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COOPERATORS' REPORT
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RESEARCH REPORT TO CALIFORNIA TREE FRUIT AGREEMENT

PERFORMANCE OF SLIP SHEETS FOR HANDLING OF STONE FRUIT

OBJECTIVES

To test the feasibility of handling western tree fruit using disposable slip sheets compared to disposable wooden pallets and its effects on container damage, fruit quality and transit temperatures.

BACKGROUND

About 53% of the fruits and vegetables shipped from California in 1977 were unitized on disposable wooden pallets. All tree fruits and grapes are shipped on wooden pallets. The standard size of pallets currently used for tree fruits (peaches, plums, and nectarines) is 42 inches by 35 inches.

The increasing cost of disposable wooden pallets and the continuing problem of solid-waste disposal for receivers in large metropolitan areas requires that research be conducted to determine the feasibility of unitizing tree fruits on slip sheets as an alternative to pallets.

In addition to determining the effects of slip sheet handling on transit temperature, container damage, and product quality, observations were made on the operation of equipment handling slip sheets in packing houses and receiving warehouses. Various types of slip sheets also were studied. During the 1978 season, tests were conducted to compare full loads of fruit on slip sheets and on wooden pallets.

PROCEDURE

Three paired-shipping tests, two pairs by truck and one pair by piggy-back trailer, were conducted with nectarines shipped from Fresno, California to Chicago, Illinois.

Each pair consisted of one load of nectarines in two-layer, place-packed, Bliss-style, fiberboard boxes unitized on slip sheets and a second load unitized on disposable wooden pallets. Observations were made on arrival of two additional loads of plums and nectarines shipped on slip sheets.

The dimensions of the slip sheets and wooden pallets were 35 by 42 inches. The slip sheets were 30 mil thick (lightweight), 40 mil thick (mediumweight) or 50 mil thick (heavyweight) polypropylene sheets or solid fiberboard sheets, 4 ply 90 mil thick. In addition, in one slip sheet test, 6 units were strapped with one horizontal band and 19 units were strapped with 2 horizontal bands and 4 corner boards for comparison.

Six sample boxes of fruit from the same lot were included in each of the pairs in each shipment for quality evaluation on arrival. Sample boxes were placed in the top, middle, and bottom layers of the loads (in both slip sheet and wooden pallet units in the 1/4 length and 3/4 length of the transport vehicle) (Fig. 1). Fruit was evaluated for bruising, cuts, stem punctures, and decay on arrival and after holding 3 days at 68°F (20°C). 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 (reduces salability).

Recording thermometers were placed inside boxes 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 hte 1/4, 1/2 and 3/4 length of the transport vehicle to monitor the temperature of the air that surrounded the fruit during transit. Recorders were also placed in the discharge air and return air duct of the refrigeration system in each vehicle (Fig. 1).

On arrival, the condition and appearance of the boxes and the slip sheet and pallet units were recorded. Observations were made of the handling of the various types of slip sheets and strapping method. Box damage was rated as: slight - does not affect usability; moderate - affects usability and appearance; serious - not usable (must be recoopered).

RESULTS

Container damage and slip sheet performance. Based on observation of 6,342 boxes shipped on slip sheets, about 1.0 percent of the boxes had some damage, on arrival, whereas boxes shipped on wooden pallets had about 0.25 percent damage. The severity of damage to containers shipped on slip sheets was as follows: slight - .15 percent; moderate - 0.2 percent; serious - 0.3 percent (Fig. 2). Most damage was caused by inexperienced operators, at both shipping and receiving points. Some boxes were damaged by the load bracing-strap hook which was left in position when the units were removed from the truck (Fig. 3). No damage occurred to boxes when experienced slip sheet operators unloaded the vehicles. The grabber bar on the push-pull attachment caused slight creasing of the lower layer of

boxes when not in proper position (Fig. 4 and 5). The severity of damage to containers shipped on wooden pallets was as follows: slight - 0.2 percent; moderate - 0.04 percent; serious - 0.01 percent. Most damage was caused by the boxes overhanging the wooden pallet and creasing on the bottom layer. In addition, if boxes were not stacked on the stacking tabs, the top boxes depressed the bottom layer box.

The two types of slip sheet material, solid fiberboard and polypropylene, performed about the same (Fig. 6). Minor rips to fiberboard and polypropylene occurred when the grabber bar on the machine was not properly placed across the lip of the slip sheet. The heavyweight (50 mil), mediumweight (40 mil) polypropylene and solid fiberboard performed equally well. However, there were two failures of the lightweight (30 mil) polypropylene sheet. The lip tore when removing the sheet from the vehicle.

No differences were observed between the slip sheet units that were strapped with two horizontal bands and four corner boards and units strapped with only one horizontal band (Fig. 7).

Product condition. Table 1 shows the percentage of nectarines injured and decayed when shipped on slip sheets and on wooden pallets. No differences in decay were detected in fruit shipped by the two methods of unitizing. However, on arrival the total percentage of bruised fruit was greater in the slip sheet loads than in the wooden pallet loads, 15 percent vs. 6 percent. After a 3-day holding period, the percentage was the same for both methods of unitizing (12 percent).

