

SLIPSHEET HANDLING OF CALIFORNIA NECTARINES AND CANTALOUPE

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INTRODUCTION

During the past 10 years, the number of unitized shipments of fresh fruits and vegetables has been increasing. Approximately 53 percent of the produce shipped from California in 1976 was unitized on disposable wooden pallets.² Some items, such as tree fruit, grapes, strawberries, melons, and tomatoes, are 100-percent palletized, whereas other items, such as lettuce, potatoes, or mixed vegetables, are seldom palletized.

The increase in the use of disposable wooden pallets for shipping fruits and vegetables has created problems for shippers, truckers, and receivers. Approximately one million disposable wooden pallets are shipped from California each year for peaches, plums, nectarines, and cantaloupes.³ The problems encountered are increasing pallet costs, disposal of solid wastes created by the one-way pallets in metropolitan areas, increased weight in transport vehicles, added storage space required, and injury to personnel from damaged pallets. Our research was directed to slipsheets as an alternative method for unitized handling of fresh produce that would retain the advantages of palletization. These advantages are:⁴

- . Shipments are secured, resulting in less damage in transit.
- . Less loading and unloading time are required.
- . Fewer laborers are needed by shippers and receivers.

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²Focus 76-77, Annual Review and Outlook. The Packer, 300 West Adams Street, Chicago. 81 p. January 1977.

³Anonymous. Marketing California peaches, nectarines, plums and melons. Federal-State Market News Service, U.S. Department of Agriculture, Agricultural Marketing Service, Market News Branch. 1979.

⁴Anthony, Joseph P., and Rebentsch, Joseph A. An evaluation of various types of disposable pallets for handling and transporting Florida citrus. U.S. Department of Agriculture, Agricultural Research Service, ARS 52-43, 10 p. 1970.

- Better utilization of warehouse space and loading dock spaces is possible.
- Quicker and simpler inventory procedures are possible.
- Less overall handling of individual packages is required, resulting in less bruising of commodities.

As defined by Hinsch, and cited by Anderson and Hammons,⁵ "A slipsheet is a thin piece of material, such as corrugated fiberboard, solid fiberboard, or plastic sheet that is used with a specially equipped forklift truck to move unitized loads (fig. 1). The forklift truck is equipped with wide platens to carry the load and a pull and push attachment to grip and move the slipsheet load on the platens."

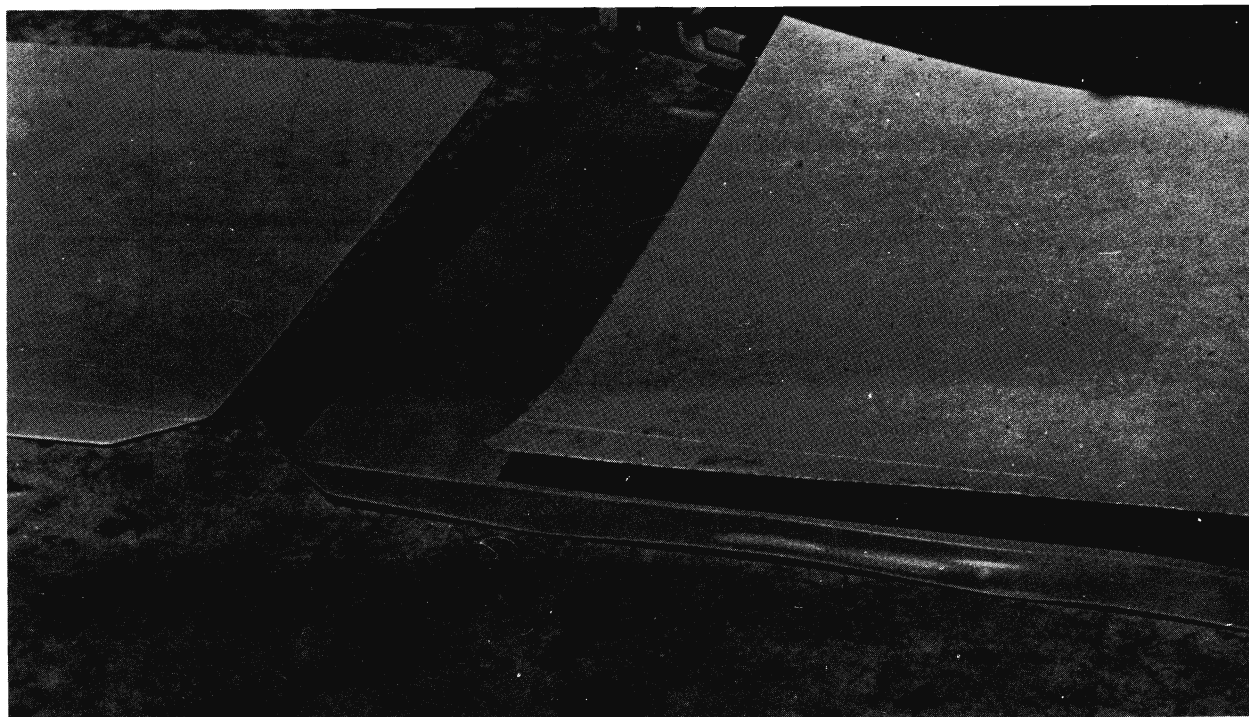


Figure 1.--Two types of slipsheet material (plastic and solid fiberboard) with pull tabs for one- or two-way entry.

Slipsheets are used in the grocery industry but are limited to shipments in railcars, which can withstand the heavy weight and size of push-pull attachments on the forklift trucks. Florida citrus shippers have used slipsheets for loading because of their convenience, but receivers have unloaded the citrus by

⁵Anderson, M. E., and Hammons, D. R. An overview of pallet standardization in the food industry. American Society of Agricultural Engineers Annual Meeting, Paper No. 77-6004. North Carolina State University, June 1977.

hand.⁶ More compact and lightweight forklift trucks and push-pull attachments are now available, which will allow trucks to be loaded and unloaded.

The purpose of this research was to determine if tree fruit and cantaloupes could be unitized on slipsheets (with slight modification of current handling practices), and to compare the effects of slipsheets and wooden pallets on transit temperatures, container damage, and product quality. Observations were made on the operation of equipment handling slipsheets in packinghouses and receiving warehouses. Two types of slipsheets were studied for unitizing tree fruit.

PROCEDURE

Nectarines

Three paired shipping tests, two pairs by truck and one pair by piggyback trailer, were conducted with nectarines shipped from Fresno, Calif., to Chicago, Ill.

One load of nectarines in each pair consisted of two-layer, place-packed, Bliss-style, corrugated fiberboard boxes,⁷ with inside dimensions of 13-1/2 by 16-1/2 by 5-3/4 inches unitized in a 2 by 3 pattern, 11 high, on a 35- by 42-inch slipsheet with a 3-inch pulltab. Glue was placed on the slipsheet and between each layer. The second load consisted of the same type boxes unitized on 35- by 42-inch disposable wooden pallets.

