Efficiency in Fruit Marketing

costs of lidding packed fruit boxes influenced by type of equipment, size of plant, length of season

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Part VII 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.

Three types of lidders are commonly used in pear, apple, and grape packing houses.

The cheapest and slowest lidder is of the stitcher type which drives one nail at a time on each end of the box.

The most expensive and the fastest type of lidder is the high-speed semiautomatic machine.

The pear and apple plants observed in this study used the intermediate—low-speed—type of lidder but both stitchers and high-speed lidders can be used with the same boxes.

Machine Capacities

Estimated machine capacities and normal working capacities for each type of lidding equipment are given in the table on page 11.

The machine capacities represent the mechanical capabilities of the equipment. The normal working capacities are based on studies of the capabilities of individual operators.

Unavoidable irregularities in the rate of flow of boxes to the lidder, require the operator to work faster during some periods and slower at other times to achieve the indicated standards. The standards thus apply to average rates of output over a period of time. They represent reasonably high levels of efficiency but should be exceeded by some workers.

The machine rate for the low-speed lidder is 720 boxes per hour. The operator can work at speeds approaching the machine capacity for short periods, but the average rate that can be sustained over a period of time is considerably less.

When no top-pad is used—as in grape packing—an efficient operator of a low-speed lidder can be expected to lid 460 boxes per hour. If a top-pad is used—as in pear and apple plants—the operator working alone can be expected to handle only about 330 boxes per hour. With a helper to place or fold the top-pad, the lidder can again turn out 460 boxes per hour.

The performance standards given in the table on page 11 are compared, in the bar graph on page 12, with actual rates of output in 34 California pear, apple and grape packing houses. These standards are represented by the horizontal lines in the graph.

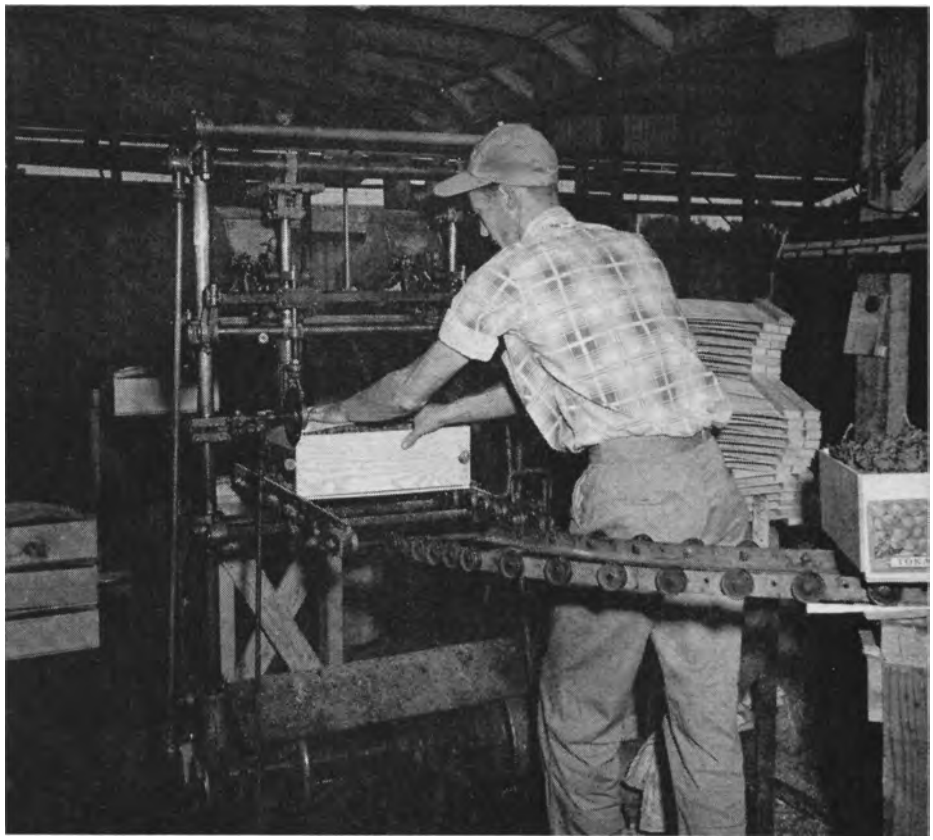
Two rates of production are represented for each plant. The shaded areas on the bars represent the rate of output per machine for each hour that the packing house operated. This is a measure of the over-all utilization of the equipment, and for most plants is considerably less than the performance standard.