Transit temperature. No differences in transit temperature were detected between the slip sheet loads and wooden pallet loads. The most important factor in determining transit temperatures was the performance of refrigeration unit of the truck, as indicated by the discharge temperature. Figures 8, 9, and 10 give the transit temperatures, based on recording thermometers, for each paired transit test.

Figure 8 shows the average temperature, based on recording thermometers, during transit of the first paired truck shipment of wooden pallet and slip sheet loads. The average temperature of the slip sheet loads was 43°F during the trip. The product temperature at time of loading was 38°F. The average temperature of the wooden pallet loads was 44°F during the trip. The product temperature at time of loading was 41°F. On arrival, the average pulp temperature was 43°F in the slip sheet load and 41°F in the wooden pallet load. During transit the air discharge temperature in the truck with wooden pallets was below 30°F. However, no freezing damage occurred to the product.

Figure 9 shows the average temperature, based on recording thermometers, during transit of the second paired-shipment of wooden pallets and

Table 1. Injury and decay of nectarines unitized and shipped on wood pallets or slip sheets from Fresno, CA to Chicago, IL and examined on day of arrival, and after holding 3 days at 20°C.[1/]

Type & degree of injury	WOOD PALLET		SLIP SHEET	
	On arrival	3 days holding	On arrival	3 days holding
	Percent	Percent	Percent	Percent
Bruised[2/]				
slight	2	5	5	7
moderate	3	4	6	3
serious	1	3	4	2
Total	6	12	15	12
Cuts	6	6	5	8
Punctures	16	15	16	18
Decay	0	5	0	3

1/ Average of 400 fruit samples each for wood pallets and slip sheets.

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

slip sheets shipped by piggy-back trailers from Fresno, Calif. to Chicago, Ill. The average temperature of the slip sheet load ranged from 36°F to 40°F during the trip. The product temperature during loading averaged 37°F. The average temperature of the wooden pallet load ranged from 37°F to 42°F during transit. The pulp temperature at time of loading averaged 42°F. On arrival, the pulp temperature of the nectarines shipped on slip sheets was 39°F and 49°F on wooden pallets. The high product temperature on arrival was due to poor truck discharge air temperature, 48°F for 16 hours.

Figure 10 shows the average temperature, based on recording thermometers, during transit of the third paired-shipments of wooden pallets and slip sheets shipped from Fresno, Calif. to Chicago, Ill. The average temperatures of the slip sheet loads ranged from 30°F to 40°F during the trip. The product temperature at time of loading averaged 38°F. The average temperature of the wooden pallet load ranged from 32°F to 36°F. The product temperature at time of loading averaged 38°F. The wide range in temperature for slip sheet loads is related to the fluctuation in discharge air of the truck refrigerating units which ranged from a high of 36°F to a low of 28°F. In contrast, the truck discharge temperature in the wooden pallet load ranged between 31°F and 33°F which maintained proper fruit temperatures.

Slip sheet handling. The conversion from unitizing tree fruit on disposable wooden pallets to unitizing on slip sheets can be made at shipping point with only minor modification of current handling practices. The principal advantage of slip sheets is the elimination of the transport and disposal of the relatively expensive wooden pallets (Fig. 11).

For the shipper, the major investment would be a special push-pull attachment for his fork truck and a transfer device, which would enable him to unitize on wooden pallets, but to switch from the pallets to slip sheets when needed to fill a slip sheet order (Fig. 12). The transfer device could be located next to the truck loading dock. Shipping containers can also be unitized directly on slip sheets off the existing packing lines without any modification or investment in additional equipment (Fig. 13). The sheet is placed on the pallet and the boxes stacked on the sheet with pallet and moved into cold storage as is the current practice.

At the receiving warehouse, the conversion to slip sheet handling of produce can be accomplished without modification to the current palletized handling system. However, a special push-pull attachment would be required on fork trucks to remove the slip sheet load from the truck and place it on the 40 by 48 inch warehouse pallet (Fig. 14). Currently, the warehouse personnel remove the wooden pallet units from the truck with a fork truck and place it on the warehouse pallet (Fig. 15). The conversion to slip

sheet would not require extra handling at the receiving warehouse. Less storage space in the warehouse racks would be required for the slip sheets due to the elimination of the 6-inch height of the 35 by 42 inch wooden pallet on the warehouse pallet (Fig. 16). In receiving warehouse operations that require the truck driver to unload, a walkie-type push-pull unit would be needed.

DISCUSSION

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

No consistent differences were detected between slip sheet and disposable wooden pallet loads for effects on transit temperature, product or container damage.

The major need for conversion to slip sheets is the training of fork truck operators to use the push-pull attachments. Trained, experienced operators can load and unload slip sheets as quickly and as problem-free as they can do so with wooden pallets.

