

FRUIT REMOVAL FROM STEEP HILLSIDE AVOCADO ORCHARDS PROGRESS REPORT

C. D. Gustafson

Farm Advisor, University of California Cooperative Extension Service, San Diego County

Photos of Donkey operation—Courtesy of Dick Krupp

*Photos of Helicopter, "fruit chute" hillside orchard and footpaths in hillside orchard—
Courtesy of Don Gustafson*

INTRODUCTION

San Diego County is the leading avocado growing county in California and is regarded worldwide as the center of commercial avocado production. During the last five years, the avocado acreage has increased rapidly in California, and the total bearing and non-bearing acreage now stands at approximately 40,000 acres. San Diego county accounts for about one-half of the state's acreage, 20,000 acres and 65 percent of the production.

Increased interest in avocados by consumers and a good return to growers in growing avocados has resulted in a great demand for land to plant new orchards. Much of the land planted is relatively steep, ranging in steepness from 30 to 70 percent.

The main reasons for using the steep lands are: (1) land is more frost-free, (2) about the only land that is available, and (3) the land is less expensive. Planting these steep hillsides causes some problems in both cultural operations and harvesting techniques that were not encountered when older orchards were planted on relatively flat land. Removal of fruit from steep hillsides proved difficult. There was a need to study present-day harvesting methods and techniques to determine what changes in equipment and methods were required to facilitate fruit removal from steep hillside planted orchards.

HISTORY OF PROJECT

In January, 1974, the author initiated a project entitled "Harvesting Avocados from Steep Hillside Orchards." The project title has now been changed to "Fruit Removal from Steep Hillside Avocado Orchards" because the project includes all aspects of moving fruit from the trees to the packing house, not just harvesting fruit from the trees.

The original committee included the following people: Peter Arth, Fallbrook, a packing house representative; Allen Chaiken, Fallbrook, grower; John Hankey, Pauma Valley, private agricultural consultant and farm manager; Paul Hansen, Irv Hardman, and Carl Larson, Fallbrook, CALAVO Growers of California, packing house representatives; Bill Johnson, Bonsall, owner-operator of Johnson Agricultural Corporation; Dick Krupp,

Escondido, grower; Bob Platt, Riverside, Extension Sub-tropical Horticulturist, University of California; Jack Smith, Escondido, Soil Conservation Service (U.S.D.A.); Dr. Bill Wildman, Davis, Extension Soils Specialist, University of California; and Don Gustafson, Project Leader, San Diego, Extension Farm Advisor, University of California.

Since the first meeting the committee has increased about three-fold due to the great interest in the project and the importance of finding better ways to remove fruit from hillsides. The additional members of the committee include: George Borst, Fallbrook, private soil consultant and former Soil Conservation Service engineer; Don Munro, Fallbrook, packing house manager; Dr. Bob Rock, Riverside, Extension Marketing Specialist, University of California; Ted Thee, Escondido, Soil Conservation Service, engineer; Ted Todd, Corona, grower; Dick Markano, Fallbrook, Conklin Engineering Company, engineer; Steve White, Escondido, Henry Avocado Company, farm manager; F. C. Gillan, Fallbrook, tractor operator; Larry Yokum, Fallbrook, tractor operator; H. Lee, Escondido, grower; Chuck Cawley and Vic Roberts, Escondido, C & R Engineering, engineers; Jim Humphrey and Rex Humphrey, Pauma Valley, tractor operators, Don Bartlett, Valley Center, farm manager; and others who attend meetings off and on with the regular members.

From the beginning, meetings have been held regularly. Visits were made to various members' orchards to observe the problem under different conditions, such as; age of trees, slope of land, ground cover, presence or absence of roads, etc. Meetings continue to be held with a good turnout of Committee members. Interest is great and some good progress has been made on this important industry problem.

PROJECT OBJECTIVES

The objectives of the project are:

- (1) To study the present problem in established orchards and determine, if possible, what modifications can be made to the orchard and the land to make harvesting and fruit removal easier.
- (2) Develop a procedure for land preparation, using a piece of raw land, that could be used as a model for the industry so fruit removal would be feasible and reasonable.
- (3) Evaluate presently available machinery for adaptation to hill side use. Also, to investigate what type of equipment is available on the market, as well as to build equipment based upon the present need.

