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Comparative study made of

Lugs and Bins for Fruit

handling between orchard and packing plant

Use of bulk containers to move fruit from the orchard to packing, or processing, plants is increasing in California.

Generally, although not standardized, bulk containers are wooden bins—approximately 46″ square and 22″–30″ deep—that hold from 925 to 1,150 pounds of fruit. The commonly used fruit lug box—13″ × 18″ × 9″—holds about 42 pounds of fruit.

The basic operations of orchard-to-plant transportation are unchanged by a shift from lug boxes to bins. However, important changes in handling methods are often required.

Detailed time and production studies of orchard handling operations were used to develop output standards for labor and equipment. Those standards were used to estimate and compare crew and equipment requirements and costs with bins and lugs in various handling and hauling situations.

Three methods of bin handling and three methods of lug handling were included in the studies.

One bin handling method—*B-1*—uses a farm tractor equipped with a fork lift attachment to move the bins from the orchard to a transfer area and to load highway trucks for the haul to the packing plant. The usual truck load is 12 bins, equivalent to 288 lugs. The fork lift is also used to move empty bins to the orchard as they are returned from the plant after unloading.

The only difference between the second bin handling method—*B-2*— and Method *B-1* is the use of tractor drawn trailers rather than highway trucks for the orchard-to-plant haul. With three trailers pulled in tandem, Method *B-2* also handles 12 bins per trip.

With the third method—*B-3*—pickers fill bins on trailers parked in the orchard. Farm tractors pull the bin-trailer units to and from the plant. Because the bins are only loaded one high, Method *B-3* allows a load capacity—with a three trailer unit—of six bins per trip, or a fruit volume equivalent to 144 lugs.

One lug handling method studied—Method *L-1*—uses farm tractors to pull orchard trailers to and from the plant. The trailers are loaded and unloaded in the orchard by hand. The full lugs are stacked on pallets, 36 per pallet, with each trailer holding two pallets. The load capacity of the haul to the packing house is 216 lugs for a three trailer unit.

The second lug handling method—*L-2*—uses a highway truck loaded directly in the orchard by hand for the orchard-to-plant haul. Usually the minimum loading crew is two men: the driver, who also at each stop lifts filled lugs to the truck bed, and the stacker, who places 36 lugs on each of six pallets on the truck for a load of 216 lugs.

Lug handling method *L-3* combines Methods *L-1* and *L-2*. Orchard trailers move the lugs from the orchard to a transfer area where they are loaded by hand onto highway trucks. A two-man crew is required for the transfer operation. As with other lug handling methods, 216 lugs are hauled per truck load.

Estimated labor requirements, as related to hauling distance and rate of output, for each of the handling methods are shown in the table on page 4. All output rates are expressed in lugs with the lug equivalent of bins figured at the rate of 24 lugs per bin.

To estimate crew requirements, an average at-plant time of 24 minutes per trip was allowed and time on the highway was based on an average speed of 20 miles per hour with trucks and 10 miles per hour with trailers.

The table on page 4 shows that the effect of shifting to bulk containers depends on a number of variables, including the lug handling method currently used, the bin handling method that is to be used, the rate of output, and length of haul.

The crew requirements given in the table on page 4 are strictly applicable only for the handling and hauling conditions used in these calculations. However, the table may be used as a guide to the relative quantities of labor needed. Local wage rates and grower estimates of equipment needs and costs would provide a basis for cost comparisons among the different methods.

A conversion of labor requirements given in the smaller table to costs and the addition of operating and fixed costs for equipment are illustrated in the larger table.