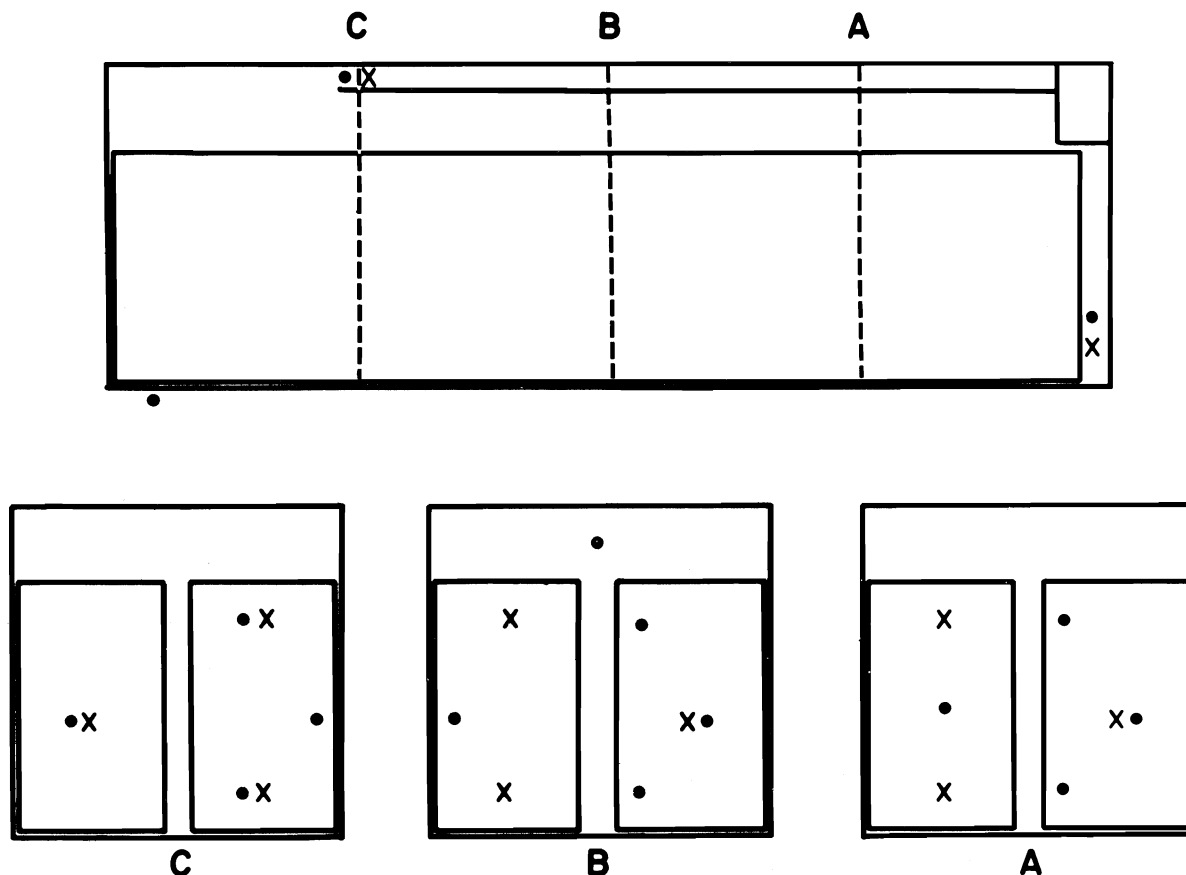
The slipsheets tested were 30-mil-thick (lightweight), 40-mil-thick (mediumweight) or 50-mil-thick (heavyweight) polypropylene sheets or four ply 90-mil-thick solid fiberboard sheets. In addition, in one slipsheet load, 6 units were strapped with one horizontal band and 19 units were strapped with two horizontal bands and four corner boards for comparison.

Transit recording thermometers, placed inside boxes to monitor the temperature of the air that surrounded the fruit during transport, were located in the top, middle, and bottom layers in two paired tests and in the top and bottom layers in one paired test. The units with recording thermometers were located in the one-quarter, one-half, and three-quarters length of the transport vehicle. Recorders also were placed in the discharge air and return air duct of the refrigeration system in each vehicle (fig. 2). Fruit pulp temperature was taken with a thermister at the time of loading and again at unloading at the receiver's warehouse.

On arrival, the condition and appearance of the boxes and the slipsheet and pallet units were recorded. Observations were made of the handling of the

⁶Miller, W. R., Risse, L. A., Hillebrand, B. M., Moffit, T., and Black, W. R. Unitized versus hand loading of van containers for exporting Florida grapefruit. U.S. Department of Agriculture, Marketing Research Report No. 1068, 13 p. 1977.

⁷Anonymous. Fiber box handbook. Fiber Box Association, Chicago, 104 p. 1976.



FRONTAL VIEW OF CROSS SECTIONS

X RECORDING THERMOMETER

• MULTIPOINT RECORDING THERMOMETER

Figure 2.--Location of recording thermometers in truck for transit test: A, one-quarter length; B, one-half length; and C, three-quarters length.

various types of slipsheets and strapping method. Box damage was rated as: slight - does not affect usability; moderate - affects usability and appearance; serious - not usable (must be repacked). Observations also were made on arrival of two additional loads shipped on slipsheets.

Six sample boxes of nectarines from the same lot were included in each shipment for quality evaluation on arrival. Sample boxes were placed in the top, middle, and bottom layers of the loads (in both slipsheet and wooden pallet units in the one-quarter length and three-quarters length of the transport vehicle). Fruit was evaluated for bruising, cuts, stem punctures, and decay after holding 3 days at 68°F. Ratings for bruising injury were: slight, more than 3/4 inch, but less than 1 inch in diameter (does not reduce salability); moderate, more than 1 inch but less than 1-1/4 inches in diameter (might reduce salability); serious, more than 1-1/4 inches in diameter (reduced salability).

Cantaloupes

A paired shipment of cantaloupes was made from Los Banos, Calif., to Chicago by refrigerated trailer. Both trailers were loaded with 924 one-half cartons stacked on 22 units. One load was on disposable wooden pallets that measured 35 by 43 inches, while the second load was on 50-mil, polypropylene slipsheets that measured 35 by 42 inches. Each slipsheet had one, 3-inch pull tab on one of the 42-inch sides. Six boxes were stacked in each layer, and seven layers were placed on the pallets and slipsheets. Glue was placed on the slipsheets before placing the first layer of boxes. A multipoint recording thermometer was placed in each trailer to monitor the temperature of the cantaloupes. The thermocouples were inserted into the flesh of the melon. Thermocouples also were located in the discharge air and return air during transit (fig. 2).

Fifteen cantaloupes were packed in each of the boxes, which were of the regular slotted-container design.⁸ The boxes were wax coated and had outside dimensions of 17 inches long by 14-3/8 inches wide by 11 inches deep. Ice was placed in each box after packing to facilitate cooling of the cantaloupes.

RESULTS

Transit Temperatures

Nectarines

Table 1 shows the average pulp temperature of nectarines at time of loading and at unloading; the high, low, and average temperature during transit; and the average discharge air temperature for three paired shipments of nectarines on slipsheets or wooden pallets.

No major differences in transit temperatures of the two kinds of loads were detected during the paired test shipments of nectarines. The most important factor in determining transit temperatures and arrival pulp temperatures of the nectarines was the performance of the refrigeration unit in the truck.