RESULTS TO DATE

During the last three years, avocado acreage increase has been most rapid, with the young trees planted on steep slopes coming into production for the first time. The Committee as a group, as well as individual committee members, have been busy working on different aspects of harvesting during this time. Projects worked upon were: (1) use of donkeys in orchards to move fruit from tree to picking bins, (2) development of a "Fruit Chute," (3) development of a plastic fruit tube, (4) new orchard land preparation, (5) use of a helicopter to remove picking bins from the orchard to a loading

site, (6) cutting footpaths into the hillside of a two-year-old orchard, (7) investigated use of a monorail system, and (8) miscellaneous activities.

Donkeys

At an early meeting, one of the first suggestions made by a committee member (Dick Krupp), as the group sat on the top of a hillside orchard in Pauma Valley contemplating the problem of harvesting off steep hillsides, was "donkeys probably will be the only way to get our fruit out of the orchard."

In November, 1976, Dick Krupp, along with Steve White (Henry Avocado Company), Bill Johnson (Johnson Agricultural Corporation), and John Hankey pooled resources and brought in mules and donkeys from a Sierra Nevada mountain pack organization.

Preliminary results indicate donkeys are better for hillside work. Mules proved to be too large and more restless than donkeys. The mules did damage to tree branches because of their size and temperament.

The week-long tests showed that donkeys would fit into the hillside harvesting operation. It was estimated that two donkeys or burros could keep pace with eight pickers. Each donkey can carry a total of about 100 pounds, equally placed in two containers hung on a special saddle hook strapped on the donkey (Fig. 3). The donkeys are tied together (Fig. 1) and led by a donkey handler (wrangler). The pack outfit is now working on the best type of fruit carrier to place on the donkeys' back. More work will be done on this interesting and unusual (for Californians) fruit removal (Fig. 1, 2, 3, and 4).

"Fruit Chute"

"Fruit Chute" is the name of a device, recently developed and manufactured by C & R Engineering Company, Escondido. Chuck Cawley and Vic Roberts designed this chute after learning about the harvesting problems faced by avocado growers with orchards planted on steep slopes (Fig. 5).

The "Fruit Chute" is a canvas chute suspended on steel cables. The cables are attached to light weight steel frames and secured at the ends to permanent anchors. The speed at which fruit travels the chute, after being dumped into it from a worker's picking bag, is regulated by baffles located along the length of the chute.



FIGURE 1—"Donkey train" waits for pickers to load fruit from their picking bags to boxes hung on special saddle.



FIGURE 2—Pickers emptying fruit from picking bags into boxes on donkeys' back.



FIGURE 2—Pickers emptying fruit from picking bags into boxes on donkeys' back.



FIGURE 4—Transfer of fruit from donkeys' back boxes to bins in the bin loading area.



FIGURE 5—"Fruit Chute" set up on a steep hillside avocado orchard. Pickers dump fruit from their picking bags onto the canvas chute, and fruit then rolls down into a large picking bin.

The "Chute" is easily assembled and disassembled, is lightweight to allow easy transportation from one location to another, and may be assembled in any lengths. Tests have shown the "Chute" to be effective for slopes of 25 to 75 percent. C & R feels that 90 percent of hillside plantings now in existence fit into this slope category.

Since the Committee saw a demonstration of this "Fruit Chute" on the Dick Zylstra orchard in Lilac (Fig. 6), a number of the "Chutes" have been purchased by packing houses and farm managers and are in commercial use in north San Diego County orchards. An improved model of the "Chute" is being tested. The principal change is that the steel cables have been replaced by telescoping aluminum support rods. Additional tests are being conducted.

Plastic Fruit Tube

Committee member Dick Markano, engineer with Conklin Engineering Company, Fallbrook, introduced their company's new plastic (inflated) fruit tube at the California Avocado Society's annual meeting in September, 1976, in San Diego. The tube consists of tubular sections that are inflated prior to use. Fruit is dropped into the top section of the tube as it lays on the ground. The plastic tube is wound up on a reel and transported within the orchard in a truck or jeep. The tube is relatively light weight and inexpensive. A small engine is used to supply air through a special device to inflate the tube.

