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ADAPTING JAPANESE CITRUS HANDLING METHODS AND EQUIPMENT TO CALIFORNIA AVOCADOS

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To a great extent, price received for a commodity determines present and future plantings. Low returns result in a sharp decrease in new plantings. Conversely, high returns encourage a sharp increase in new plantings.

The avocado is no exception to this rule. Presently, the avocado is riding a crest of better than average returns. The net result is a rapidly expanding acreage. Everyone wants to get into the business or present growers want to expand or diversify their holdings.

There are two sources of land available for planting new avocado acreage; namely, (1) the conversion from some other crops such as citrus, walnuts, or field crops, or (2) the planting of barren hillsides previously used for grazing cattle.

Granted, avocados are better suited to hillside planting because of fewer cultural practices required to raise the crop and in addition, the frost hazard is usually less. However, hillsides, at best, are marginal for avocados because of the problem created in harvesting and transporting the fruit from steep terrains.

During January 1974, an Avocado Harvesting Committee met in San Diego County to discuss possible solutions to handling harvested avocados from hillside plantings. The committee consisted of growers, engineers, researchers, ranch managers, and farm advisors.

The morning was spent visiting hillside plantings to better understand the problem facing the industry as thousands of acres of new avocados come into production. Many orchards have been planted on hillsides ranging from 25 to 45 degrees with an occasional planting up to 75 degrees. The afternoon was spent discussing what was observed and possible solutions. After several hours, it was concluded that perhaps the burro—yes, the burro—being a trainable, docile beast of burden, would offer the best solution. The meeting adjourned on that note.

Reflecting on the day's activities and accomplishments as I drove home, I recalled attending a meeting several years ago where the citrus industry of Japan was discussed. Remembering their use of cables and other mechanical devices for transporting satsuma mandarins from hillside planting, the idea came to me that someone should visit Japan to observe fruit handling methods and equipment and their application to the avocado industry of California.

A sabbatical leave plan was developed and approved, allowing me to spend October and November 1975 in Japan. This period was selected because it parallels their harvest season. During these two months, 21 universities, Research and Experiment Stations in 13 Prefectures were visited.

Japanese Situation

Japan has 490,000 acres of citrus compared to 325,000 acres in California. The Japanese industry is composed mostly of small acreages on steep to very steep hillsides. Fruit removal after harvest is accomplished with a variety of equipment including endless belts, tramways, cables, gondolas, mechanical chutes, carts, sleds, wagons, mechanized wheelbarrows, and monorails. Of all the equipment observed, the monorail and mechanized wheelbarrow will be most applicable to the avocado industry of California.

Cable systems are rapidly giving way to the monorail. In one area, three cable systems were observed. Two of these had been abandoned and the power units removed. In their place 130 monorail systems have been installed. A 1973 survey indicated over 13,000 monorail systems were operating in Japan. A newer survey completed in June of 1976 indicated over 40,000 monorail systems have been installed. A major factor responsible for the monorail takeover is the government farm-road building program. The government pays 90 percent of the cost of building zig-zag roads up hillsides planted to citrus. Each property touches a road at one point. From this point a grower runs a monorail through the orchard, usually at right angles to the terraces. Fruit is carried out of the orchard on a monorail, then loaded onto a small truck and hauled to the packinghouse via a road.

Many different companies manufacture monorails, but all have the same basic components—a power unit, a real, and a trailer. The power unit is a 3½ to 4½ hp, air-cooled, two-cycle gasoline engine. The galvanized steel rails are usually 50 mm by 50 mm (two inches) square, mounted on vertical pipe supports. Where necessary for added strength, angle supports are attached to vertical supports. Each rail is six meters (19.7 feet) in length. Usually, each length of rail is supported with four supports. Propulsion is accomplished with a wheel engaging various types of gears, cogs, holes, or traction points. Gears or cogs mesh into corresponding gears or holes on the rail. One manufacturer uses only indentations on the top of the rail and a hard-rubber roller to create traction. Fruit is harvested, then placed in plastic field boxes which are loaded onto trailers attached to the power unit. One, two or three trailers may be pulled singly or in tandem. A trailer is a metal frame made of strap or angle iron with suitable mechanisms for attaching to the rail. A safety chain is used between the power unit and the trailers. The size of trailers will vary with manufacturers but typically measure 1800 mm by 600 mm (approximately 6 feet by 2 feet).

Because of the uneven terrain of individual properties, no two monorail systems are identical; therefore, installations must be made in the orchard with modifications to fit the property. The tubular rails are easily bent and curved with crewtype or hydraulic rail benders.