Average transit temperatures in paired shipment No. 1 were based on recording thermometers (fig. 3). The paired shipment was transported by truck from Fresno to Chicago. The slipsheet loads averaged 43°F during the trip; pulp temperature at time of loading averaged 38°. The wooden pallet loads averaged 44° during the trip; pulp temperature at the time of loading averaged 41°. On arrival, the average pulp temperature was 43° in the slipsheet load and 41° in the wooden pallet load. During transit, the air discharge temperature in the truck with wooden pallets was below 30°, but no freezing damage occurred.

The average transit temperatures in paired shipment No. 2 were based on recording thermometers (fig. 4). These nectarines were shipped via piggyback

⁸See footnote 7, p. 3.

Table 1.--Average pulp temperatures of nectarine at time of loading and at unloading; high, average, and low transit temperature; and discharge air temperature for the paired shipment by type of load and shipment number

Type of load	Paired shipment	Average discharge air	Temperature at loading	Transit temperature ¹			Temperature at unloading
				High	Average	Low	
	No.	°F	°F	°F	°F	°F	°F
Slipsheet	1	39	38	48	43	40	43
	2	36	37	41	38	36	39
	3	32	38	40	37	31	40
Wooden pallet	1	35	41	50	44	38	41
	2	43	42	43	40	37	49
	3	32	38	36	34	31	39

¹Highest and lowest temperature recorded regardless of position in load.

trailers from Fresno to Chicago. The average temperature of the slipsheet load was 38°F during the trip, and the average temperature of the wooden pallet load was 40°. The pulp temperatures of both shipments at time of loading averaged 42°. On arrival, the pulp temperature of the nectarines shipped on slipsheets was 39° and of those on wooden pallets was 49°. The high product temperature on arrival was due to poor truck discharge air temperature, 48° for 16 hours.

The average transit temperatures of paired shipment No. 3 were based on recording thermometers (fig. 5). This paired shipment was transported by truck from Fresno to Chicago. The average transit temperatures of the slipsheet load was 37°F during the trip; the product temperature at time of loading averaged 38°. The average temperature of the wooden pallet load was 34°; the product temperature at time of loading also averaged 38°. The wide range in temperature for slipsheet loads is related to the fluctuation in temperature of the discharge air from the refrigeration units; this temperature ranged from a high of 36° to a low of 28° and averaged 32° during the trip. In contrast, the truck discharge temperature in the wooden pallet load ranged between 31° and 33° and averaged 32°, which maintained proper fruit temperatures.

Cantaloupes

Average pulp temperatures and discharge air temperatures in truck shipments of cantaloupes on slipsheets or wooden pallets were recorded (using a multipoint recording thermometer) from Los Banos to Chicago (fig. 6). The average pulp temperature of melons on slipsheets ranged from 41° to 44°F during the trip; the product temperature at time of loading averaged 43° and on arrival, after 72 hours transit, averaged 46°.

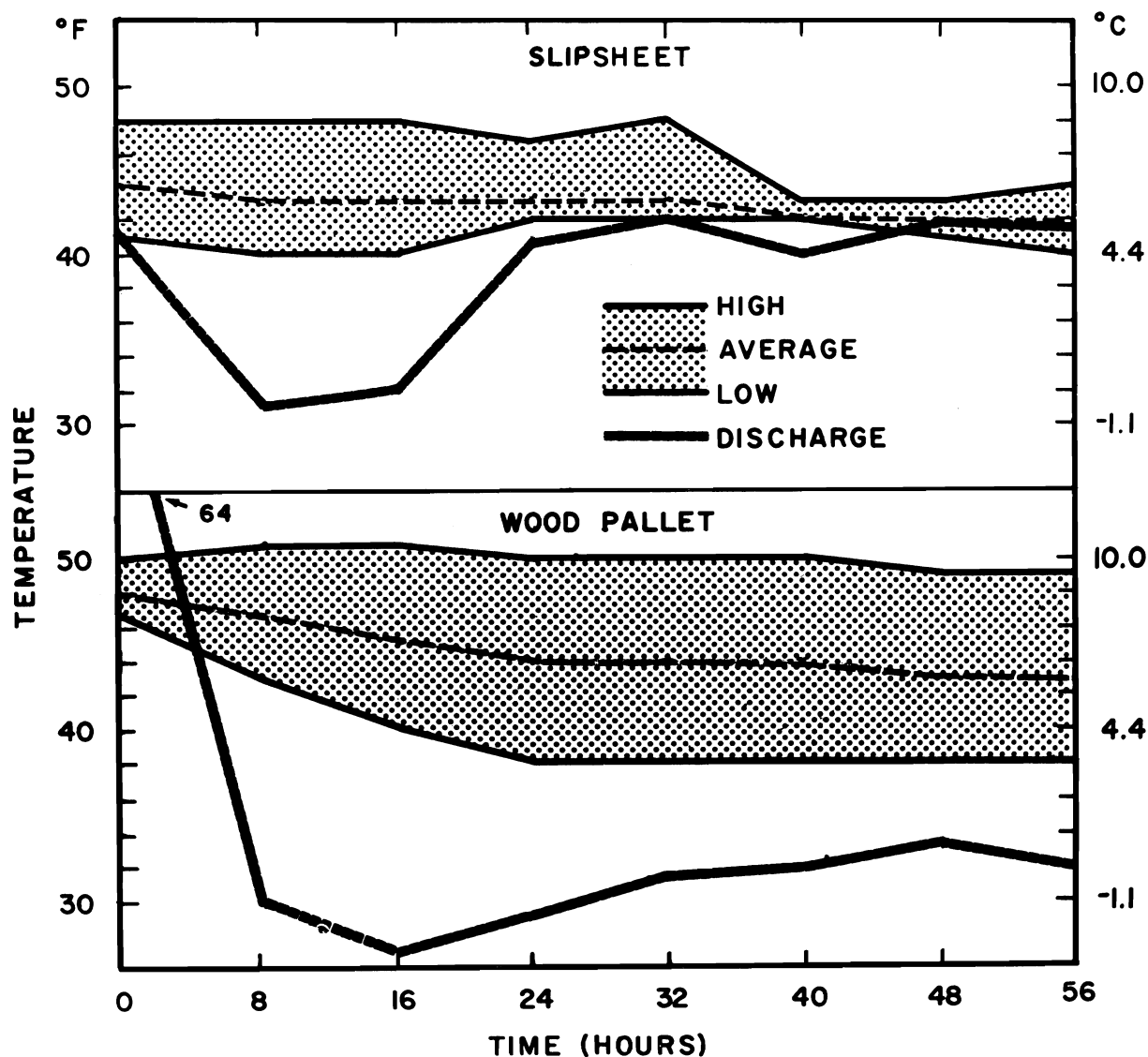


Figure 3.--Average transit temperatures of paired shipment No. 1 in which nectarines were unitized on slipsheets or wooden pallets and transported by truck.

The high and low transit temperatures ranged from 48° to 39°F. The average pulp temperature of cantaloupes shipped on wooden pallets ranged from 41° to 46° during transit. At time of unloading, the pulp temperature averaged 43°. The overall temperatures in the wooden pallet load were higher than those in the slipsheet load because the truck refrigeration system was not operating during part of the transit time.