Land Preparation

Bill Johnson, Committee member and owner-manager of Johnson Agricultural Corporation, Bonsall, provided a raw piece of land that the Committee could use for land preparation. The objective of this phase of the project is to try to develop a criteria in preparing orchard land to facilitate easy cultural and harvesting operations.



FIGURE 6—Steep hillside avocado orchard, planted on terraces.

Ted Thee, engineer, U.S.D.A.'s Soil Conservation Service, working with Bill Johnson, designed an orchard layout, complete with orchard and access roads, in hopes of alleviating some of the harvesting problems after the trees come into production. This orchard will be under observation.



FIGURE 7—Helicopter used to remove full picking bins from steep hillside orchard to a truck loading area within the orchard.

Helicopter

A demonstration using a helicopter to lift 700-pound fruit bins out of orchards was arranged by Steve White, farm manager for Henry Avocado Company, Escondido. The test was carried out in one of Henry's orchards on the steep slopes of Pala Loma in north San Diego County (Fig. 7).

Western Helicopters, Inc. of Rialto performed the work in lifting the bins from the orchard to a pad where they were loaded on trucks to be transported to the packing house. The helicopter company devised a 25-foot long steel cable and hook to lift the bins. The hook attaches to the top of the bin, and the bin then is suspended underneath the helicopter on its trip from the orchard to the loading pad.



FIGURE 8—Footpaths cut into hillside on a two-year-old orchard.

The one-hour long demonstration was an actual operation, with ground crews attaching empty bins to the cable, the helicopter flying the empty bins to the hillside orchard and depositing them for the picking crews. At the same time, a full bin was attached and the helicopter returned it to the loading area.

The operation went smoothly. The Committee was encouraged that this technique may be of practical use as one phase of removing fruit from steep hillsides where road access to the picking bins is limited or non-existent. Future work on this aspect of the project is planned.

Footpaths

Committee member John Hankey had footpaths cut into the side of a hillside orchard after the trees were two years old. The paths were cut out by hand with the use of shovels and hoes. They were placed below each tree row, about three feet wide. It is the first step in making it easier for the orchard worker to move around the face of a steep slope. More work is needed on this phase of the project, namely, modifying land in established orchards (Fig. 8).

Monorail System

An engineering subcommittee studied the possibility of importing a Japanese manufactured monorail system. Members included in the engineering group were Dick Markano, Ted Todd, Allen Chaiken, Bill Johnson, and the author. Dick contacted the Japanese firm, one of the leading manufacturers of monorail systems in Japan, to

determine if they would be interested in cooperating in a test. Dick reported a lack of interest by the Japanese. The firm was in no way willing to give concessions on the price of their equipment. As a result, after study by the subcommittee, it was decided to discontinue any further contact with the Japanese firm. The high cost of their product and the large amount of equipment required by individual growers made the cost of this system prohibitive.

Further study of the principle of the monorail system will be done. The study will be confined to determine what similar products can be obtained in the U.S.A., or if a local firm could develop and manufacture a similar system.

Miscellaneous activities included individual efforts by growers and non-growers on the following items: (1) a specially constructed picking pole bag chute, (2) a fruit chute attached to ladder legs eliminating need for a picking bag usually worn by picker, (3) a free handed pick and drop chute, and (4) use of various pieces of equipment to aid in fruit handling—specially constructed trailers, fork-lifts mounted on tractors and jeeps, electric winches on trucks to move bins, etc.

CONCLUSIONS

The first conclusion is that fruit removal from steep hillside avocado orchards is a very important problem; probably, second only in importance to the avocado root rot disease.

There appears to be no one complete answer to this problem. The answer lies in a combination of: (1) proper land preparation prior to planting, or a modification of land in established orchards, (2) use of donkeys, possibly, to move fruit from trees to bins, or to fruit conveyors to bins at lower levels in the orchard, (3) use of helicopters to remove bins from orchard to loading area, and (4) modification of present type machinery, and/or development of new equipment.

More research is required with accompanying funds to pursue this problem. More people and interested organizations need to participate in the program. For example, the success of the avocado advertising and promotional programs during the last 15 years is a direct result of large sums of money (supplied by all growers) being spent by a group of knowledgeable people doing a consistently good selling job. The same will be required if progress is to be made in streamlining harvesting methods and solving the problems inherent in orchards planted on steep hillsides.