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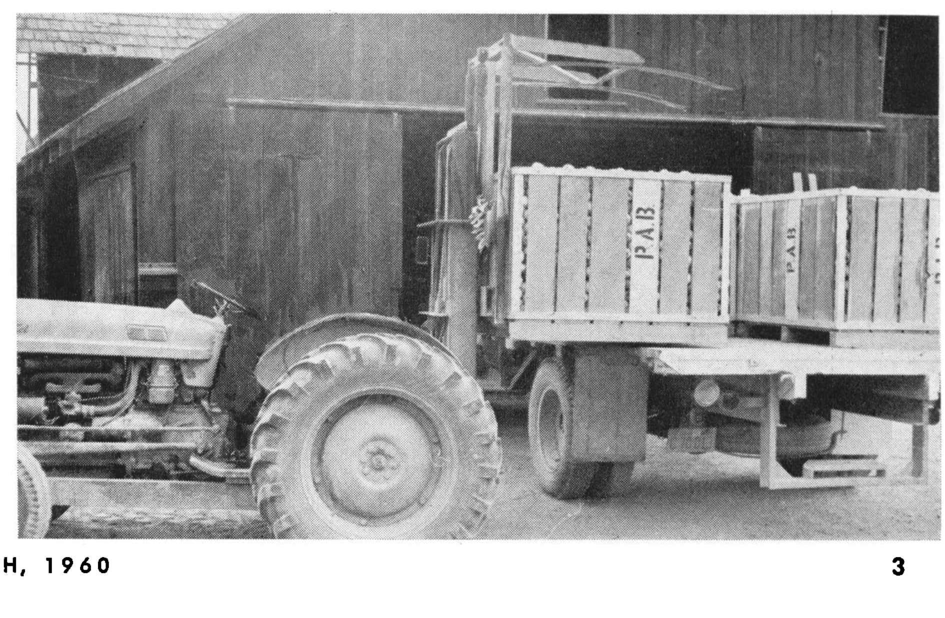
Orchard-to-packing-plant handling of bulk bins with fork lift.



FRUIT HANDLING

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Operating expense of 29¢ per hour for each truck or tractor hauling unit, and a wage rate of $1.35 per hour for labor were used. The hourly fixed costs for the various pieces of equipment were determined by allocating the 1959 replacement costs over a representative length of life for the equipment to obtain an annual fixed charge. The annual fixed charge was reduced to an hourly basis by dividing by 250, which is considered to be an appropriate approximation of average annual use of deciduous tree fruit harvesting equipment in California. In cases of tractors and trucks only 50% of the annual fixed costs were charged to the handling operation. The total hourly handling costs—variable operating expenses plus fixed charges—formed the basis for comparing the various handling methods.

If bins are the container used, and the hauling distance is one mile, Method *B-3* is of least cost for output rates less than 100 lugs per hour; *B-1*, for rates between 100 and 200 lugs per hour; and *B-2*, for output rates greater than 200 lugs per hour.

With a length of haul of three miles, *B-3* is the least-cost bin handling method for rates of output less than 70 lugs per hour; for higher rates of output *B-1* is the least-cost bin handling method. Method *B-2* is not the least-cost bin handling method at any rate of output when the one-way hauling distance is as long as three miles. *B-1* is the least-cost bin handling method for all output rates greater than 50 lugs per hour at five miles and for all output rates, except very low rates, at 10 miles.

Handling by *B-3* is the least-cost bin method for low output rates at the one mile and three miles hauling distances, because no investment in bin handling equipment is required and—except for tractor operators—no handling labor is needed in the orchard. However, the cost advantage of *B-3* is gradually lost as the rate of output is increased because the limited load height—one bin—reduces the load capacity of the trailers by one half. Therefore a high rate of output requires a relatively large number of tractor-trailer combinations and operators. The higher picking rate and more numerous orchard-loading sets also tie up a large number of trailer units and add to the cost as output rate rises.

Handling method *B-1* has lower total handling costs than *B-2* at all rates of output when the hauling distance is longer than one mile, because of the greater hourly hauling capacity of the higher speed highway trucks.

Comparison of the estimated total handling costs for the three alternative lug handling methods shown in the larger table indicates that, for one-way hauling distances of five miles or less, *L-1* is the least-cost method. For hauling distances longer than five miles, *L-2* is lowest in cost at the higher rates of output and becomes the least-cost method for a wider range of outputs as the hauling distance is increased.

Method *L-3* is of higher cost than *L-1* and *L-2* at all rates of output and hauling distances, primarily because of the labor cost of transferring the containers from one transportation vehicle to another. Despite its high cost, there are many situations where orchard conditions require Method *L-3* if lugs are used.