In some plants the actual rate per machine hour was low enough to indicate that a lidding setup of lower capacity would be adequate. For example, pear and apple plants L, N, S, and R probably could have achieved their rate of production without a helper for the lidder. The output per machine hour in these plants was considerably below the performance standard for a lidder alone.

Similarly, grape plants 24 and 18 could have used stitchers rather than low-speed lidders, and several of the plants using high-speed machines—8, 9, 6, and 28—probably could have handled the required volume on low-speed lidders at least during the periods in which these studies were made.

The total areas of the bars in the graph represent the output per hour that the operator actually worked, including allowances for rest periods and personal time. All other observed delays—ranging from 2% to 56%—were removed from

The low-speed lidder—intermediate in cost and speed—drives all nails with one blow. The operator pushes the packed box into the machine and inserts the lid. Most low-speed lidders are equipped with automatic ejectors for lidded boxes.



the total operating time to obtain the net working time. This figure was used to calculate the output per hour of productive work time.

In these terms, nine of the 34 plants equaled or exceeded their standards, while a number of others were close. Those plants that did not come up to their standards probably could have done so if rate of plant output had been great enough to induce a higher rate of worker activity.

Cost Comparisons

Lidding crew requirements and labor cost per hour for various rates of plant output are given in the table on page 12. The crew requirements are based on the performance standards given in the table on this page.

From the labor costs per hour given in the table on page 12 the savings in labor cost through use of one type of equipment as compared to another may be calculated.

These savings, when multiplied by the hours of operation per season, give the total savings in labor cost per season. This figure can be balanced against the difference in pro-rated annual cost of the three types of equipment to determine which is most economical.

For example, in a packing house handling between 371 and 460 boxes per hour the high-speed lidder saves $1.35 per hour in labor cost as compared to the low-speed machine. For a 100-hour season a labor saving of $135 for the high-speed lidder would be balanced against the difference in equipment cost resulting from the lower cost of the low-speed machine.

In a similar manner the stitcher can be compared to either the high-speed or low-speed lidder.

In general, the savings in labor with the high-speed machine increase with the length of the operating season and with the size of the packing house.

The general conditions under which each type of lidding equipment is likely to be most economical may be illustrated by the approximations given in the following table. The individual plant manager may use his own equipment cost figures.

Approximate Installed Prices—1950—Estimated Annual Costs.

Lidder	Approx. installed cost	Estimated annual cost
Stitcher	$1,500	$220
Low-speed	2,000	295
High-speed	3,400	500

The price of the high-speed machine includes the cost of an accumulator. Annual costs were obtained by applying a standardized set of charges—depreciation

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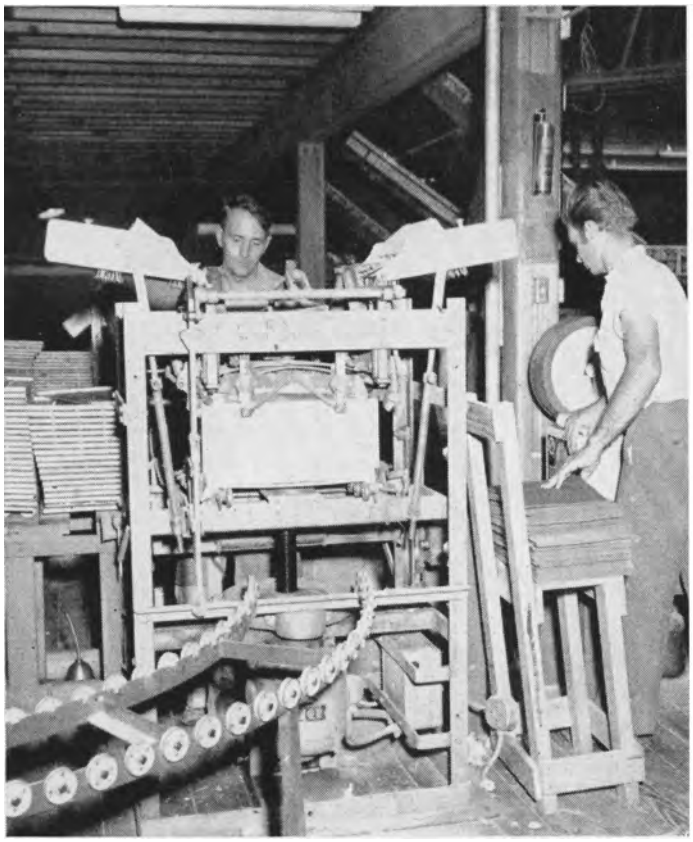
Performance Standards for Lidding Pear, Apple, and Grape Boxes.

