of setting the ladder in the proper locations. This too has an adverse effect upon his rate of pick. It appears as if more research should be done to determine the effectiveness of the ladder as a man-positioning device in a range of orchard conditions. It may be that much of the observed variations in rates of pick are due to varying effectiveness of the ladder as a man-positioning device in different orchard situations and this may be due to either or both tree configuration or the location of the fruit in the tree.

If we assume that the orchard cannot be modified to make the ladder more effective in difficult situations, we can follow two approaches in more effectively positioning the picker for picking fruit. One way is to improve the ladder. This might be done by extending the ladder with power from small motors, reducing the weight of the ladder and picker against the tree by some auxiliary supporting device such as small mobile bases, designing the ladder so it more effectively engages the tree, etc. A second way is to develop man-positioning machines which position the picker independent of the tree. In these the picker's work station is usually some sort of bucket or seat supported

in space by a boom or mast. Examples of such machines are the Selma Tree Master, Power Ladder, Genie Trump Girette and Tree Pacer.

A large number of machines of this nature have been built and tried in various tree crops and so far their use in picking fruit has been extremely limited. In general, the small increases in picking efficiency that the pickers may have realized have been more than offset by the high initial costs of the machines, their large size, their need for proper soil and orchard conditions for their use, and all the operational problems involved in the use of large machines in harvesting crops under varied orchard conditions and with large crews. In general, the absolute efficiency of such machines should be about the same in avocados as in other tree crops, and from our data they are; but their potential use in avocados is better because of the many instances of general inefficiency of the standard ladder as a man-positioning device in avocados and because of the use of small crews in avocado picking which would tend to minimize the operational problems. It would appear that, with the right conditions, such man-positioning machines could be used to advantage in harvesting avocados.

The most promising approach to greater efficiency may be to improve the ladder as a man-positioning device. In oranges where the ladder has been as efficient as the machine in placing the picker in the tree, the rate while picking is only slightly less from the ladder than from the machine. It would appear that this should also be the case in avocados. Also, there are many orchards where man-positioning machines cannot be used because of orchard and ground conditions, but an improved ladder concept could.

FRUIT HANDLING

Fruit handling in the orchard occurs in all phases of the operation but it can be separated into two operational areas: (1) fruit handling connected with the picking operation; (2) fruit handling in preparation for transport to the packing house. The latter includes all fruit handling from the time the picker leaves his tree to dump his fruit to the time the fruit is loaded on highway vehicles for transport to the packing house. The picking systems, operational procedures, and orchard conditions all have an effect upon the time for fruit handling so in any efficiency study fruit handling cannot be ignored. Under present operational procedures most of the time for fruit handling in preparation for transport is done by the picker. Because of this and because carrying fruit has a fatiguing effect upon the pickers which may affect his picking rate, the part played by the picker in fruit handling should be examined closely. The time spent by the picker in carrying fruit from the trees to field containers depends upon the distance of carry but is normally at least .5 minute for each box of fruit picked. By our time data the picker spent another .6 minute per box in fruit dumping and smoothing the fruit and getting and stacking boxes. The boxes contain about 65 fruit which means that dumping time chargeable to each fruit is about .01 minute. This is about four times greater than for citrus. The reasons for this relative large time appear to be due to the nature and size of avocados; the small size of the field containers, about 2200 cubic inch capacity as compared to a typical citrus container of about 3000 cubic inches; and the discrepancy between picking bag and field box capacity. The packing bags held about 3000 cubic inches of fruit. This difference in capacities between containers, particularly because of

the larger picking bag, meant that the picker was spending extra time dumping fruit into two boxes instead of one and smoothing and moving fruit from one box to another.

In summary it appears as if greater efficiencies may be possible in avocado harvesting with improved equipment and management techniques.