

Efficiency in Fruit Marketing

packing labor efficiency and costs in California pear and apple packing plants influenced by varying factors

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Part IV of a series of reports of studies on the effects of packing-house equipment, plant layout, and work methods on efficiency and costs. These studies have been made co-operatively by the University of California Giannini Foundation of Agricultural Economics, and the Bureau of Agricultural Economics, United States Department of Agriculture, under the authority of the Research and Marketing Act. Detailed reports are available by addressing the Giannini Foundation, 207 Giannini Hall, University of California, Berkeley 4.

Packing labor represents the most important single component of the packing-house wage bill. It accounts for roughly half of the total labor costs in California pear and apple packing plants.

Packers are key workers whose output has a substantial effect on the efficient utilization of labor and equipment in the entire packing house. Effective use of the packers—sometimes overlooked because usually they are paid on a piece-rate basis—will give them higher take-home pay, with improved labor relationships and reduced pressure for higher piece-work rates.

The packer's work operations include obtaining and placing the fruit box, stamping the box with the packer's number, placing and adjusting pads and liners, wrapping and place-packing the fruit, and moving the packed box from the packing stand to the conveyor that transports it to the lidder.

Most California Bartlett pears for out-of-state shipment are wrapped and packed in standard boxes containing 48 pounds of fruit. The bulk of the pears for local markets are packed naked or unwrapped in San Francisco lugs holding about 48 pounds or in Los Angeles lugs usually containing 24 to 25 pounds of fruit. Apples destined for distant markets are commonly wrapped-packed in standard apple boxes, the net weight depending on the variety. Gravensteins, the

major California variety, average about 42 pounds per standard box. Apples for local markets are often placed loosely in used northwest apple boxes.

For many years, pears have been packed from bins.

The fruit drops into the bins from rope-sizers and rolls down the sloping canvas bottoms to the packer. Bin boys are commonly used to keep the fruit piled up at the bottom of the bins where it will be most convenient for the packers.

Bin equipment is still used in many pear plants, and sometimes is available as stand-by or emergency equipment in plants that have converted to other types of equipment. In all the apple plants studied and in several pear plants, the packers worked from packing tubs. The tubs commonly observed were large—with 7½' diameters—and packers on both sides of the machine—or they were small 2½' to 3' tubs set in double rows. Both types of tubs have spring-weighted bottoms that keep the fruit at a convenient level, and both rotate in order to keep the packers evenly supplied with fruit. Curtain or rope sizers are commonly used in pear plants, while weight-sizers were observed in all apple plants.

Performance Standards for Packing California Pears and Apples

Boxes per packer-hr.	Size-number fruit per standard box							
Bartlett pears	90	100	110	120	135	150	165	180
Standard boxes	20.9	18.7	17.0	15.5	13.8	12.4	11.2	10.3
San Francisco lugs	30.7	27.2	24.5	22.2	19.6	...	...	...
Los Angeles lugs	61.4	56.2	51.7	47.9	43.4	...	...	...
Boxes per packer-hr.	Size-number fruit per standard box							
Gravenstein apples	88	100	113	125	138	150	163	180
Standard boxes	19.0	17.7	16.5	15.5	14.5	13.7	13.0	12.1

