

Efficiency in Fruit Marketing

costs of dumping field lugs and receiver-trucking costs studied in relation to packing-house methods

L. L. Sammet

Part IX of a series of reports on the effects of packing-house equipment, plant layout, and work methods on efficiency and costs. These studies were made co-operatively by the University of California Giannini Foundation of Agricultural Economics and the United States Department of Agriculture under the authority of the Research and Marketing Act of 1946.

Studies of labor utilization and costs in 15 California pear and apple packing plants indicate labor costs for dumping field lugs that range from \$0.10 to \$0.34 per 1,000 pounds of fruit dumped. These costs are based on standardized wage rates selected as representative of the industry. The range includes costs for several different methods and this suggests that methods and equipment used may have an important bearing on costs.

In itself, the dumping operation represents a relatively small proportion of the total plant labor cost, but the dumping method used also affects the cost of transporting incoming fruit. When these two operations are considered together the costs comprise a substantial portion of the total plant labor.

Comparison of costs with different methods, however, must include consideration of direct costs other than labor, such as electric power, and fixed costs for equipment. To obtain comparable estimates of these costs with different methods, standardized production and cost rates based on studies of packing house operations have been used.

The standardized production and cost rates used may not be specifically applicable to a particular plant, but they are representative for the industry and indicate reasonably well the relative costs with different methods.

Both direct and fixed costs are estimated at the 1950 price level. Although the level of costs presently is higher than in 1950, the relative costs for different

methods are essentially as indicated in this report.

Two basic methods—hand dumping and machine dumping—were studied, with variations of each method.

Hand Dumping

In one method of hand dumping the full lugs are trucked to a point adjacent to the dump-man in single 5- or 6-lug stacks or on 30- to 36-lug pallets. The lugs are emptied on the dumping table and restacked by the dump-man. Empty lugs are taken to a storage point by a trucker.

Assuming the dump-man and the trucker alternate, the capacity dumping rate per station would be about 350 lugs per hour. The equipment requirements for hand dumping consist of a dumping table and elevator to the sorting table. Their replacement cost is approximately \$500.

Adding another worker and dumping station as the capacity rate is reached would increase the dumping rates for two stations to 700 lugs per hour, and so on for still larger plants.

Estimates of dumping costs are computed from the labor and equipment requirements per station and the labor and equipment cost rates. With two dumping stations, for example, the direct costs would be labor, \$2.70 per hour; electric power, \$0.03 per hour; equipment repair, \$0.05 per hour; with total direct costs, \$2.78 per hour. The replacement cost for equipment would be \$1,000, and annual

fixed costs for equipment, at a percentage rate of 13.5, would be \$135. These cost estimates may be used to compute total costs per season.

Use of Conveyor Aids

In a variation of the hand dumping method two aids are introduced. Full lugs are trucked to a conveyor belt leading to the dumping station where they are placed on the belt by a set-on man. Each lug is emptied by the dumper, who places the empty lug on a conveyor to the storage area. At this point the empties are set-off and stacked, trucked to a temporary storage and, later, taken to the grower's truck.

In this method, the set-on man and dump-man alternate and have a capacity rate of about 460 lugs per hour. The set-off man has a capacity rate of about 585 empty lugs per hour.

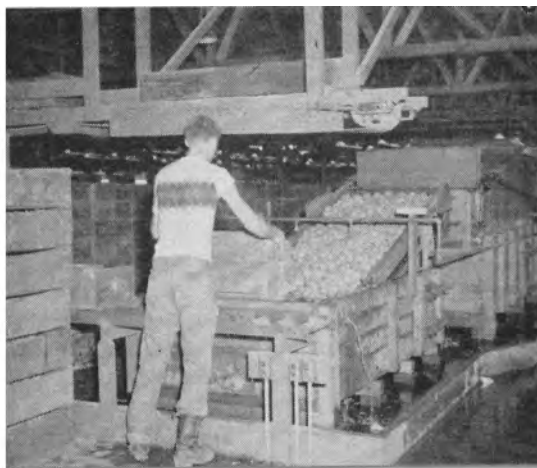
The equipment requirements per station include the dumping table and elevator, as in the previous method. In addition, two power conveyors are required—approximately 25' each for full and empty lugs—and about 40' of gravity conveyor for empty lugs. Replacement costs for the conveyors total about \$650 and—including the dumping table—the replacement costs for equipment total \$1,150 per station.

Equipment and crew requirements and costs for a given dumping rate can be estimated from these data. With a dumping rate of 1,400 lugs per hour, for example, the crew consists of three dumpers,

Hand dumping without conveyor aids. Lugs are supplied to the dumper on pallets—full lugs on the dumper's left and empty lugs on the right.

Hand dumping with conveyor aids. The full lug comes to the dumper from the left on a conveyor at waist-height. The empty lug is placed on the overhead conveyor which transports it to the empty-lug storage area.

