

# Time Study of Plum Packaging

comparative study of labor requirements in packing plums in wooden crate and in experimental carton in test shipments

Dale G. Stallings, Ralph I. Crane, and L. L. Sammet

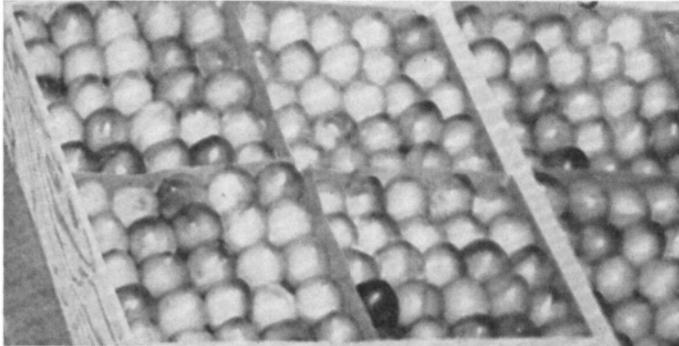


Photo by Edmund J. Pilz  
Completed pack with standard plum container. Wooden crate contains four split-wood baskets with three layers of fruit per basket.

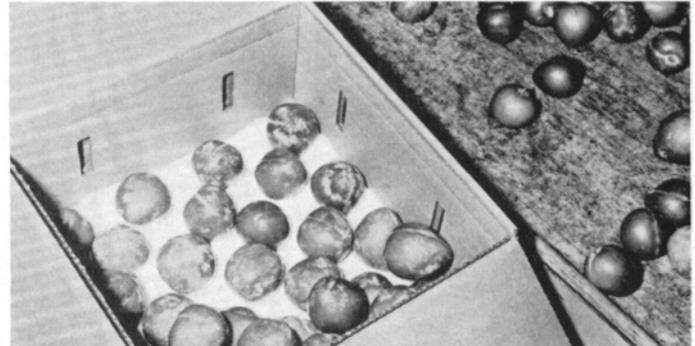


Photo by Rene Guillou  
Experimental carton with bottom layer of fruit. To complete the pack, two or more additional layers plus a top tray and facing layer were used.

**Plum packing** labor requirements with the standard 4-basket crate and corrugated paper carton were studied during the 1954 season.

The plum crate studied was the usual wooden container with inside dimensions approximately 16" x 16" and holding four split-wood baskets. Each basket takes three layers of plums. The number of plums per layer, the pattern of placement, and the height of the crate depend on the size of fruit packed. The layers of plums are separated by cardboard shims, and the top layer is usually enclosed in a cardboard collar. The net weight per package ranges from 26 to 33 pounds.

The second type of container studied was a corrugated paper carton approximately 13" x 13" x 6½" high. The fruit was place-packed in layers. The number of layers and number of fruit per layer depended on the size of fruit packed. Usually three or four layers of fruit were placed in each carton; then a cardboard tray and a top-facing layer of fruit were added. The net weights per carton ranged from 24 to 26 pounds and averaged about 25 pounds.

Several different types of test cartons were studied. The principal differences were in the methods of carton assembly and closing. Because the packing method was essentially the same—regardless of the type of carton used—no attempt was made to measure the effect of those differences on labor requirements.

The principal packing methods studied—with both crate and carton—required the packer to select individual fruits of desired size and to place-pack them in

the container. Two types of equipment were used; one required the selection of unsized fruit from a conveyor belt; with the second type, the fruit was passed over a rope sizer and delivered by size category to separate bins from which it was place-packed.

Comparisons of labor requirements with crates and cartons are based on time and production studies of the packing operations in 20 different packing houses. Those studies provide estimates of the labor required to perform various elements of the packing job, such as obtaining an empty box, putting it on the packing stand, selecting and placing fruit in the container, and placing shims. Measurements were also made of non-productive time.

In studies of individual lots of fruit, the packing labor required per package will vary with the average skill and pace of the packing crew, the variety and quality of fruit packed, the number of plums per package, the amount of miscellaneous work required—such as placing the baskets in the crates or placing pads in the cartons—the amount of non-productive time and type of packing equipment.

To compare packing labor requirements with the crate and the carton, it was necessary to take these factors into account.

Two adjustments in the observed data were necessary to make the estimates of labor requirements with the two types of containers comparable. A speed-rating procedure was used to account for differences in speed of motion and effort in packing the crate and the carton. To

adjust for differences in skill acquired through long experience in packing the standard crate in contrast with the unfamiliar carton, the studies were designed to show the rate of improvement as packer experience increased. Based on the relationships thus determined, the values for the select-and-place-fruit element shown in the table have been adjusted to 70% of the average observed time.

To adjust for the wide variation in number of plums per package, the labor required to select-and-place fruit was analyzed in terms of time per 100 plums, and the average times were used to estimate labor requirements with the same

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## CALIFORNIA AGRICULTURE

Progress Reports of Agricultural Research, published monthly by the University of California Division of Agricultural Sciences.

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## PLUM PACKING

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number of plums in the crate and carton. The analysis also indicated that size of fruit was the principal varietal difference which affects packing labor requirements. This makes it possible to compare labor requirements with a given number of plums per package without differentiating as to variety.

Labor requirements for the miscellaneous work elements with the different containers were partially standardized by using the same unit times with both containers for work elements having an exact counterpart in packing crates and cartons. Differences shown in labor required with different types of containers for the miscellaneous work elements thus can be attributed to variations in the miscellaneous jobs required with the different containers. The effect of nonproductive time was standardized by using the same allowance with both types of container.