Container Damage, Product Condition, and Slipsheet Performance

Observations of 6,342 boxes of nectarines shipped on slipsheets showed that about 0.75 percent of the boxes had some damage on arrival, whereas about

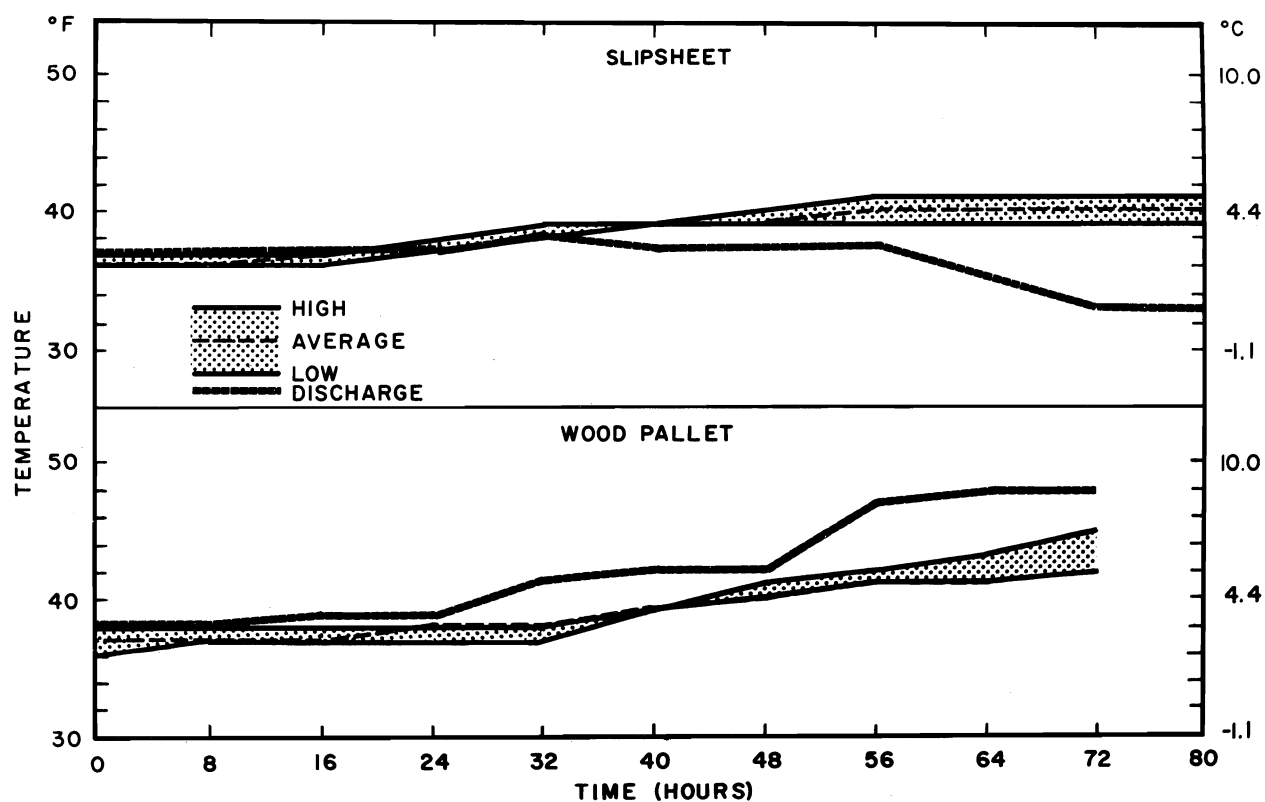


Figure 4.--Average transit temperatures of paired shipment No. 2 in which nectarines were unitized on slipsheets or wooden pallets and transported by piggyback trailer.

0.25 percent of boxes shipped on wooden pallets were damaged. Of the 940 boxes of cantaloupes shipped on slipsheets and wooden pallets, no damage occurred to the boxes. That damage which did occur to nectarine boxes on slipsheets was caused mostly by inexperienced operators at both shipping and receiving points. In addition, the grabber bar on the push-pull attachment caused slight creasing of the lower layer of boxes when it was not in the proper position (fig. 7). Damage to nectarine boxes on wooden pallets occurred when the boxes hung over the edge of the wooden pallet and the bottom layer became creased. In addition, if the boxes were not stacked on the stacking tabs, the bottom of the top box depressed the top of the box in the next layer below it.

The two types of slipsheet material, solid fiberboard and polypropylene, performed about the same in the nectarine test shipments. Only a heavyweight (50-mil) polypropylene sheet was used for the cantaloupe test due to the high moisture conditions resulting from the ice packed in the boxes. Minor rips to the fiberboard and polypropylene occurred when the grabber bar on the machine was not properly placed across the lip of the slipsheet. The heavyweight and mediumweight (40-mil) polypropylene and the solid fiberboard slipsheets performed equally well; however, two of the lightweight (30-mil) polypropylene sheets tore at the tab when we attempted to remove the loaded sheets from the