Switch units are available and are usually installed on larger parcels where two rails are required to cover different sections of a property. Direction can be quickly changed by manually moving a small section of rail in a switch unit from one main rail to another.

The monorail engine can be stopped automatically at any predetermined point by engaging a kicker-arm mounted on the rail support. When the clutch handle strikes a kicker-arm, the clutch is disengaged and the engine immediately stops.

Monorail systems are usually sold in units which include the engine, the trailer, and 100 meters (328 feet) of rail. Additional rail and switches are optional, depending upon the need. An installed unit costs approximately $2,000 (1975) installed, but this price will vary somewhat between companies.

Most monorail systems are designed to carry 150 to 200 kilos (330 to 440 pounds) of fruit on 45-degree slopes. More or less fruit may be carried, depending on the steepness of slope. Power units travel at 17 meters (55 feet) per minute.

The monorail engines are remarkably stable and operate without swaying, wobbling, or falling off the rail. Nevertheless, manufacturers are conscious of safety and many are developing sophisticated braking systems that automatically stop the power unit above a certain rpm.

Most of the fruit, after it is picked, is transported along a terrace by a mechanical wheelbarrow. The mechanized wheelbarrows are simple frame-type carriers powered by a small 1½ to 2 hp, air-cooled, gasoline engine. The price of mechanized wheelbarrows ranges from $200 to $300.

While many other types of equipment were observed, these two—the monorail and the mechanical wheelbarrow—seem to be most adaptable to the California avocado industry.

Fruit Transport Concept

The following is a concept for transporting avocados on hillside plantings using these two pieces of equipment. It assumes that no mechanical equipment will be available for actually picking or positioning a man in a tree to pick the fruit on the hillsides. In other words, fruit will continue to be harvested by hand with the aid of ladders and picking poles.

Most hillside plantings are planted with a contour terrace road between every four to six rows of trees. Pickers now carry fruit from two or three trees up or down the hill to a terrace road. This practice is fatiguing to the pickers, time consuming, sometimes dangerous, costly, and should be eliminated.

This concept proposes placing a picker in each row and let him move along that row at right angles to the slope of the hill. To facilitate movement, a two-foot walk path is made on the up-hill side and parallel to the tree row. Fruit would be harvested in the usual manner and placed in standard field boxes. Then, with the aid of a mechanized wheelbarrow, the field boxes would be moved laterally along the hillside to a monorail which would carry the fruit up or down hill to a central collecting point. In Japan, where every row is terraced, the need for a two-foot footpath is not necessary.

Negotiations are under way to import a complete monorail system and test it under actual field harvest conditions in a hillside avocado planting in Ventura County. Based on observations made in Japan, this concept utilizing the monorail and mechanized wheelbarrow is a practical and economical solution to a problem plaguing the growers of hillside avocados in California.