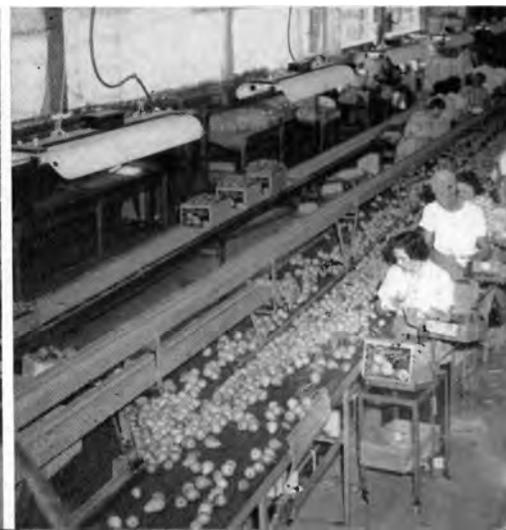
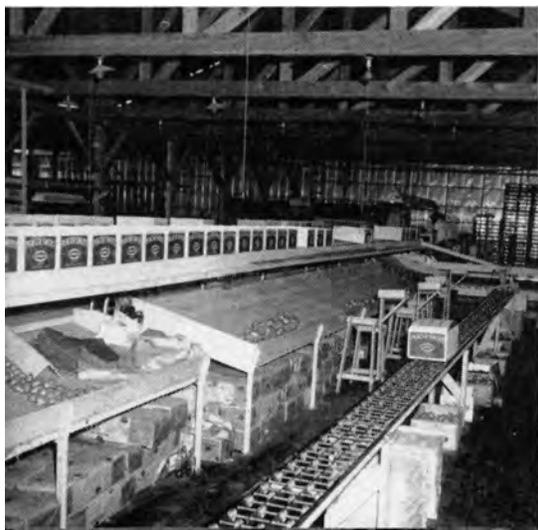
A newer type of packing equipment—actually a revival of an old method—was observed in several pear packing houses. In this system the fruit is packed directly from conveyor belts on which the fruit circulates past the packers who select the particular size to be packed.

The basic packing job remains essentially unchanged regardless of the differences in the type of equipment used. Detailed studies of individual pear packers and of entire packing crews failed to reveal consistent differences in packing efficiency for the types of equipment.

The table at the top of page 10 summarizes the results of these studies in terms of average boxes packed per productive packer-hour. The upper half of the table refers to studies of individual packers taken over short periods of time and when supplies of fruit were adequate. These figures indicate that there were not very marked differences in the

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Three types of packing equipment for pears and apples. Left, packing bins used in many fruit packing houses. Center, one model of packing tubs. Right, the modern revival of an older method—packing directly from conveyor belts.



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average rate of packing any given type of box from the three types of equipment. Moreover, the differences that are indicated are not consistent—packing from tubs, for example, gave the lowest rate of output in standard boxes and the highest rate in Los Angeles lugs.

The lower half of the same table shows the results of studies based on all packers in a number of plants, and represents the average rates of output for periods of several days. These rates have been adjusted to eliminate the effects of delay and idle periods and show the average outputs for periods while actually working. Probably the rates are more indicative of normal packing-house operations than the individual packer studies, however, and in general show somewhat lower rates of sustained output. These data suggest that, over a period of time, the output per packer-hour is highest with packing belt equipment and lowest with packing bins.

In line with the apparently unchanged basic packing job, the standards for reasonably efficient operation given in the table on page 9 apply for all types of equipment. The standards refer to fruit of several sizes, and include allowances for normal delays and rest periods. When expressed relative to the averages of the various sizes packed in each type of container, the standards are: Bartlett pears—13 standard boxes per packer-hour, 21.4 San Francisco lugs; and 46.6 Los Angeles lugs; Gravenstein apples—15.5 standard boxes per hour.

Hourly rates of output in nearly all of the sample plants equaled or exceeded the standards on some days during the seasons studied. Considering all of the sample plants together, apple plants equaled or exceeded the standard on

23% of the days while pear plants exceeded the standard on 21% of the days of operation.

The relative costs of the packing operation with the several types of equipment depend on such factors as the skill of the packers, the average size of fruit, the regularity of fruit supply and the utilized capacity of the equipment. Many of these factors vary from plant to plant, so any simple comparison is questionable. The general nature of relative costs may be suggested by estimates based on standard boxes, average fruit size, and capacity rates of operation based on the table of performance standards on page 9.

Such estimates are summarized in the lower table on this page. Investments in equipment are estimated on the basis of 1950 prices and costs, and have been converted to estimates of annual costs by applying standardized rates for depreciation, repairs, insurance, taxes, and interest. Direct packing labor is entered at the going piece-work rates per standard box. The wages of two bin boys are included for each bin packing line, as this was the most commonly observed arrangement. Other costs, such as the costs for electrical power and for plant floor space, undoubtedly differ somewhat among the three types of equipment, but their minor effects are ignored here.