A few tree fruit shippers have made commitments to ship on slip sheets during the 1978 season. About four major receivers have received loads of produce on slip sheets. However, shippers of other commodities have made commitments to ship on slip sheets or have expressed an interest in shipping on slip sheets. Some lettuce, citrus, tomatoes, potatoes and apples are being shipped on slip sheets or soon will be. Some melon shippers are committed to slip sheets during the 1979 season. As more receivers realize the potential savings of slip sheets and make the conversion to receiving slip sheets, the number of commodities shipped by this method will increase, making slip sheet handling a standard method of unitizing fresh fruits and vegetables.

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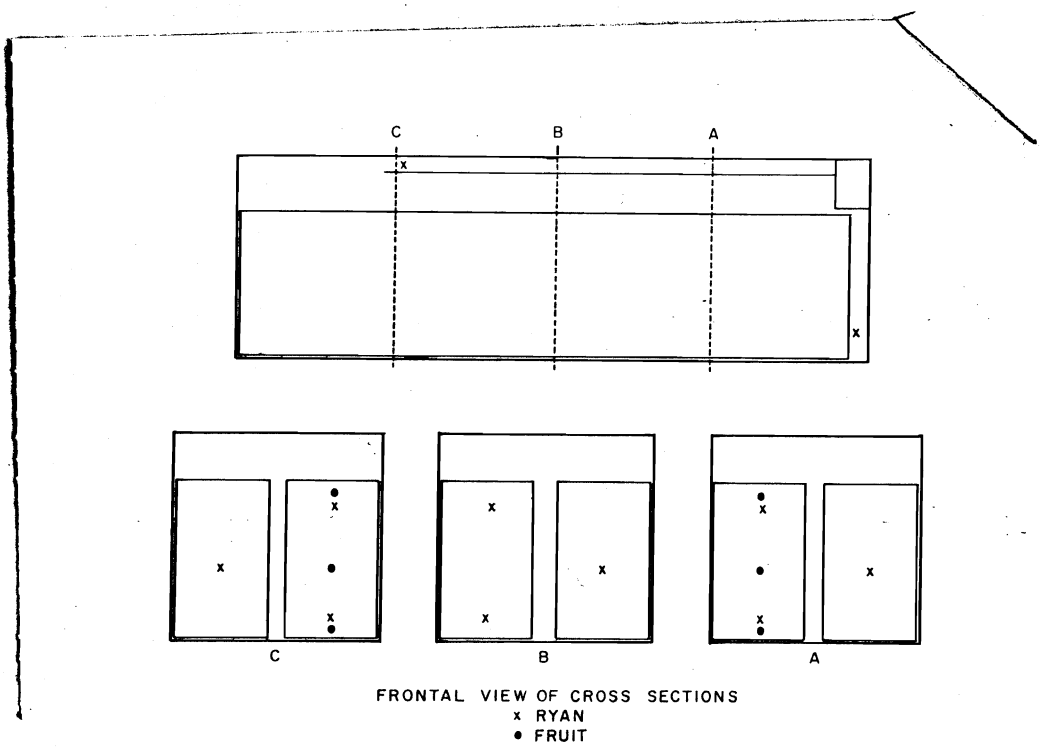

Figure 1. Location of recording thermometers and fruit sample boxes in truck for transit test; A = 1/4 length, B - 1/2 length and C = 3/4 length.