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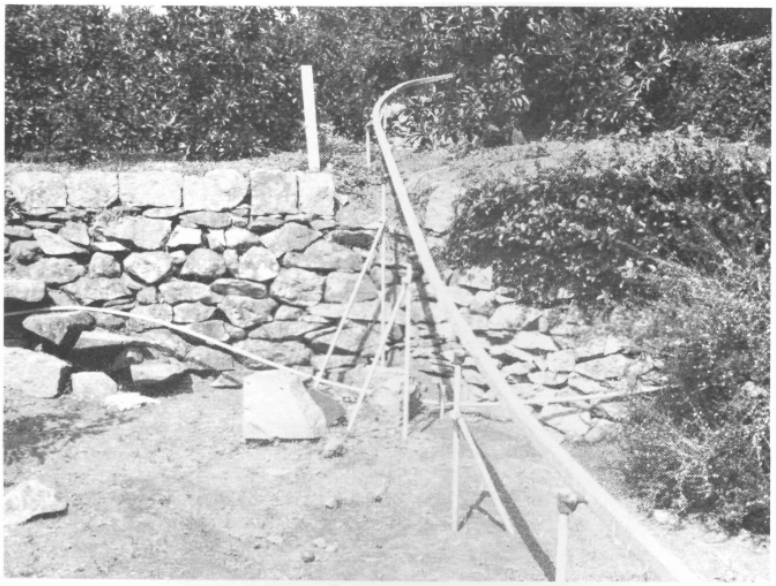
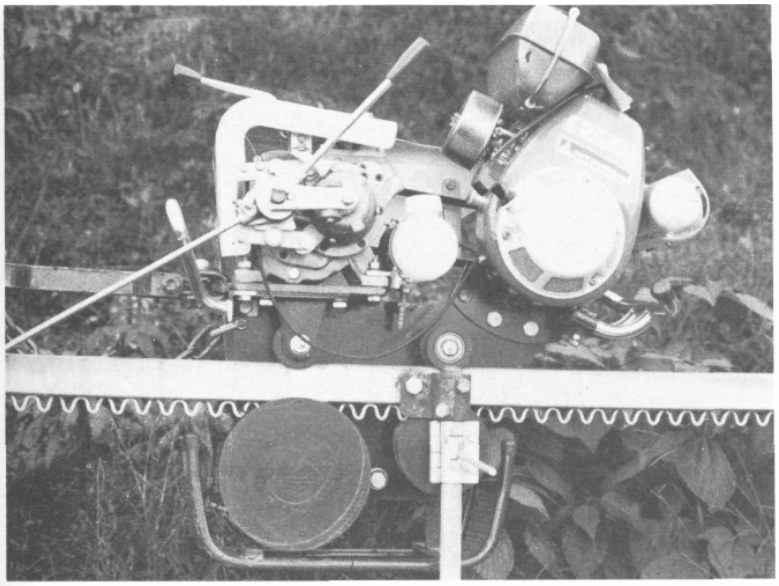
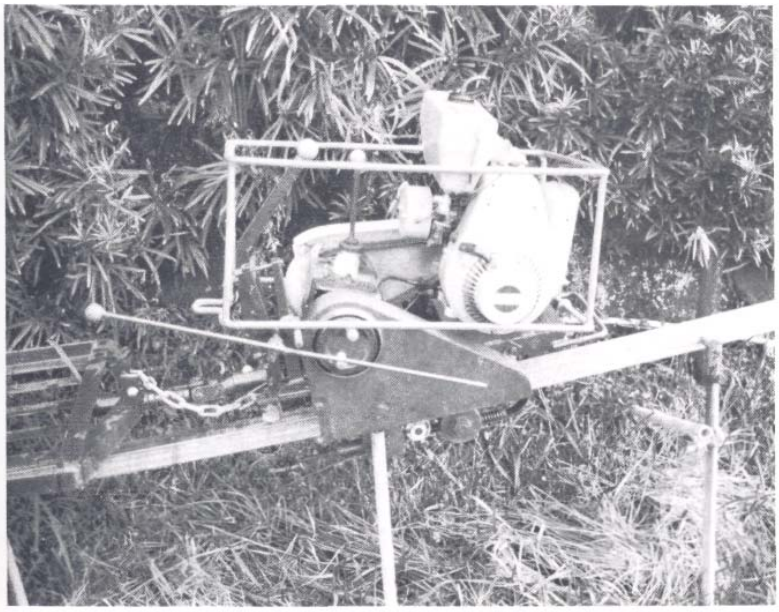


Track of monorail running up through orchard. Rail sections are 6 meters (19.5 feet). Four pipe ctanchions support each section of rail. Angle supports used for stability.

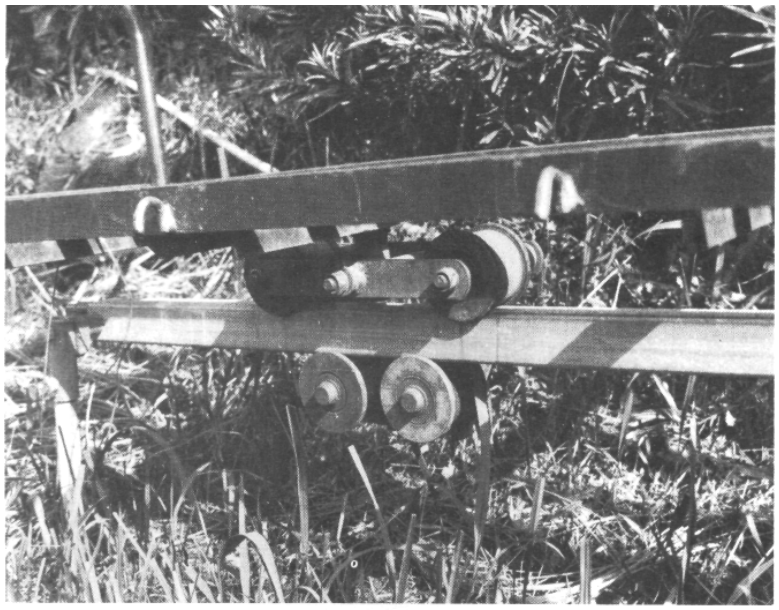
Two parts of same orchard can be serviced with the same power unit by changing short section of rail from one tract to another.