The figures in black type in the table on costs denote the minimum cost of attaining the various rates of output at each of the specified hauling distances. Lugs handled by *L-1* have minimum costs for output rates up to 250 lugs per hour when the hauling distance is one mile. Above the 250 lug rate, bins handled by *B-2* have the lowest handling cost. At longer hauling distances the point at which bins become the more economical container occurs at relatively low rates of output. The increasing advantage of bins, as the length of haul is increased, is primarily due to the larger net loads that can be hauled on a given transportation vehicle.

When any but the least-cost lug handling method in a particular situation is considered, a shift from lugs to bins would result in savings. For example, selection of least-cost method in chang-

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Labor Requirements with Alternative Handling Methods as Related to Rate of Output and Hauling Distance

Output Lugs/hr.	Handling method*	One-way hauling distance, Miles: 1	3	5	10
		Men required			
100	B-1	1	1	1	1
	B-2	1	1	1	2
	B-3	1	2	2	3
	L-1	1	1	2	2
	L-2	2	2	2	3
	L-3	2	2	2	3
200	B-1	2	2	2	2
	B-2	2	2	2	3
	B-3	2	3	3	5
	L-1	2	2	3	4
	L-2	4	4	4	5
	L-3	4	5	5	6
300	B-1	3	3	3	4
	B-2	3	4	4	5
	B-3	3	4	5	7
	L-1	3	4	4	6
	L-2	6	6	7	7
	L-3	7	7	8	8

*B = Bins, L = Lugs.

Hourly Handling Costs in Moving Fruit from the Orchard to the Plant in California in Relation to Handling Method, Rate of Output, and Length of Haul. (Container cost not included) 1959

One-way hauling distance (Miles)	Rate of output (Lugs/hr.)	Methods and hourly handling costs *: B-1 **	B-2	B-3	L-1	L-2	L-3
1	50	$3.73	$4.13	$3.02	**$2.69**	$3.90	$4.37
	100	4.73	5.00	4.64	**3.91**	5.23	6.49
	150	5.73	5.87	6.25	**5.13**	6.54	8.59
	200	6.73	6.74	7.86	**6.35**	7.87	10.71
	250	7.72	7.61	9.48	**7.57**	9.14	12.82
	300	8.72	**8.48**	11.09	8.79	10.51	14.93
3	50	3.88	4.37	3.54	**3.07**	4.12	4.68
	100	4.96	5.47	5.62	**4.52**	5.54	6.90
	150	6.05	6.58	7.70	**5.97**	6.97	9.13
	200	**7.14**	7.69	9.78	7.42	8.40	11.35
	250	**8.23**	8.80	11.86	8.87	9.83	13.59
	300	**9.32**	9.91	13.94	10.32	11.27	15.81
5	50	4.02	4.61	4.06	**3.45**	4.33	4.98
	100	5.20	5.95	6.61	**5.12**	5.86	7.32
	150	**6.38**	7.30	9.15	6.81	7.40	9.67
	200	**7.56**	8.64	11.70	8.49	8.94	12.01
	250	**8.74**	9.99	14.25	10.17	10.47	14.35
	300	**9.92**	11.33	16.79	11.85	12.01	16.70
10	50	**4.37**	5.19	5.35	4.40	4.86	5.75
	100	**5.78**	7.14	9.07	6.66	6.66	8.38
	150	**7.19**	9.08	12.78	8.91	8.47	11.01
	200	**8.60**	11.02	16.49	11.17	10.27	13.64
	250	**10.01**	12.95	20.21	13.42	12.07	16.27
	300	**11.42**	14.90	23.92	15.68	13.87	18.91

* Figures in black type represent least-cost methods.
** B-1 = Bins-trucks. B-2 = Bins-trailers. B-3 = Bins filled on trailers.
L-1 = Lugs-trailers. L-2 = Lugs-trucks. L-3 = Lugs transferred from trailers to trucks.

able potassium content but not from soils with high levels of available potassium. Crop uptake of cesium137 was inversely correlated with the level of available potassium in soils.