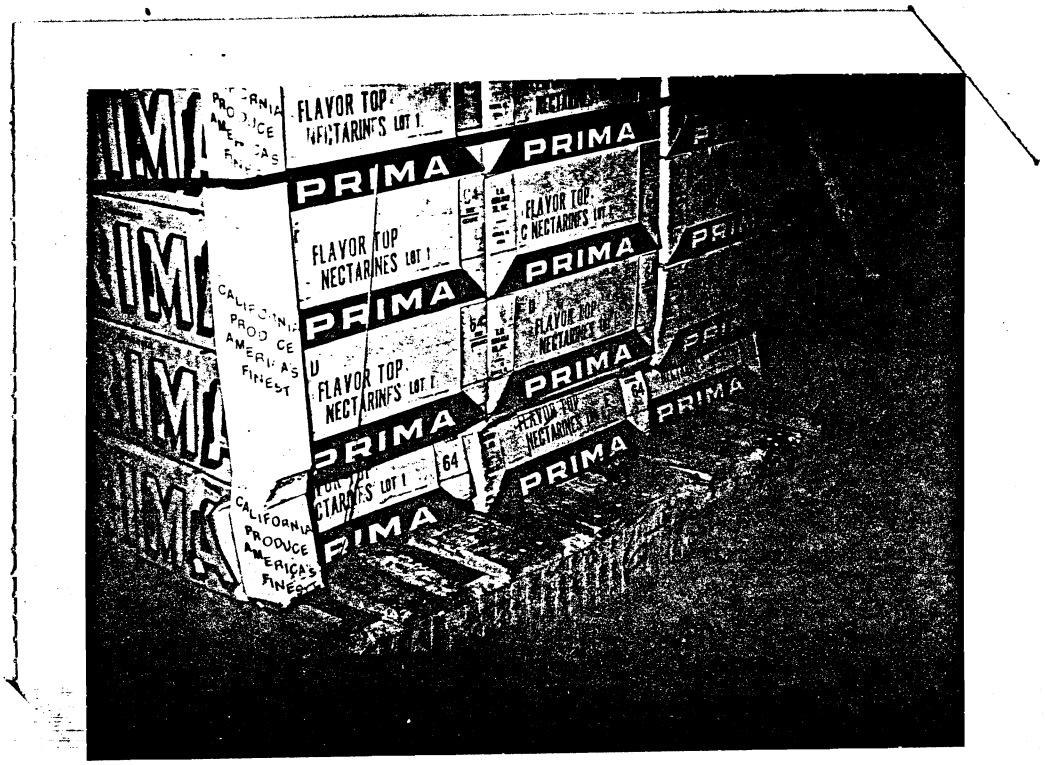

Figure 2. Illustration of serious damage categories to shipping containers.

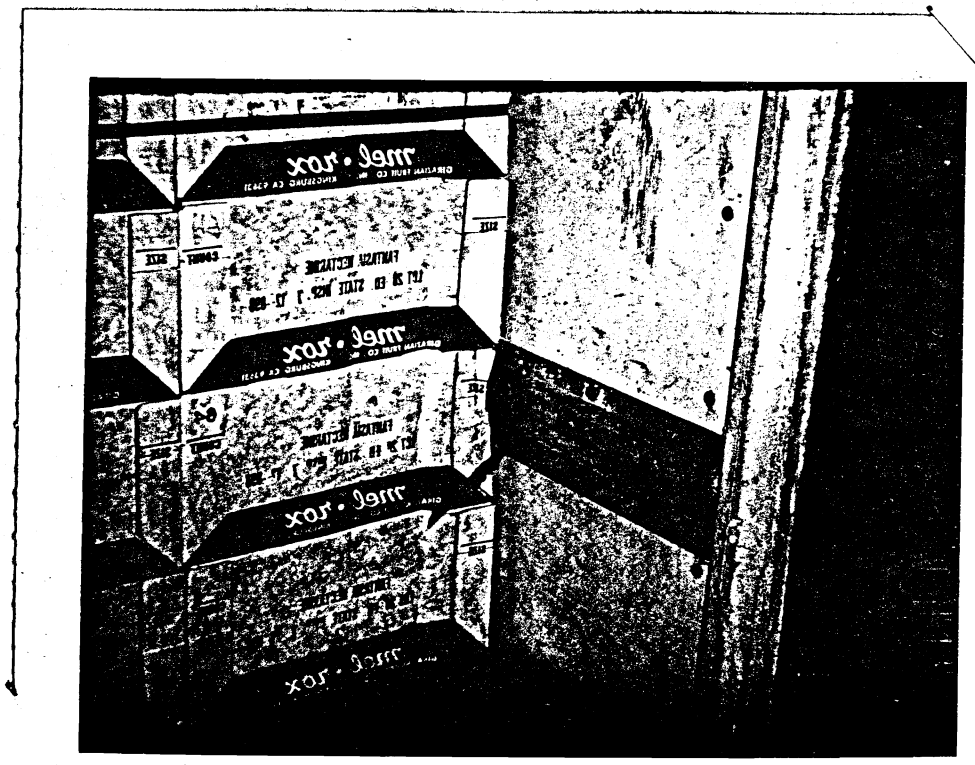

Figure 3. Photo of bracing strap which caused damage to container on removal from truck.