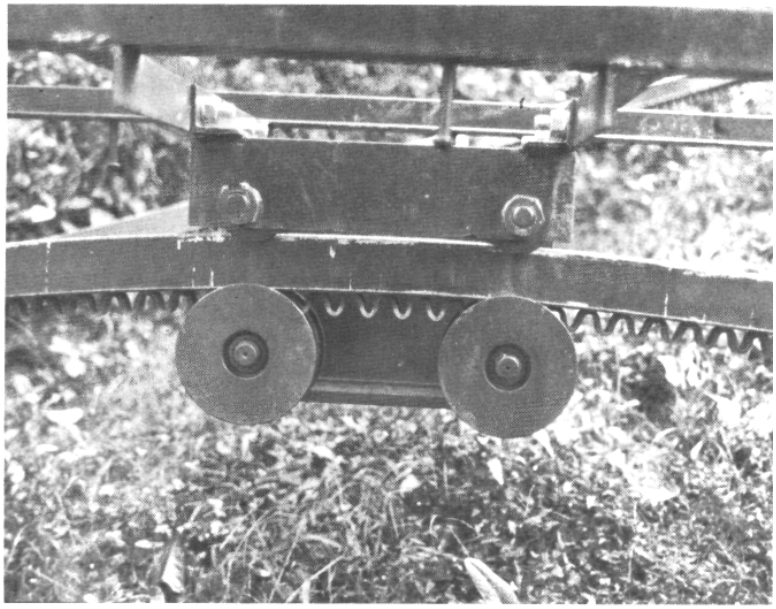
Power unit of a typical monorals system. Loop gears engage year wheel mounted under track. Tongue of trailor seen at left center.



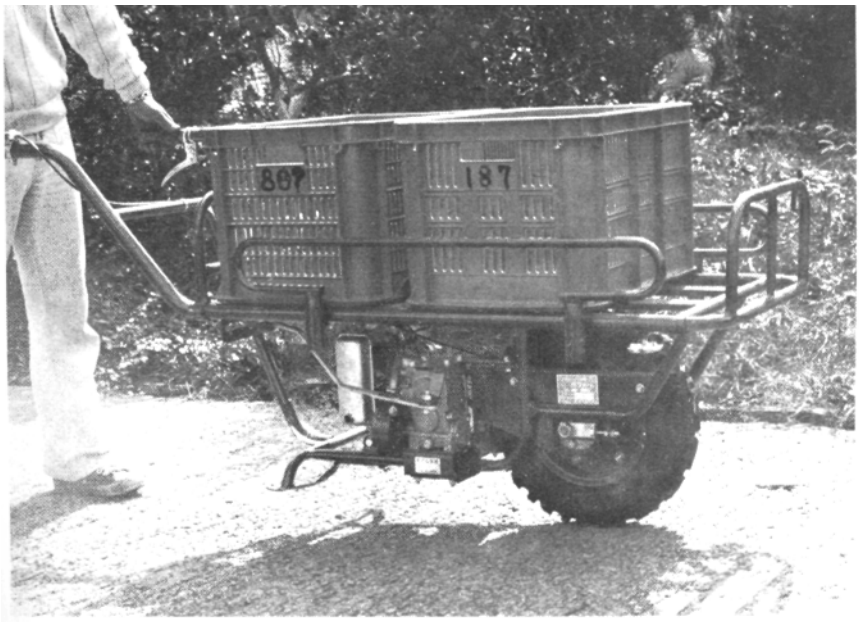
Another type of monorail system. Hard rubber roller engages shallow indentations on top of rail. Note trailer attachment, safety chain and guard rail around power unit.