It was necessary also to differentiate the estimates of labor requirements with respect to type of packing equipment used.

In those packing houses with bin-type equipment, the labor requirements for the select-and-place-fruit element of packing—either crate or carton—were only 75% as great as in packing from belt-type equipment. The tabulations on this page apply only to packing from belt-type equipment. Adjustments of the values in the table to the level applicable to packing from bin-type equipment would not significantly change the relative labor requirements for the crate and for the carton as given in the table.

The reasons for this difference in level of labor requirements with the two types of equipment were not shown by the studies, although it appears that much of the difference could be eliminated by adjustment in operating procedures.

The described procedure provides estimates of labor requirements with the two types of container under comparable conditions. The levels of labor requirements shown in the table are considered typical for the industry, although variation from these levels can be expected in different plants and with individual lots of fruit.

### Labor Requirements

The productive time requirements for the miscellaneous work elements are 0.86 minute per crate and 0.59 minute per carton. Thus, use of the carton would reduce labor requirements for this portion of the packing job by 0.27 minute per package. For the select-and-place-fruit element, the labor required with belt-type equipment to pack 176 plums

in the crate was 5.91 minutes in contrast with 5.67 minutes required for the carton. Typical nonproductive time requirements were estimated as 1.37 minutes per container.

Combining the estimates of labor used in the miscellaneous, select-and-place-fruit, and nonproductive elements, the total time required per container in packing from belt-type equipment was 8.14 minutes with the crate and 7.63 minutes with the carton. The difference in total time is 0.51 minute per container, a saving with the carton of about 6% of the labor required with the crate.

A possible modification in packing the carton would be to omit the top tray which would eliminate the time required to place the tray and would result in a slightly lower average time requirement for the select-and-place-fruit element. Consequently, packing labor requirements with the carton would average about 12% less than with the crate.

An additional consideration is the effect of size of container. Because of their smaller capacity net weight, approximately 15% more cartons than crates would be required to pack a given quantity of fruit. This would mean an adjustment of the estimates of unit times for the miscellaneous and nonproductive elements in packing the carton. The amount of adjustment, however, would be small and would not alter the general indications of the data in the table.

### Other Filling Methods

Two alternatives to the generally used place-packing procedures were considered. One system uses a bulk method whereby the fruit rolls freely from a conveyor belt or bin into the container. Although no observations of plum packing with this method were made, studies of packaging cannery fruit in apple and pear packing houses indicate the bulk method might reduce plum-packing labor requirements to about one minute per package. Compared with place-packing 176 plums per package, this method could reduce direct packing labor requirements by about 85%.

A second alternative method is the so-called upside-down pack which uses the Brentwood lug—slightly smaller in dimension than the standard plum crate and containing about 25 pounds net weight. The lug is assembled with the top, rather than the bottom, in place. One layer of plums is place-packed in a pattern against the lid. The packer fills the remainder of the lug in a jumble fashion by transferring fruit by hand from a belt or bin. After the bottom is nailed on, the lug is turned right side up. This method involves relatively little place-packing and provides an orderly arrangement of the top layer of fruit

### The Effect of Type of Container on Labor Requirements for Place-Packing Plums from Belt-Type Equipment, California, 1954\*

Element	Type of container packed	
	Stand-ard crate	Test carton
minutes per package		
<b>Productive time</b>		
<b>Miscellaneous elements**</b>		
Get box, mark, place on stand . . . . .	.19	.19
Place 4 baskets . . . . .	.13	
Place 8 shims . . . . .	.20	
Place 4 collars . . . . .	.23	
Place 1 pad . . . . .		.11
Place 1 tray . . . . .		.18
Transfer box to conveyor . . . . .	.11	.11
Subtotal . . . . .	.86	.59
Select and place fruit . . . . .	5.91	5.67
<b>Nonproductive time</b>		
Change lots . . . . .	.55	.55
Rest periods . . . . .	.32	.32
Miscellaneous . . . . .	.50	.50
Subtotal . . . . .	1.37	1.37
Total . . . . .	8.14	7.63

\* Labor requirements per package are based on place-packing 176 plums per package. Unit times for a different number of plums per package can be estimated by recalculating the times for the select-and-place-fruit element, using the following rates: standard crate, 3.36 minutes per 100 plums; test carton, 3.22 minutes per 100 plums. Other element times would remain unchanged.

\*\* Some variation in the miscellaneous operations in packing the wooden crate was observed. In some plants, the wooden baskets were placed by the crate-supply crew, and some plants used a paper liner in addition to the wooden baskets and shims.

when the lid is removed for inspection. On the basis of a limited sample, the labor requirements with this method are estimated as about 4.25 minutes per lug, roughly one half that required in packing 176 plums in the 4-basket crate. This figure would vary in different plants, particularly in relation to the care used to size the jumble-packed fruit.

Several questions—in addition to the effect on labor requirements—must be considered when choosing a type of plum container: the possible differences in market acceptance; the quality of fruit on arrival in the market; and the costs of packing materials, equipment, and labor. These other phases are to be given continuing study.

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Ralph I. Crane was Research Assistant in Agricultural Economics, University of California, Berkeley, when these studies were made.

This report is based on co-operative studies made by the University of California, Agricultural Experiment Station, the Agricultural Marketing Service, U. S. Department of Agriculture. The studies were made in conjunction with test shipments organized by Edmund J. Pilz of the California Grape and Tree Fruit League.