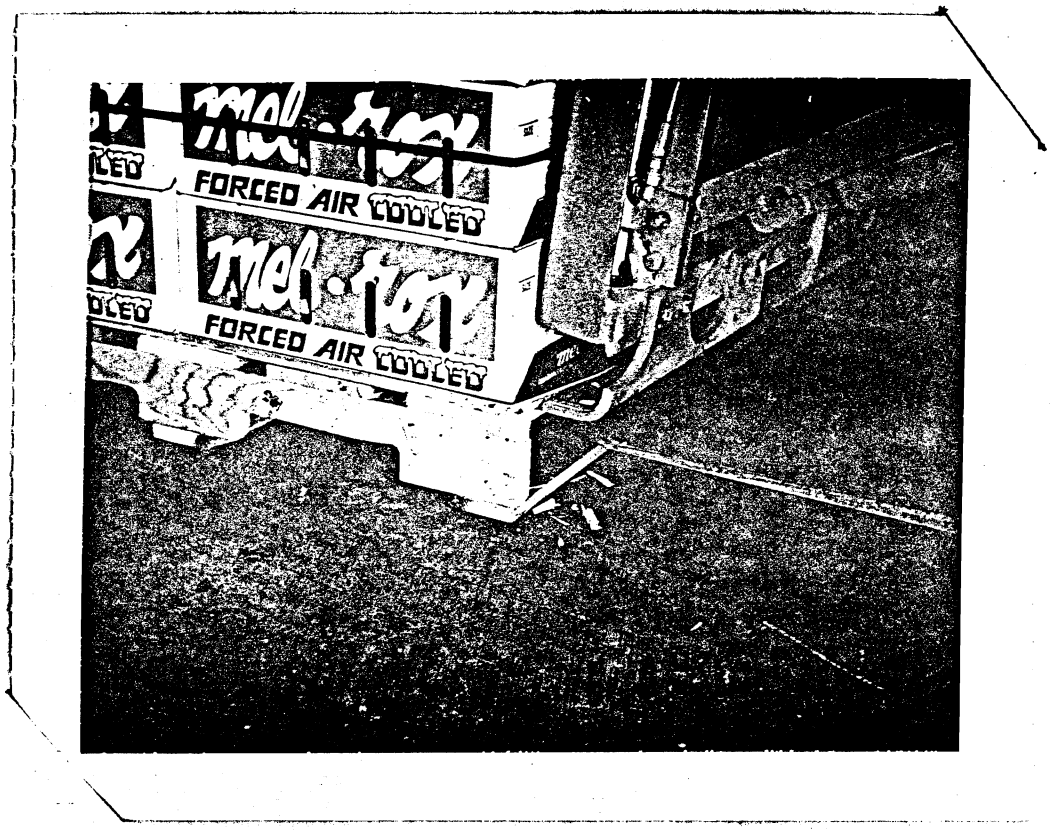

Figure 4. Angle of push-pull attachment which causes creasing to bottom layer boxes.

Figure 5. Boxes creased by push-pull attachment.

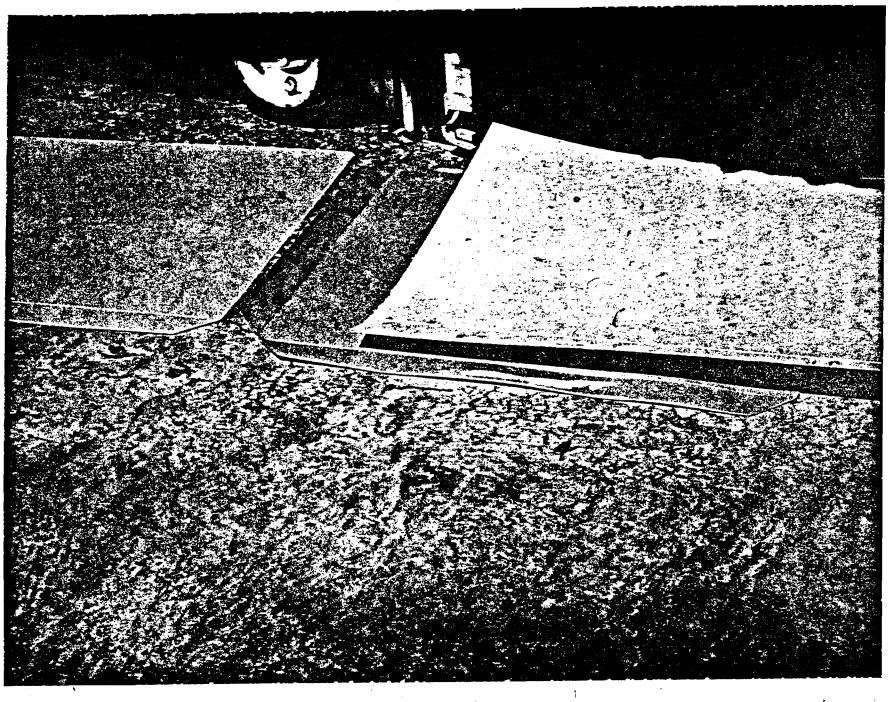

Figure 6. Two types of slip sheet material tested--solid fiberboard and polypropylene of two thicknesses (40 mil and 50 mil).