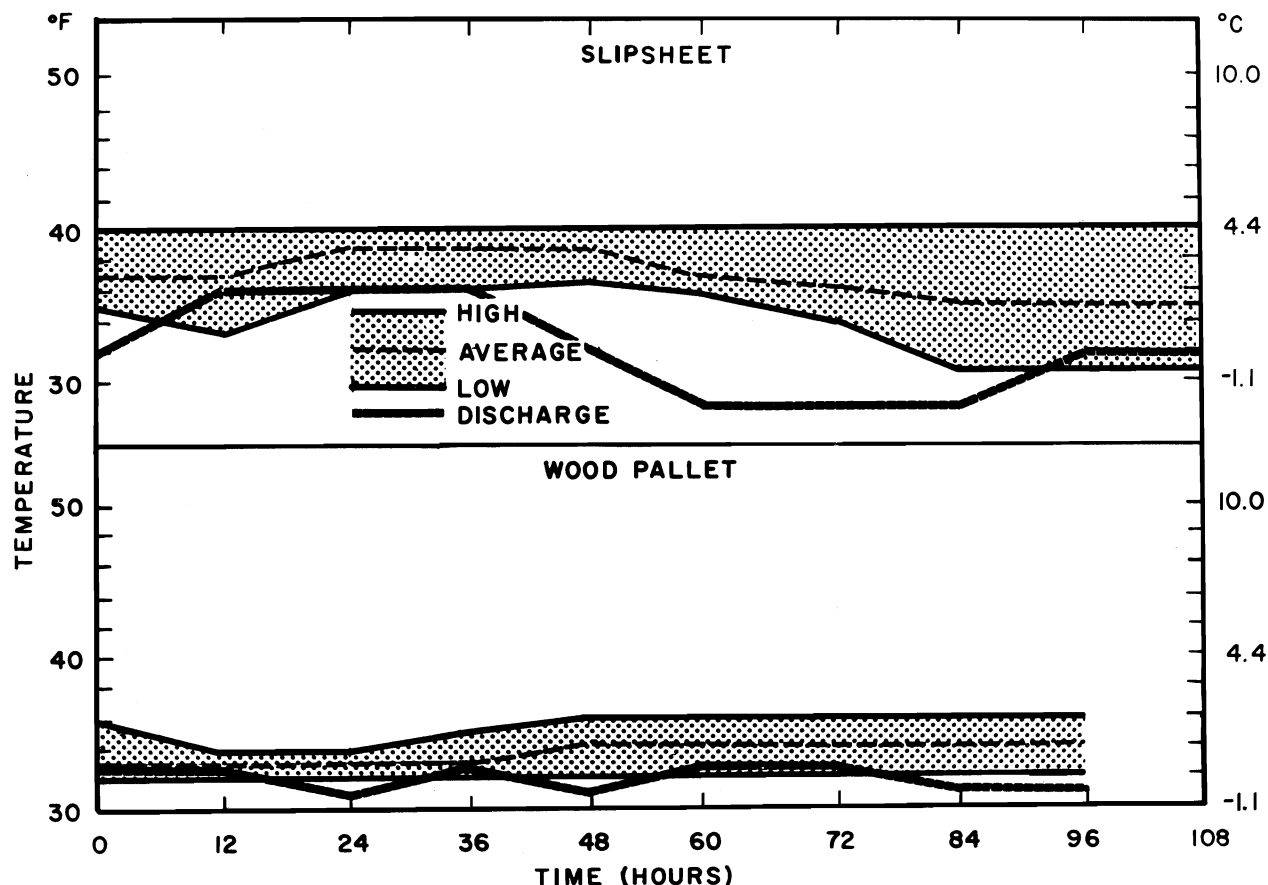


Figure 5.--Average transit temperature of paired shipment No. 3 in which nectarines were unitized on slipsheets or wooden pallets and transported by truck.

vehicle. The platens had to be chiseled under the load (fig. 8) in order to remove it.

No differences were observed between the nectarine boxes on slipsheets that were strapped with two horizontal bands and four corner boards and those strapped with only one horizontal band (fig. 9).

The cantaloupes on slipsheets were strapped with two horizontal bands. The glue used on the slipsheets to hold the bottom layer of boxes was ineffective due to the wax coating of the boxes and water from the melting ice packed in the boxes; however, the glue failure did not affect the stability of the unit when it was loaded or unloaded (fig. 10).

No differences in product condition, bruising, or mechanical damage were detected in nectarines or cantaloupes unitized on slipsheets versus wooden pallets. Samples of 400 fruit each were taken from unitized loads on wooden pallets and on slipsheets after arrival in Chicago. The type and degree of injury after holding the nectarines for 3 days at 68°F were as follows:

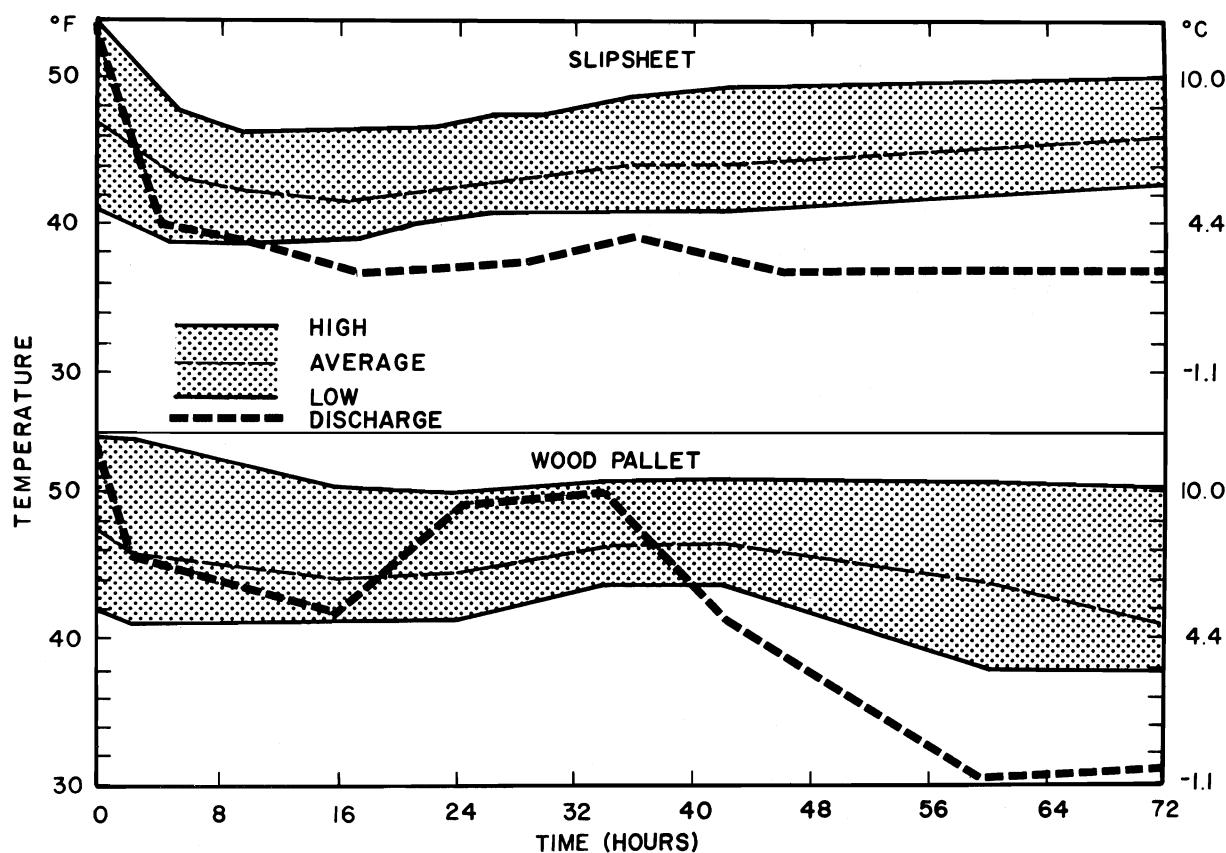


Figure 6.--Average transit temperature of cantaloupes unitized on slipsheets or wooden pallets.

Type and degree of injury	Wooden pallets Percent	Slipsheets Percent
Bruised: ¹		
Slight.....	5	7
Moderate.....	4	3
Serious.....	3	2
Total...	<u>12</u>	<u>12</u>
Cuts.....	6	8
Punctures.....	15	18
Decay.....	5	3

¹Bruised: slight, more than 3/4 inch but less than 1 inch in diameter; moderate, more than 1 inch but less than 1-1/4 in diameter; serious, more than 1-1/4 inches in diameter.

Slipsheet Handling

The conversion from unitizing nectarines or cantaloupes on disposable wooden pallets to unitizing these products on slipsheets can be made at shipping point with slight modification of current handling practices.