The estimates stress the fact that the advantage of bin packing equipment lies in its relatively low original investment and annual equipment costs. In addition, shorter sections of packed-box conveyor together with the availability of bin-boys to occasionally push the boxes, permits the use of relatively low-cost gravity conveyors rather than the powered belts usually found in belt and tub packing plants.

The disadvantage of bin plants, on the other hand, is that extra labor costs are involved for the bin-boys.

As indicated by the estimated direct packing costs per box the bin plants have a significant cost advantage over the other types—when hours of operation per season and total volume per season are low. With the

The Effects of Type of Packing Equipment and Type of Container on Output per Productive Packer-Hour, Bartlett Pears.

	Average rate of output—boxes per packer-hour		
	Bins	Tubs	Belts
Individual Packer Studies			
Standard box	15.8	13.5	14.3
Los Angeles lug	50.8	52.6	50.4
San Francisco lug	26.0	...	22.4
Packing Crew Studies			
Standard box	13.1	13.8	14.1
Los Angeles lug	44.4	49.3	50.5
San Francisco lug	20.8	22.8	...

equivalent of 50 hours of capacity operation, this advantage amounts to 3.6¢ per box less than tub equipment and 2.4¢ per box less than packing belt equipment. At 150 hours of operation per season, bin and belt equipment packing costs are about equal and each have an advantage of 0.4¢–0.5¢ over tub plants. If hours of operation amount to 200 per season, tub and bin costs are about equal. For all hours of operation above 200, belt plants show the lowest costs, bin plants the highest costs, and tub plant costs are intermediate.

The indirect effects of the efficiency of the packing operation—which influence the efficiency and utilization of the entire plant—may overshadow the direct effects.

Many factors influence packing efficiency. Those factors most directly under the control of the packing-house manager include:

1. Selection of better than average packers and the elimination of inefficient packers.

2. Elimination or reduction in the delays and unproductive time caused by such factors as the break-for-lots, equipment failure, and uneven flow of fruit.

3. Adjustment of sizing equipment to level off the peaks in the size distribution, to permit a larger proportion of the packers to work on the sizes where the volume flow is largest and most constant.

4. The size of the labor crews should be adjusted to the actual rates at which fruit is being handled.

It is estimated that if all California packing plants operated at rates approximating the performance standards presented in this report, at least 30,000 packer-hours in the pear packing industry and 16,000 packer-hours in the apple industry would be freed and made available for other work.

B. C. French is a co-operative agent of the University of California Agricultural Experiment Station and of the United States Bureau of Agricultural Economics.

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.

Estimated Cost of Operating Bin, Tub, and Belt Packing Lines, Bartlett Pears.

	Bins	Tubs ¹	Belts
Approximate length per section ..	42'	80'	60'
Packers per section	13–15	18–20	15–17
Normal—capacity—			
standard boxes per hour	182	247	208
Installed cost, 1950 ²	\$1,300.00	\$6,520.00	\$4,100.00
Annual equipment cost ³	\$213.00	\$880.00	\$615.00
Packing labor cost per box, 1950 ..	\$0.155	\$0.155	\$0.155
Bin boy labor cost per hour ⁴	\$2.10	.....	.....
Estimated cost per box			
Hours operation per season			
50	\$0.190	\$2.26	\$2.14
100 .....	.178	.191	.185
150 .....	.174	.179	.175
200 .....	.172	.173	.170
250 .....	.171	.169	.167
400 .....	.169	.164	.162

¹ Based on large tubs; 7 per section. Costs for small tubs slightly higher, depending on spacing of tubs.

² Includes cost of packed box conveyors, with powered belts for tubs and belt plants and gravity conveyor for bin plants.

³ Total allowances for annual costs of depreciation, repairs, insurance, taxes and interest: Bins—16.4% of original investment; tubs—13.5%; belts—15%.

⁴ Two bin-boys per section, at \$1.05 per hour each.