	Stitcher Type Lidder[a]	Low-Speed Lidder	High-Speed Lidder
	Boxes per hour		
Maximum machine capacity	500	720	1,600
Normal working capacity[b]			
No top-pad used	370	460	1,010
Helper places top-pad	370	460	1,010
Machine operator places top-pad	280	330	540

[a] Standards are based on an average of three nails per side.
[b] Includes allowances of 4.2% for rest periods, 4% for personal time and 10% for getting lids, oiling machine and miscellaneous.

The stitcher type of lidder—the cheapest and slowest—drives one nail at a time in each end of the lid as the operator pushes the box through the machine. Usually three nails are driven in each end.



The high-speed semi-automatic lidder—the most expensive and fastest type. The operator feeds in the lids, the machine does the rest—carries the box into the lidder, lids and ejects.

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tion 6.7%, repairs 3%, taxes 1%, insurance 1%, and interest 3%—to the installed prices. Operating costs such as electricity are minor and were disregarded. In view of the short seasons and the approximate nature of the annual cost estimates depreciation and repairs—although related to hours of use—are treated as fixed annual charges independent of the length of operating season.

Estimated Equipment Costs

In comparison with the high-speed lidder, estimated annual equipment costs are $205 less with the low-speed lidder and $280 less if a stitcher is used.

Whether or not the labor savings of the high-speed machine is great enough to offset these equipment cost differences depends on the length of operating season and the size of the plant.

For very small plants the high-speed lidder saves only 30¢ per hour in labor cost so the stitcher is most economical for plants with outputs below 280 boxes per hour, provided the season is less than 900 hours. This is considerably longer than most of the plants operate.

For plants not using top-pads, the stitcher gives lower costs up to 370 boxes per hour.

For higher rates of output, the high-speed equipment offers greater labor economies.

For example, in the range of 461 to 540 boxes per hour—using a top-pad—the savings in labor cost for high-speed as compared to the low-speed machine amounts to $1.70 per hour.

Cost Advantages

Using the equipment cost estimates of this study, for a 100-hour season the low-speed lidder has a cost advantage of $205 less $170 or $35 per year. The two lidders would break even as to total cost at about 130 hours. Beyond 130 hours the high-speed lidder becomes increasingly advantageous. At 300 hours, for example, the high-speed machine has a cost advantage of $510 less $205 or $305 per year.

In a few plants the lidder operators were paid by the box and the rate of earnings and costs were generally higher than in plants that paid by the hour. However, with piece rates the normal working capacity may be increased by as much as 25%.

In some cases—particularly with short seasons—a higher labor cost associated with piece rates may be substituted for an additional lidding machine.

For example, a plant with an output of 550 boxes per hour—no top-pad—might use one operator on a low-speed lidder at the typical incentive wage of 80¢ per 100 boxes in place of two hourly pay operators and two machines.

The use of two lidders paid by the hour would save $4.40 less $2.80 or $1.60 per hour in labor but would add $295 in equipment costs. In this instance, for seasons of less than 180 hours the piece-rate pay gives lower costs and for longer seasons the hourly pay is the most economical.

B. C. French is a co-operative agent of the University of California 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. Address Agricultural Publications, 22 Giannini Hall, University of California, Berkeley 4, California.