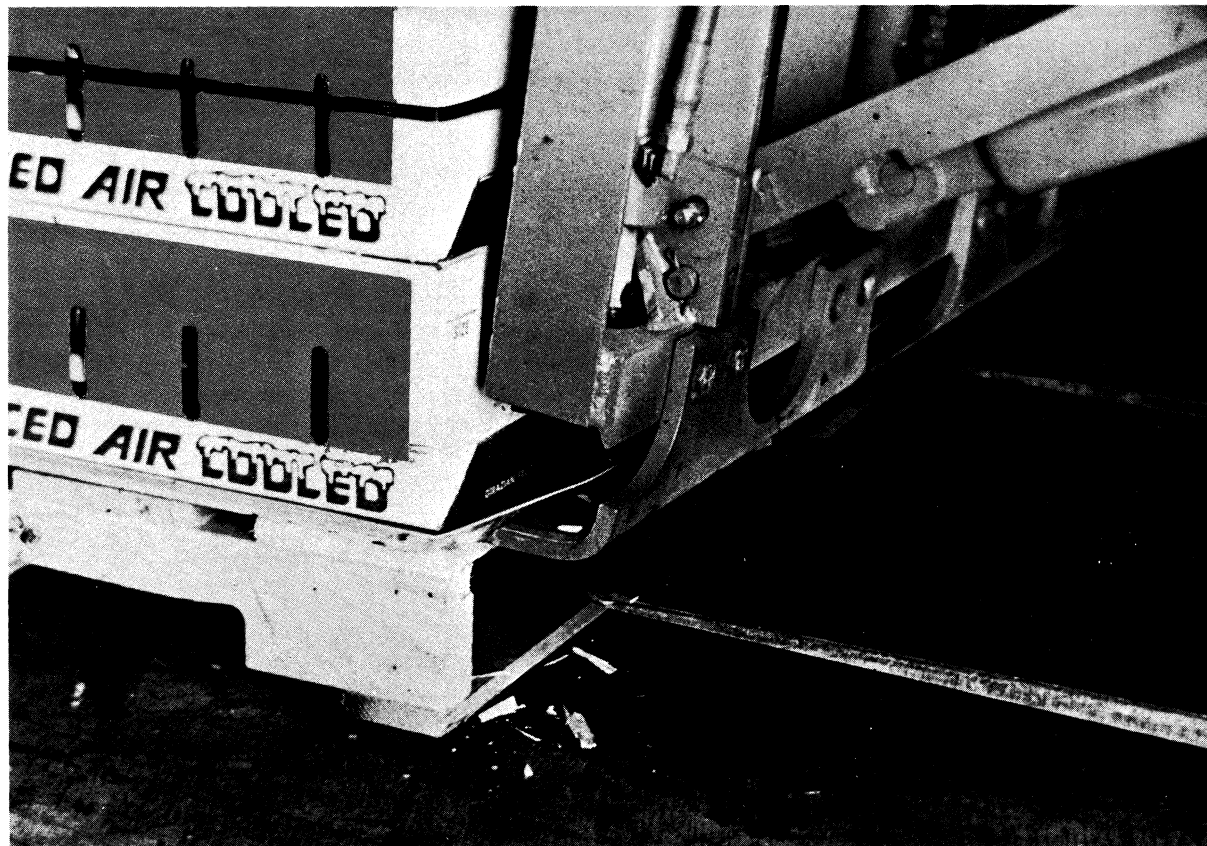


Figure 7.--Improper angle of push-pull grabber bar may cause creasing of bottom layer boxes.

For the shipper, the major investment would be a special push-pull attachment for his forklift truck and a transfer device, which would enable him to unitize on wooden pallets, but to switch from the pallets to slipsheets when an order is received that specifies delivery on slipsheets. The transfer device could be located next to the truck loading dock (fig. 11). Shipping containers can also be unitized directly on slipsheets off the existing packing lines without any modification or investment in additional equipment (fig. 12) if the sheet is placed on top of the pallet. The unitized boxes stacked on the sheet with pallet can be moved into cold storage as is the current practice. In packing sheds that have automatic palletizers, the slipsheets can be inserted automatically (fig. 13).

At the receiving warehouse, the conversion to slipsheet handling of produce can be accomplished without modification of the current palletized handling system; however, a special push-pull attachment would be required on forklift trucks to remove the slipsheet load from the truck and place it on the 40- by 48-inch warehouse pallet. In some warehouses, personnel remove the 35- by 42-inch disposable wooden pallet units from the truck with a forklift truck and place them on the 40- by 48-inch warehouse pallet. The conversion to slipsheets, therefore, would not require extra handling at the receiving warehouse. Less storage space in the warehouse racks would be required for the slipsheets because they eliminate the 6-inch height of the 35- by 42-inch wooden pallet

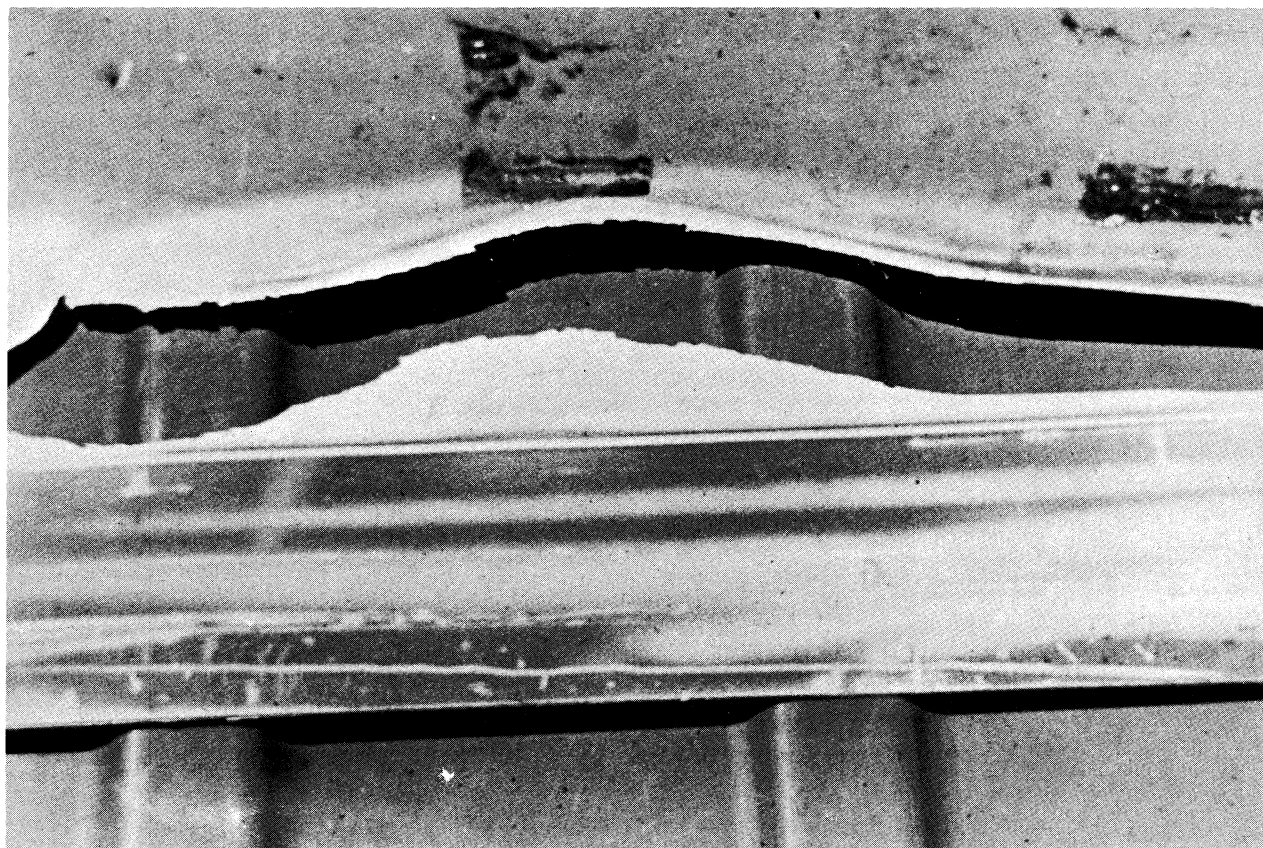


Figure 8.--Failure of the lightweight (30-mil) slipsheets during unloading.

stacked on the warehouse pallet (fig. 14). In receiving warehouse operations that require the truck driver to unload, a pallet jack with a push-pull unit would be needed.