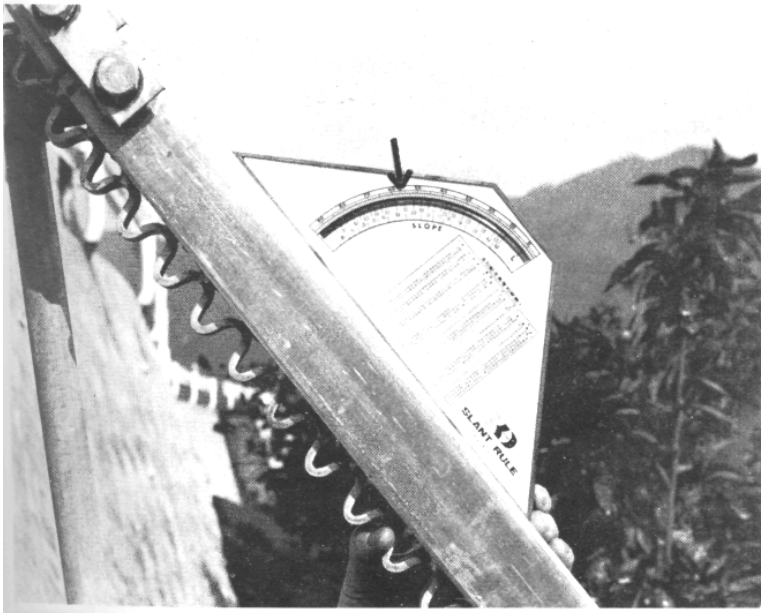
Attachment of trailer on rail with hard rubber rollers.



Another type of trailer attachment.

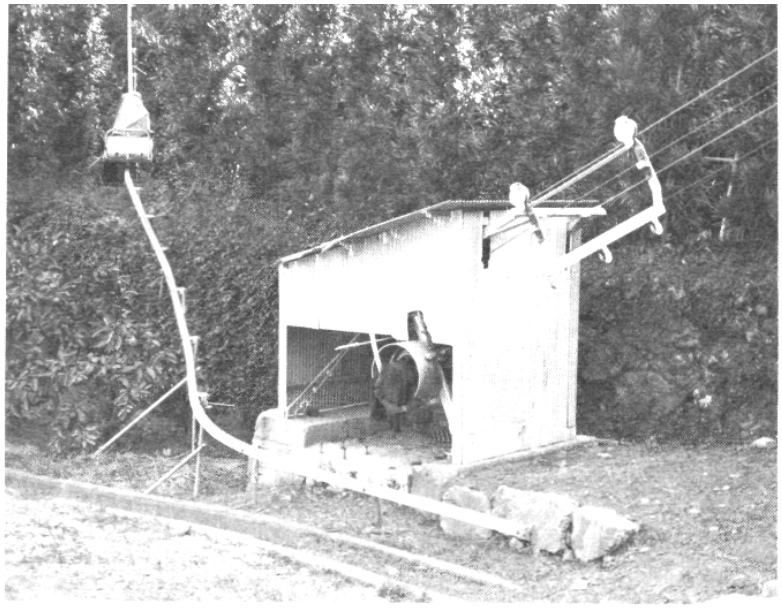


Mechanized wheelbarrow to move fruit along terrace or walkpath to monorail. Frame on front extends to accommodate four 44-pound plastic field boxes. Two-cycle, 1 to 2½ hp, air-cooled gasoline engine.

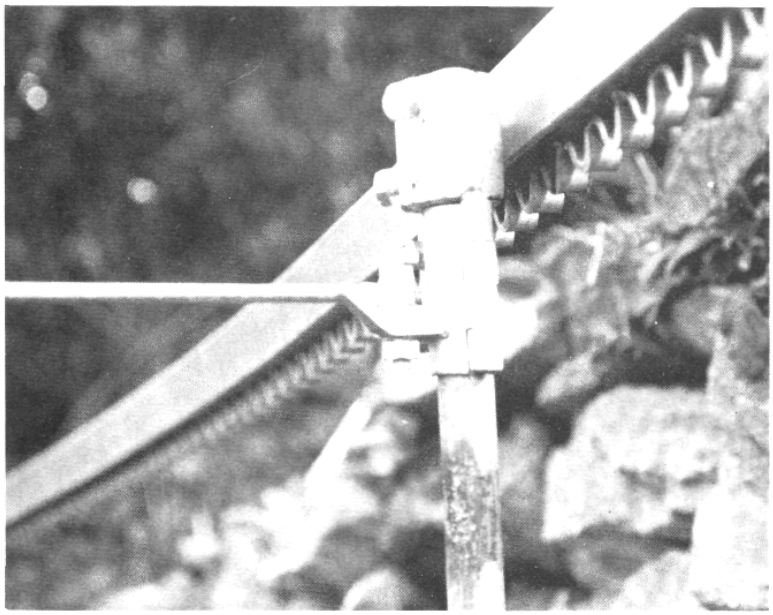


Slant rate on monorail track. Arrow indicates 58°.

Manual cart for moving fruit to monorail.



Cable system with monorail installed along side to serve another section of property.



Kicker-arm or bar used to automatically stop power unit. When in out position, the bar disengages the clutch lever on the power unit, stopping the engine. Kicker-arm or bar must be pre-set at predetermined points.