DEVELOPMENTS IN CITRUS PICKUP EQUIPMENT

ARS-S-84
January 1976

AGRICULTURAL RESEARCH SERVICE • U.S. DEPARTMENT OF AGRICULTURE

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Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE
in cooperation with
University of Florida
and
Florida Department of Citrus

DEVELOPMENTS IN CITRUS PICKUP EQUIPMENT

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ABSTRACT

Numerous fruit pickup concepts have been investigated, but none found entirely successful under the wide range of existing citrus grove conditions. Machines range from comparatively simple tractor-pulled windrow pickup units to elaborate self-propelled machines that gather fruit from a wide area, remove trash, and store the fruit until a truckload is accumulated. A straight-through windrow pickup machine using a rod draper chain and loading directly into a grove truck has been most successful and is commercially available.

INTRODUCTION

Each year, Florida faces the continuing problem of obtaining enough hand labor to harvest its orange crop. Florida orange production is expected to increase from 6.4 million tons in 1972–73 to 8.6 million tons in 1979–80.[2] For the past 12 years, work has been under way to develop mechanical harvesting systems for citrus fruits in Florida.[3] A common approach is to remove all the fruit, drop it on the ground, and then pick it up with some mechanical equipment. A number of such pickup devices were tested and observed by personnel of the Agricultural Research Service; the results obtained are the subject of this report.

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[2] Florida Department of Citrus. 1972. Estimated Florida orange Temple grapefruit production, 1972–73 to 1979–80. Florida Department of Citrus Economic Research Report.

[3] Coppock, G. E. 1969. Review of citrus harvest mechanization. *In* Cargill, B. F., and Rossmiller, G. E. (eds.), Fruit and Vegetable Harvest Mechanization: Technological Implications, pp. 77–805. Rural Manpower Center Report No. 16, St. Joseph, Mich.

PICKUP MACHINES TESTED

In 1967, a vacuum pickup unit, shown in figure 1, was designed and built at the Agricultural Research and Education Center, Lake Alfred, Fla. The vacuum source for the pickup unit was an 18-inch-diameter centrifugal fan rated at 2,000 cubic feet per minute of air at 20 inches water-column static pressure and a speed of 3,600 revolutions per minute. Air-volume flow rate for this system was 546 cubic feet per minute through the pickup tube. Pickup was made by hand-manipulating a 4-foot-long rigid tube over each fruit, which was then conveyed through a 4-inch-I.D., 19-foot-long, flexible vinyl hose to an air lock, where it was discharged into a storage box. The duct work of this system was designed to separate the fruit from the trash by allowing the trash to follow the airflow through the transition and blower, while the fruit fell into an air lock. The air-lock system separated the fruit from the trash using a double set of doors (fig. 2). The upper doors closed off about 80 percent of the cross-sectional area, which provided sufficient vacuum retention, and yet when the lower door closed, equalization of pressure allowed the fruit to fall through the upper doors. The operator, with practice, could pick up two

FIGURE 1.—USDA vacuum pickup machine (1967).

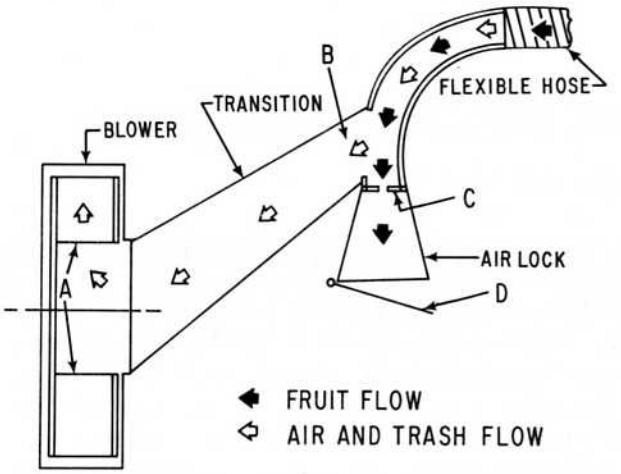

FIGURE 2.—Cross section of vacuum pickup machine, showing air and fruit flow.

fruit per second, disregarding breakdown or unplugging time (a pickup rate of 20–30 pounds per minute). Tests with this unit showed that the minimum acceptable ratio of fruit diameter to duct diameter was 2:3. Because of the low potential capacity, excessive horsepower requirements, noise, dust, and fan-wear problems, this method of pickup was abandoned after the initial design information was obtained.

Initial tests with a USDA-developed tung nut pickup machine in 1967 showed promise for picking up citrus fruit.[4] This unit (fig. 3) had a 34-inch-diameter, double-pitch, spiral brush 7 feet long. The brush, mounted at a 70° angle from the direction of machine travel was made up of 1-inch-diameter, smooth-finished rubber fingers 5 inches long. The cleaning and conveying components used for tung nuts were removed and fruit-handling conveyors added. No attempts were made to remove any trash other than that which fell through the open wire mesh conveyor.

Fruit was either handpicked and dumped from field boxes in the center of the row to form a windrow, or a limb shaker shook the fruit to the ground and the machine simply picked up fruit in its path. On a continuous run of 23.5 minutes, including basket changes, a pickup rate of 210 pounds per minute was obtained. With a forward travel speed of one-half mile per hour, the average pickup rate of the unit was 408 pounds per minute, excluding basket change time.

The tung nut pickup machine was not designed for use in soft, sandy soils, and the tractor-front-mounted unit did not maneuver well. However, this concept for citrus pickup showed promise for development into a useful system.

The manufacturer of the tung nut harvester, Gotcher Engineering and Manufacturing, Clarksdale, Miss., intended to modify the standard pickup for use in citrus groves. However, they were unable to find citrus growers willing to contract to purchase unproven equipment and abandoned the development of this machine.

In 1967, Continental/Moss-Gordon, Inc. (CMG), a private manufacturing company in Prattville, Ala., built an experimental tractor-mounted citrus pickup machine (fig. 4), which was a modification of a commercial nut pickup

[4] Jezek, R. E., Kilby, W. W., and Butler, J. L. 1971. Windrower and harvester for tung fruit. U.S. Dep. Agric. Prod. Res. Rep. No. 123, 9 pp. Marshall, D. E., and Hedden, S. L. 1970. Design and performance of an experimental citrus fruit pickup machine. Trans. ASAE (Am. Soc. Agric. Eng.) 13(3): 406–408.

FIGURE 3.—USDA tung nut pickup machine in grove trial (1967).

FIGURE 4.—Continental/Moss-Gordon pickup machine (1967).