DISCUSSION

The increase in the use of disposable wooden pallets for shipping fruits and vegetables has created problems for shippers, truckers, and receivers. The problems encountered are: increasing pallet costs, disposal of solid wastes created by the one-way pallets in metropolitan areas, increased weight in transport vehicles, added storage space required, and injury to personnel from damaged pallets. Slipsheet handling of fresh fruits and vegetables could reduce some of these problems.

California melons and tree fruit (peaches, nectarines, and plums) packed in corrugated fiberboard boxes can be unitized on slipsheets with slight modification of current handling procedures at shipping point and at receiving point.

In eight test shipments, no consistent differences were detected between unitizing and shipping on slipsheets or on disposable wooden pallets. Product



Figure 9.--Arrival of unitized load on slipsheets with two horizontal straps and corner boards (right) and only one horizontal strap (left).

temperatures during transit and product quality or container damage on arrival at receiving warehouses were about the same for both methods of unitizing.

Conversion to slipsheet handling requires thorough training of forklift truck operators in the use of the push-pull attachments. Trained, experienced operators can load and unload slipsheets as quickly and with as few problems as they can load and unload wooden pallets.

The selection of the type of material for the slipsheets depends on the environment in which the sheet will be used. In high humidity or wet conditions, such as occur in top-iced loads, a very moisture resistant material should be used.

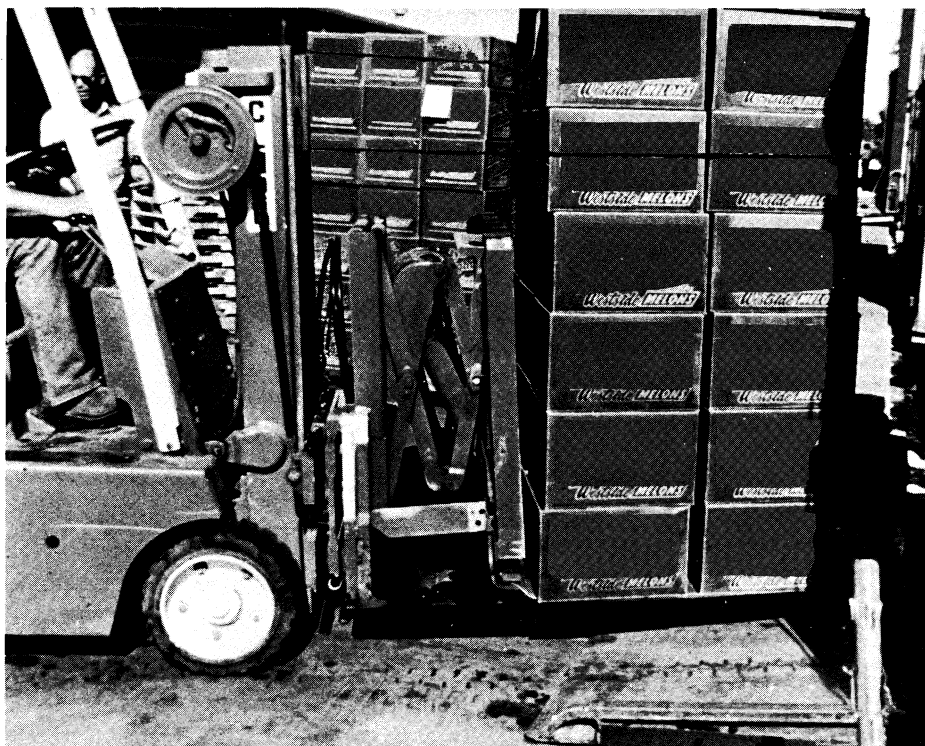


Figure 10.--Cantaloupes unitized on slipsheet with two horizontal straps being loaded in truck.

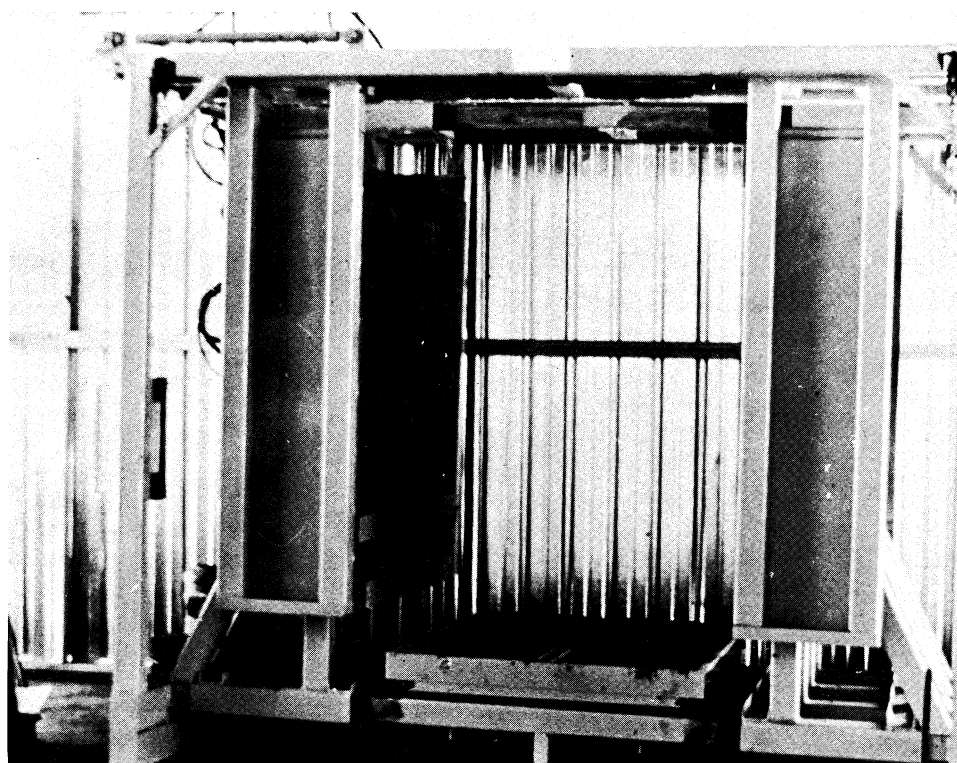


Figure 11.--Mechanical device for transferring unitized loads from wooden pallets to slipsheets before loading truck.