The addition of stable cesium amendments to soils was ineffective in reducing cesium137 uptake even when applied at levels that were toxic to the plant.

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BORER

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gave a measure of control when treatments were spaced at monthly intervals.

The past four seasons' work on peach tree borer suggests that Thiodan, Endrin, or Dieldrin applied as trunk sprays will control the Western peach tree borer on apricots and, probably, on cherry, almond, peach, and prune.

When Thiodan, Endrin, or Dieldrin is used, extreme care must be taken to avoid contamination of fruit. Pump pressure must be reduced and a coarse spray nozzle used. Under no circumstances should a blower-spray be used. Hand spraying, with careful attention to confining the sprays to the tree trunk, offers the most readily controlled application.

What effect sprinkler irrigation may have on deposit of the toxicants is an important factor to be determined in further studies on trunk sprays to control the Western peach tree borer.

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FRUIT HANDLING

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ing from *L-3* to bins with a one mile haul would involve bin methods and savings of: at an output rate of 100 lugs per hour, use of Method *B-3* and an hourly savings of about $1.85; with an output rate of 200 lugs per hour, Method *B-1* and savings of about $4.00 per hour; with an output of 300 lugs per hour, it would be Method *B-2* and a savings of about $6.45 per hour.

The savings shown by the table are strictly applicable only when operating conditions, variable cost rates, equipment investment, and allocation rates are as specified. However, considerable changes in these factors would be possible without important shifts in the relative cost of the various methods.

Investment costs and carrying charges for containers depend on construction details, but run 35%–65% less per unit of fruit handled with bins than with lugs. When container and handling costs are combined, bins are the more economical container throughout the range of operating conditions considered in this study.

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MARKET STRUCTURE

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has stayed relatively stable over the years, shifts among products are evident, and recent trends indicate a strong consumer preference for processed convenience foods.

Technological improvements developed to satisfy consumer preference for convenience foods emphasize the need for the fruit and vegetable canning industry to be progressive and dynamic—with new or improved processing techniques, cost-saving methods and specialized markets as in the cases of baby foods and dietetic products—to compete for consumer preference. Changes in marketing-sales-distribution organization and merchandising operations are being sought by some processors to strengthen their marketing position in the canning industry.

Industry Structure

A changing market structure confronts the canners of fruits and vegetables. The onetime prevalent independent wholesalers have been widely replaced by large scale organizations buying directly from canners for chain stores, voluntary cooperative buying groups, and wholesaler-retailer teams.

The competitive nature of the canners market is being restructured with altered bargaining relations. Some canners have turned to integration and merger and to improved and varied product lines as a means of meeting new and prospective market structure developments.

In efforts to protect and enhance their position, many growers have turned to cooperative bargaining associations and cooperative canning and to marketing order programs—under state enabling legislation—to regulate grade, size, quality and volume marketed and to increase demand through promotion and advertising.

From grower to retailer, the fruit and vegetable canning business has undergone significant changes and further change is in prospect. New and different market structures and institutions, technological developments, modifications in consumer attitudes and preferences require the canning fruit and vegetable industry to be alert and progressive to achieve further growth and development.

Market Demand

A current problem is the expanding farm output of fruits and vegetables for processing, because of increases in acreage and in yield.

Technological improvements in the canning industry seem able to meet the pressure of the increasing raw product supply while introducing increased cannery case-yield per ton for some products. But break-even production capacities and break-even product prices are being edged upward because of external developments. Canners and growers operate between supply pressure and cost pressure, and unit-cost reducing technology is needed by both growers and canners.

The demand for processing fruits and vegetables is directly related to the demand on canners—at the f.o.b. level—for the canned product. There is a strong tendency for the season average price of the canned product—for the marketing year, on an industry-wide basis—to be related to certain economic-marketing influences: the quantity of canned product sold; the level of national disposable income; and the level of prices of competing products. The interaction of these influences is highly significant in determining the industry-wide seasonal average f.o.b. prices received by canners.

The uptrend in national income has tended to raise the f.o.b. demand for

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