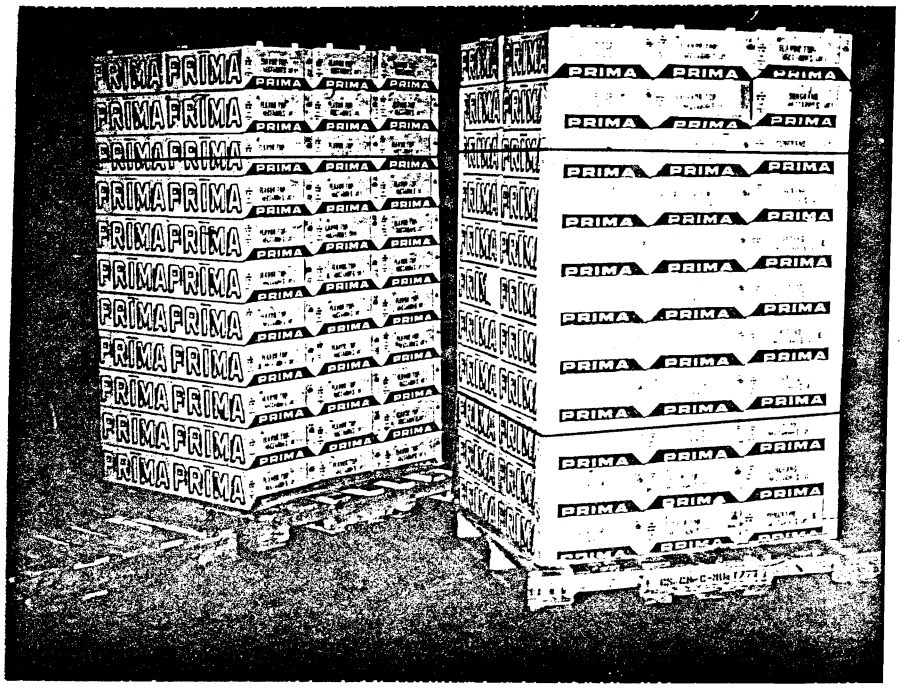

Figure 7. Arrival of slip sheet unitized load with two horizontal straps and corner boards (right) and only one horizontal strap (left).

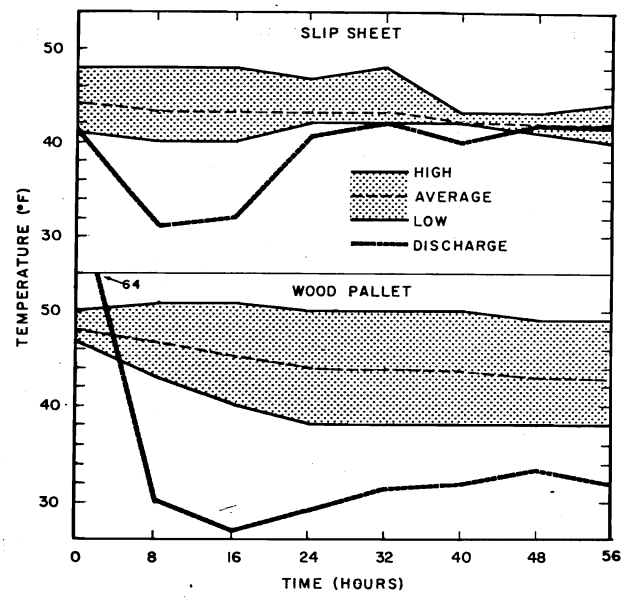

Figure 8. Average transit temperature of the first paired truck test shipment of nectarines unitized on slip sheets or wood pallets.

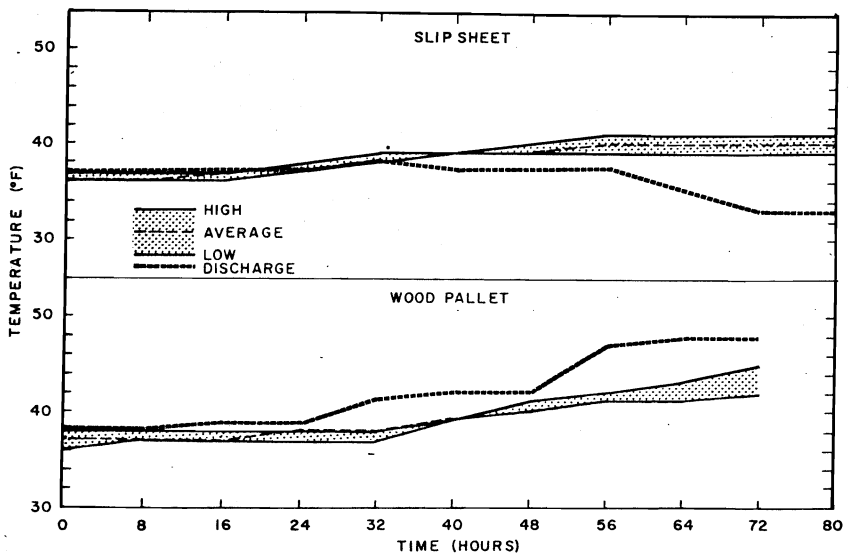

Figure 9. Average transit temperature of a paired piggy-back trailer test shipment of nectarines unitized on slip or wood pallets.