Single-box dumping machine. Field lugs are fed by conveyor from the left to a dumping table, which tips and empties the box, then delivers empty box to empty lug conveyor, right.



three set-on men, and three set-off men. The costs for this dumping rate consists of an annual charge of \$570 for equipment and direct costs for labor and electric power of \$11.70 per hour.

Accelerated Dumping

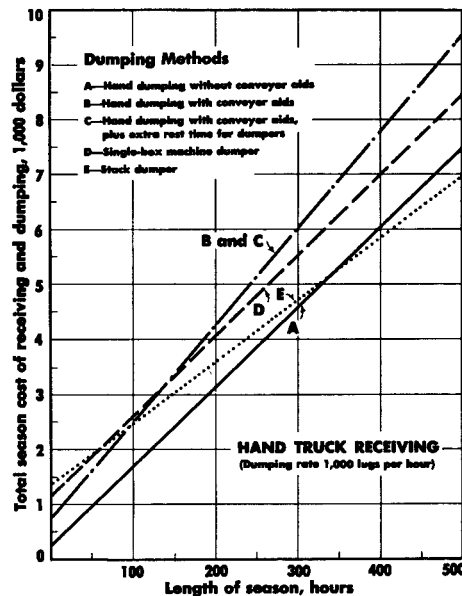
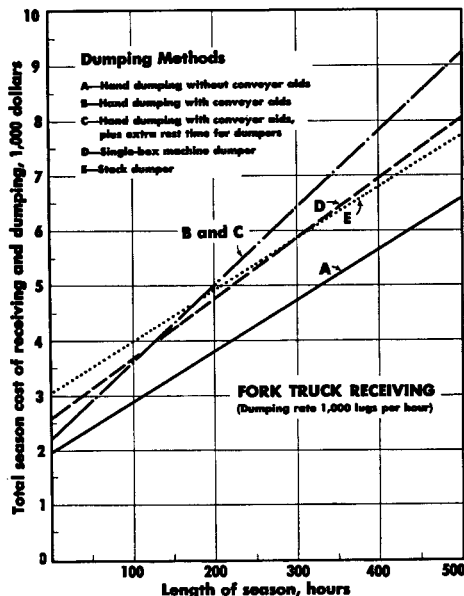
The rate of dumping per station is determined by the number of packers served by one dumping station, the rate of packing, and the proportion of cannery and cull fruit. In some plants the required rate of dumping per station exceeds the capacity for hand dumping even with conveyor aids.

One means of increasing the dumping rate per station is to provide additional rest for the dumper, thus allowing him to operate at an accelerated pace while actually working. Estimates of costs of this procedure are based on dumping rates applicable when the additional rest time is approximately 20% of the total work time.

For one dumping station, the crew organization consists of one set-on man, one dumper, two truckers, and one relief man. This five-man crew rotates through the various jobs, with one of the five men always in a rest status.

With the addition of the relief element, the capacity rate for the dumper and set-on man increases from about 460 to about 610 lugs per hour. However, the capacity rate of the set-off man remains the same. There also is a substantial change in the conveyor requirements because the increased dumping rate requires—in most plants—a distribution belt to route sorted fruit to two or more different packing lines.

The increased dumping rate requires a slightly higher investment in conveyor equipment and an additional investment of about \$700 per station for the fruit distribution belt. Labor costs per station also are higher because of the additional rest time. These increases in costs, however, are offset by the increased dumping rate per station and unit dumping costs re-



Effect of work methods and type of equipment on total season costs for receiving and dumping field lugs in pear and apple packing plants. Left, fork-truck receiving. Right, hand truck receiving. Dumping rate, 1,000 lugs per hour.

main about the same as with the previous method of hand dumping.

Machine Dumping

One type of dumping machine—the single-box dumper—receives the full lug from the set-on conveyor, automatically dumps it and puts the empty lug on the set-off conveyor.

The crew for the single-box dumper consists only of the set-on and the set-off men. No special labor for machine care is required because the set-on man works where he can supervise its operation.

Each type of machine has a variable speed drive so the rate of dumping can be adjusted over a considerable range. For this report, the capacity rate has been standardized at what is considered a good working rate of 750 lugs per hour. With a 20% delay proportion applied to the dumping crew, this results in an effective rate of 600 lugs per hour.

The set-on man feeding the conveyor to the single-box dumper has an hourly capacity of about 460 lugs. The set-off man's rate is about 585 lugs per hour.

Equipment requirements per station include the dumping machine—with a replacement cost of \$1,100 to \$2,600 depending on the type used—plus lug conveyors and a fruit distribution belt valued at \$1,300, and a dumping table valued at \$500. Using the lower cost dumping machine, annual equipment charges total \$500 per station. Direct costs per station—for a dumping rate of 600 lugs per hour—are approximately \$4.00 per hour.

Another type of machine is the stack dumper where the full lugs are fed into the machine by a floor chain conveyor in stacks six-lugs high. The machine automatically destacks the lugs one at a time,

umps them and places the empties on the conveyor. As the last box in the stack is dumped, a new stack is moved automatically into place.