Labor Requirements and Costs of Lidding Pear, Apple and Grape Boxes

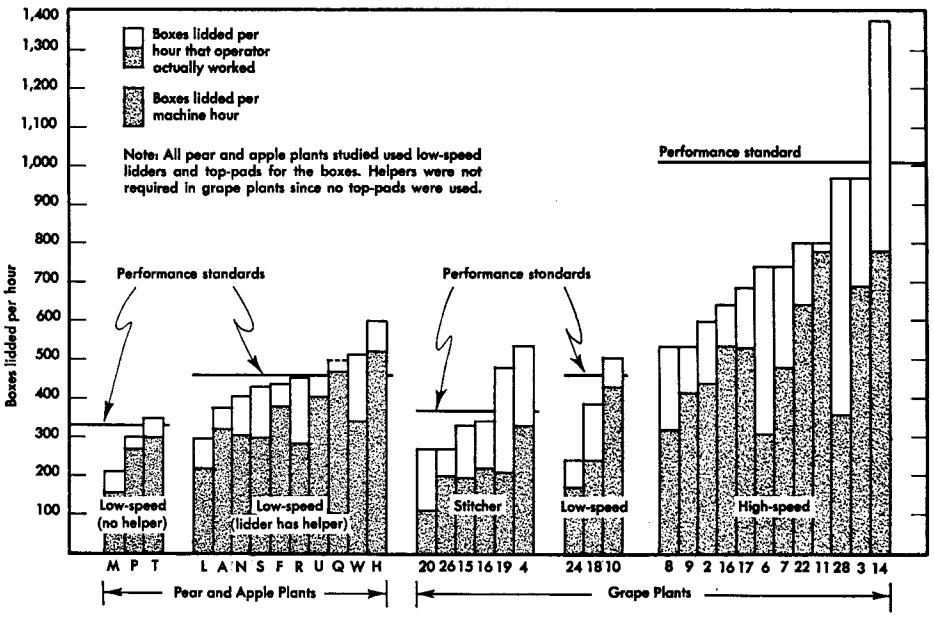
Average Rate of Plant Output (Boxes per Plant hour)	Estimated Lidding Crew: Stitcher L	Stitcher H	Low-Speed L	Low-Speed H	High-Speed[a] L	High-Speed[a] H	Labor Cost Per Hour: Stitcher	Low-Speed	High-Speed[b]
Top-pad Used									
0–280	1	–	1	–	1	–	$1.40	$1.40	$1.10
281–330	1	1	1	–	1	–	2.45	1.40	1.10
331–370	1	1	1	1	1	–	2.45	2.45	1.10
371–460	2	–	1	1	1	–	2.80	2.45	1.10
461–540	2	–	2	–	1	–	2.80	2.80	1.10
541–560	2	–	2	–	1	1	2.80	2.80	2.15
561–660	2	1	2	–	1	1	3.85	2.80	2.15
661–790	3	–[c]	2	1	1	1	4.20	3.85	2.15
791–840	3	–	3	–	1	1	4.20	4.20	2.15
841–930	3	1	3	–	1	1	5.25	4.20	2.15
931–1,000	4	–[d]	3	–	1	1	5.60	4.20	2.15
No Top-pad									
0–370	1	–	1	–	1	–	1.40	1.40	1.10
371–460	2	–	1	–	1	–	2.80	1.40	1.10
461–740	2	–	2	–	1	–	2.80	2.80	1.10
741–920	3	–	2	–	1	–	4.20	2.80	1.10
921–1,000	3	–	3	–	1	–	4.20	4.20	1.10

[a] L-Lidder, H-Helper. Number of lidders corresponds to number of machines. Crew is set up to give minimum labor cost for any output.

[b] Wage rates used: Lidder—Low-Speed or Stitcher, $1.40 per hour; High-Speed, $1.10 (less skill required with High-Speed Machine); Helper, $1.05 per hour.

[c] An additional helper could be added, rather than another lidder, up to 740 boxes per hour. Labor costs would be $4.90 per hour instead of the $4.20 indicated, but equipment costs would be reduced. The economical decision depends on the length of season and the cost of the machine.

[d] As above, additional helpers could be added rather than an additional machine.



Rates of lidding pear, apple, and grape boxes in a sample of California packing houses.