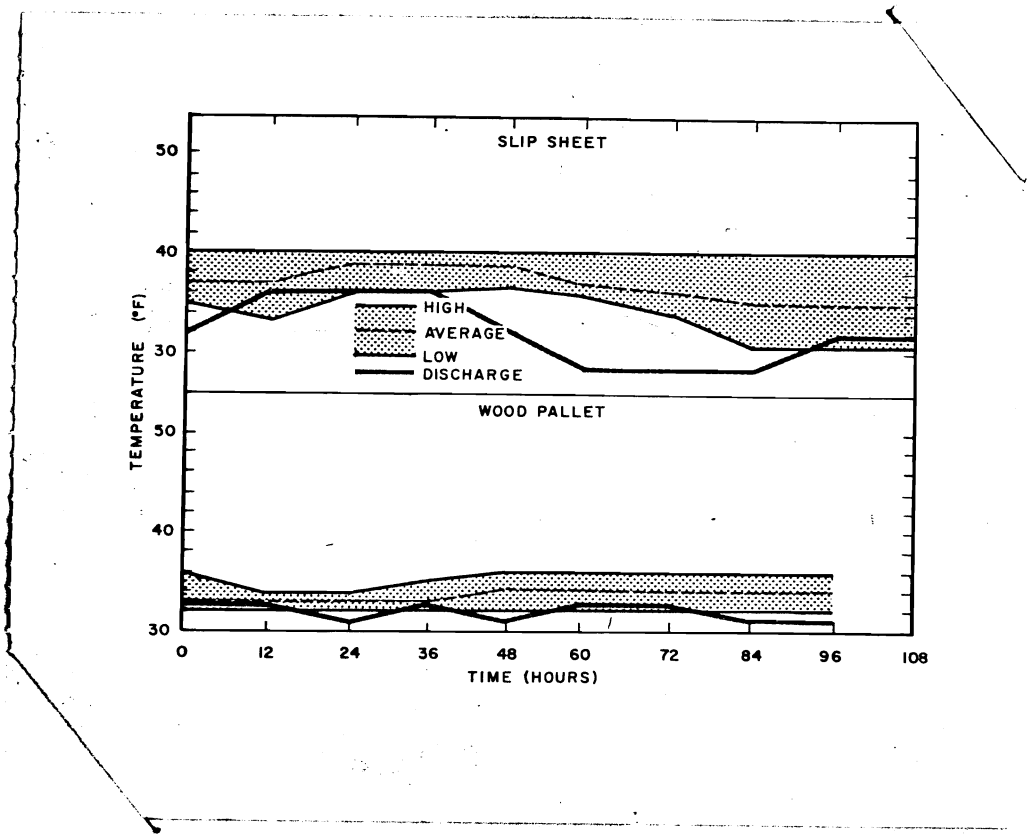

Figure 10. Average transit temperature of the third paired-test shipment of nectarines unitized on slip sheets or wood pallets.

Figure 11. Unitized slip sheet being loaded in truck without wood pallet.

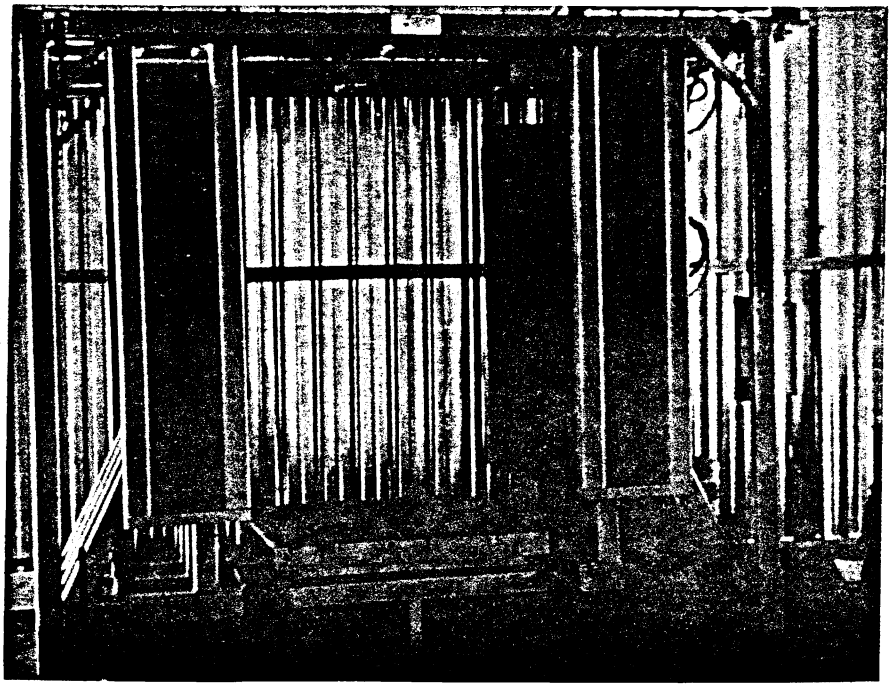

Figure 12. One type of device available to transfer unitized loads from wood pallets to slip sheets before loading truck.