Considering 750 lugs per hour as a good working rate—with a delay proportion of 20% of the total work time—makes the effective dumping rate about 600 lugs per hour.

The stack dumping machine has a replacement cost—1950 level—ranging from \$2,200 to \$3,800. The chain floor conveyor—20'—costs about \$610. Other equipment is the same as for the single-box dumper.

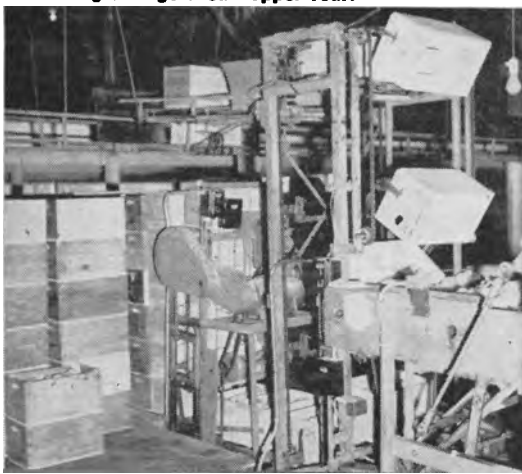
In plants with hand-truck receiving, direct costs with the stack dumper include only the cost of power and direct expense for the equipment, plus the labor cost for the empty lug set-off men. In the fork-truck plants, however, an additional labor cost is included for a hand-trucker who transfers stacks of full lugs from pallets to the floor conveyor. In plants with more than one dumping station, an additional labor cost for a machine-tender is included.

Trucking and Dumping Costs

Dumping and trucking operations in the receiving area of the plant are closely integrated, so costs must be studied jointly. For example, in a representative plant where the lugs are hand-dumped without conveyor aids at the rate of 1,000 lugs per hour and the plant operates 200 hours per season, the total season costs for dumping would be \$1,200, and the total season costs for the trucking operations would be \$2,600. Total dumping and trucking costs are then \$3,800 per season. Similarly, if the lugs are hand-

Continued on next page

Stack dumper. Boxes are fed into the machine by a floor conveyor—lower rear. The boxes are automatically destacked and dumped; the empty boxes are placed on a conveyor to the empty-lug storage area—upper rear.



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EFFICIENCY

Continued from preceding page

dumped—but with conveyor aids—the total cost of the dumping and trucking operations in receiving in this plant would be \$5,000.

Combined costs for trucking and dumping with other methods can be estimated and the most economical method may be selected by comparing these costs. In doing so, however, another important factor—the length of operating season—must be considered.

Comparison of labor and equipment costs for five methods of dumping which take into account the length of season are illustrated in the chart on the left on page 15. The costs presented apply to a plant with fork-truck receiving in which the dumping rate is 1,000 boxes per hour.

This chart indicates that costs for hand-dumping without conveyor aids are lowest for any length of season. For example, with 250 hours of operation per season, costs with this method are approximately \$4,200 per season, in contrast with costs of \$5,700 per season for hand-dumping with conveyor aids, and \$5,300 per season with machine dumping.

Hand dumping without conveyor aid, however, has a capacity dumping rate per station of only about 350 lugs per hour. If requirements imposed by the equipment for sorting and packing require a higher dumping rate per station, one of the other methods must be used, even though costs are higher.

Hand dumping with conveyor aids is less costly than machine dumping for a season less than about 150 hours of operation. For longer seasons, costs are less

with machine dumping than with hand dumping. Comparison of the single-box dumper with the stack dumper indicates that costs are lower with the stack dumper if the season exceeds about 300 hours.

Although season costs for dumping and receiving in a hand truck plant are different than in a fork-truck plant, the results of cost comparisons are much the same in both types of plant—except in those using the stack dumper as shown in the chart on the right on page 15.

Relative costs with the stack dumper are lower with hand truck receiving than with fork-truck receiving because in the hand truck plant the floor chain conveyor eliminates the set-on operation with no additions to the trucking costs. The stack dumper is more economical than the single-box machine dumper or hand dumping with conveyor aids for seasons longer than about 50 hours of operation. Of all the methods, costs with the stack

dumper are least for operation longer than about 350 hours per season.

The most economical method is indicated by comparing total season costs, as may be done for a dumping rate of 1,000 boxes per hour as represented by the charts. A different level of costs would result with rates of dumping different from those used in the charts, but relative costs for the different methods would be approximately as illustrated.

L. L. Sammet is a Co-operative Agent of the California Agricultural Experiment Station and the Bureau of Agricultural Economics, U.S.D.A.

Other reports in this series compare house operations, methods, equipment, and arrangements. The comparisons may be used to establish standards for efficient and low-cost operation. With minor modifications, the results of these studies can be applied to many of the problems of packing and processing other fruits and vegetables. For detailed reports, address Agricultural Publications, 22 Giannini Hall, University of California, Berkeley 4, California.



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