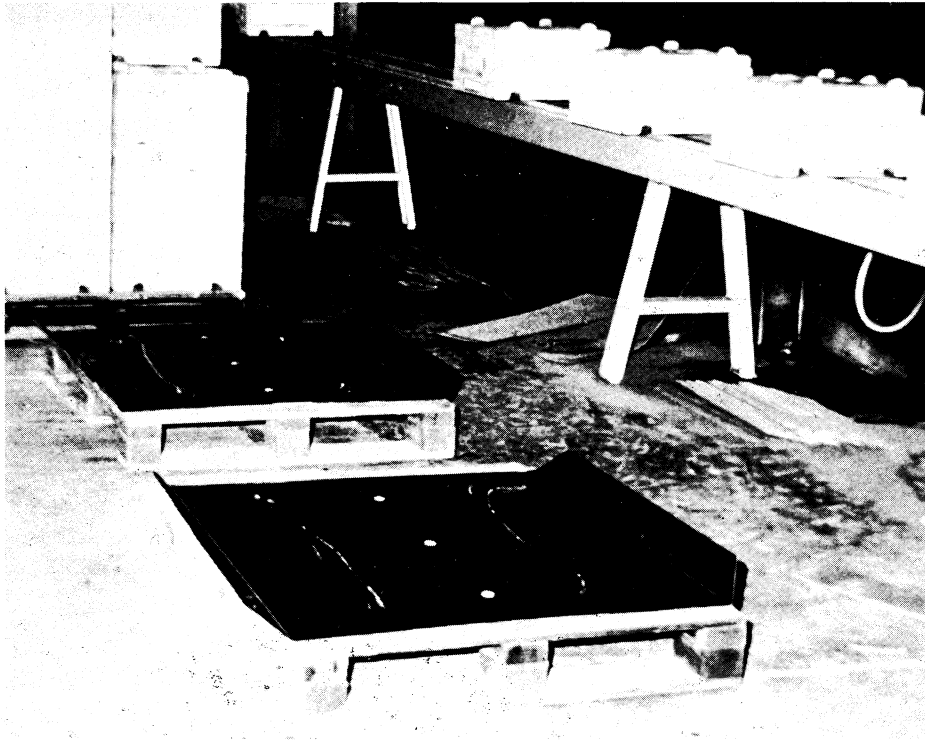


Figure 12.--Unitizing boxes on slipsheets off packing line conveyor.

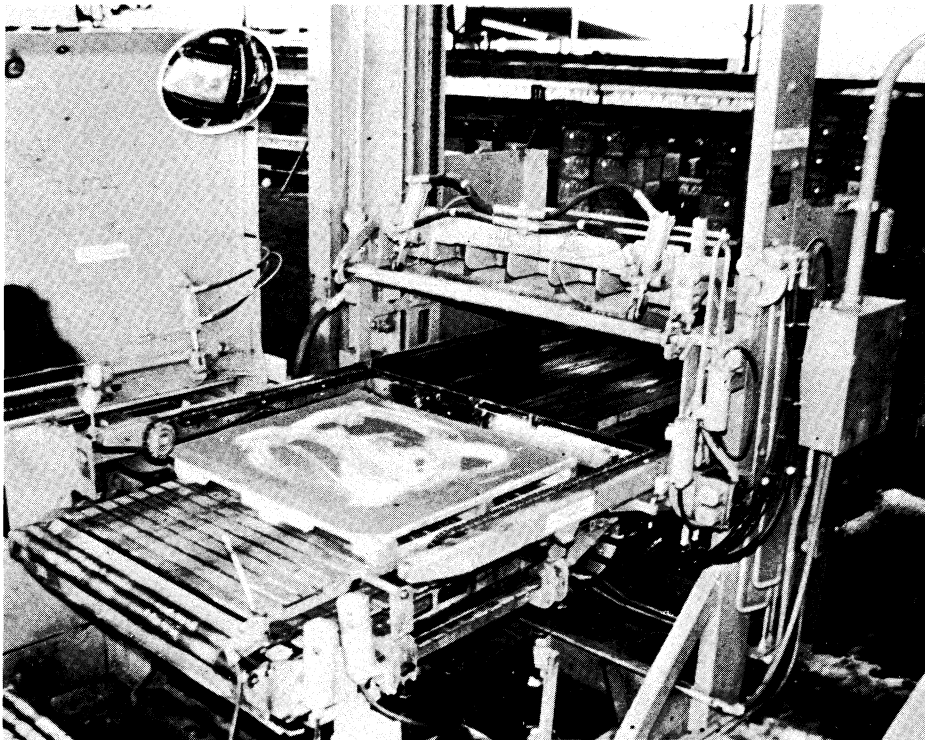


Figure 13.--Slipsheet on wooden pallet in automatic palletizing unit ready for first layer of cantaloupe boxes.

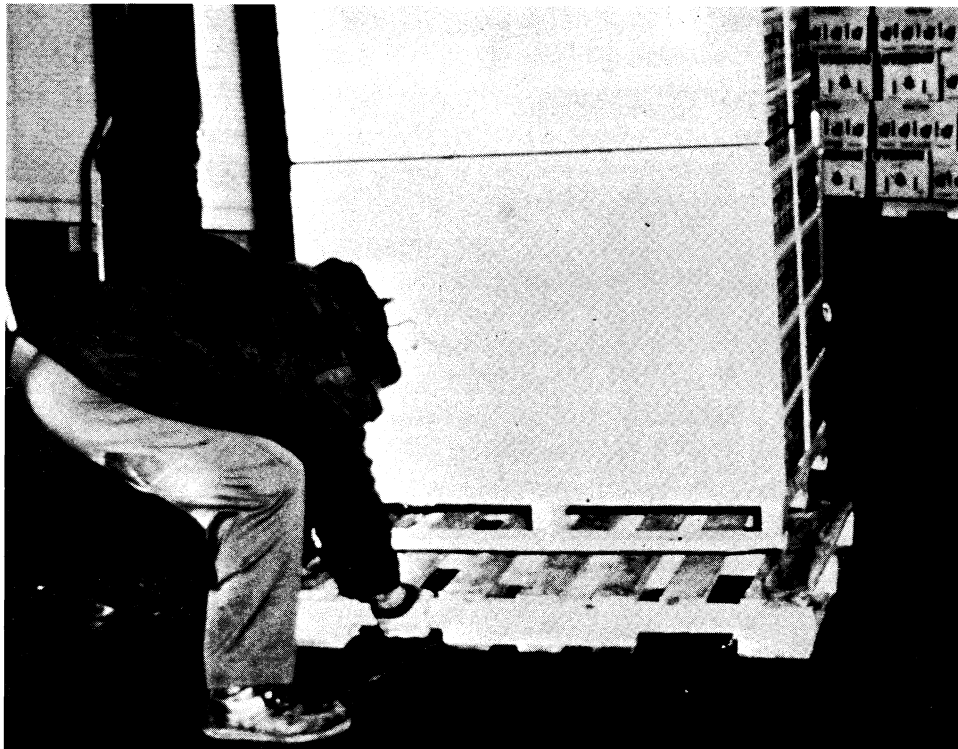


Figure 14.--Placing a 35- by 42-inch wooden pallet on top of a 40- by 48-inch warehouse pallet at the receiver's warehouse.

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