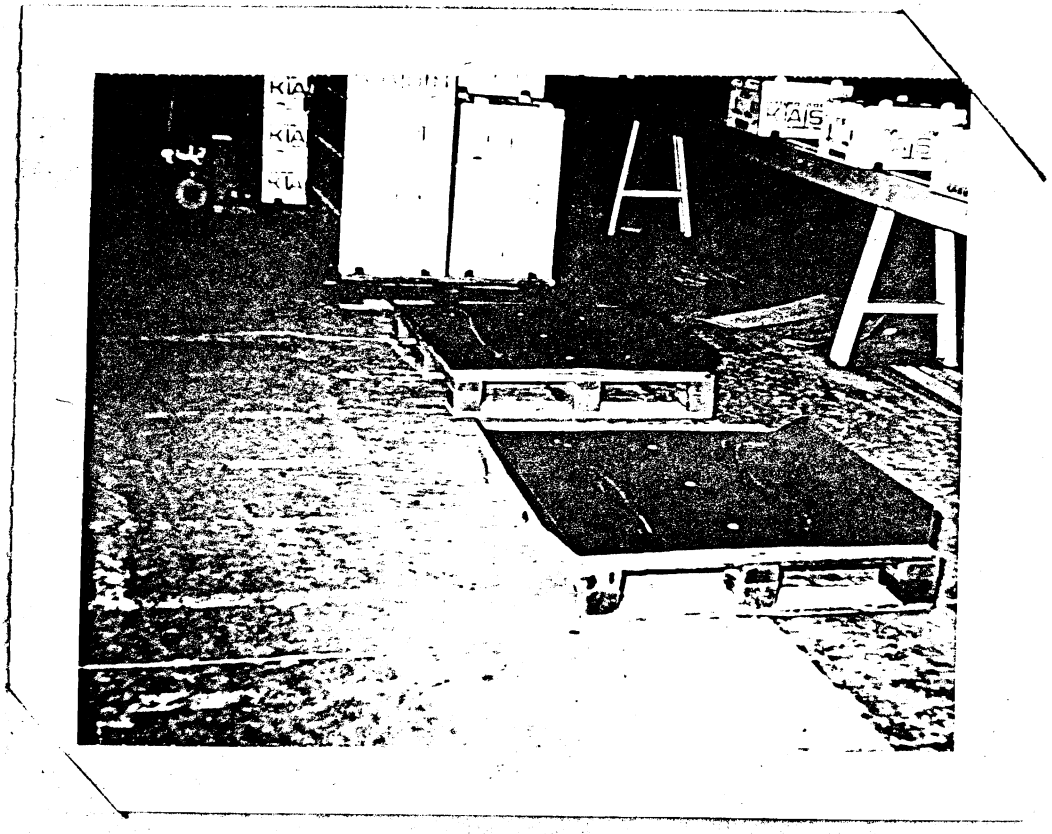

Figure 13. Unitizing boxes on slip sheets off packing line conveyor.

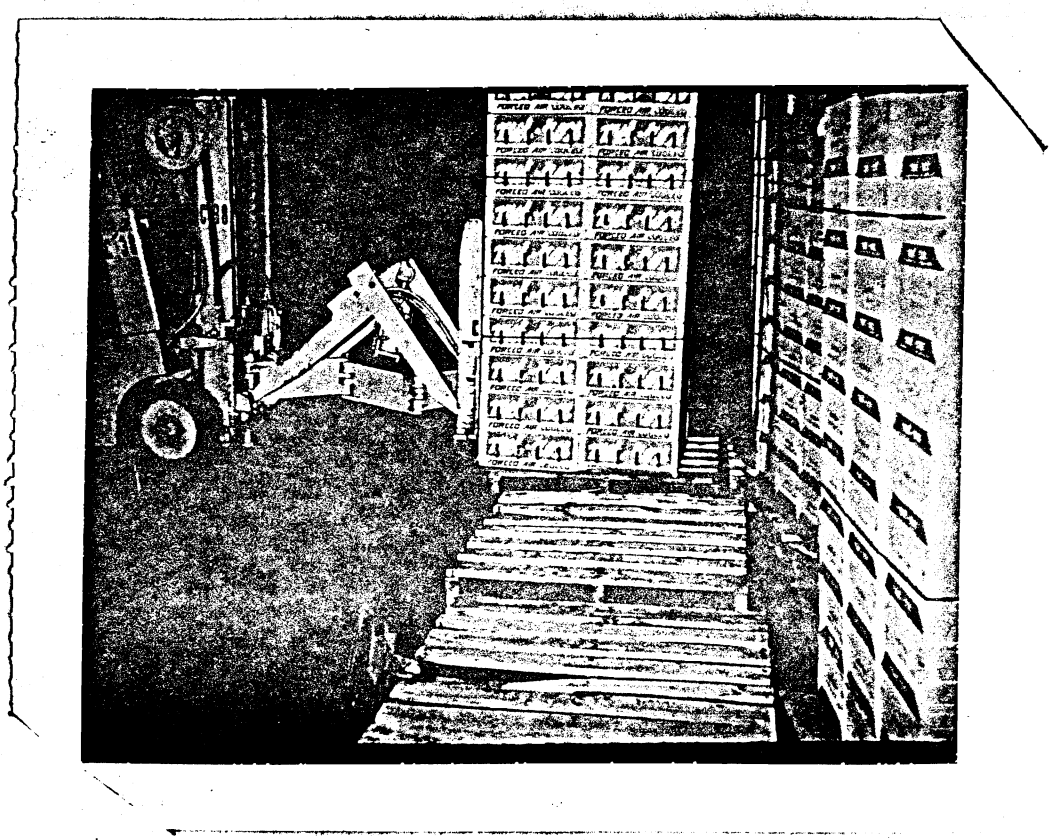

Figure 14. Placing unitized slip sheet on 40 x 48 inch warehouse pallet at receiver's warehouse.

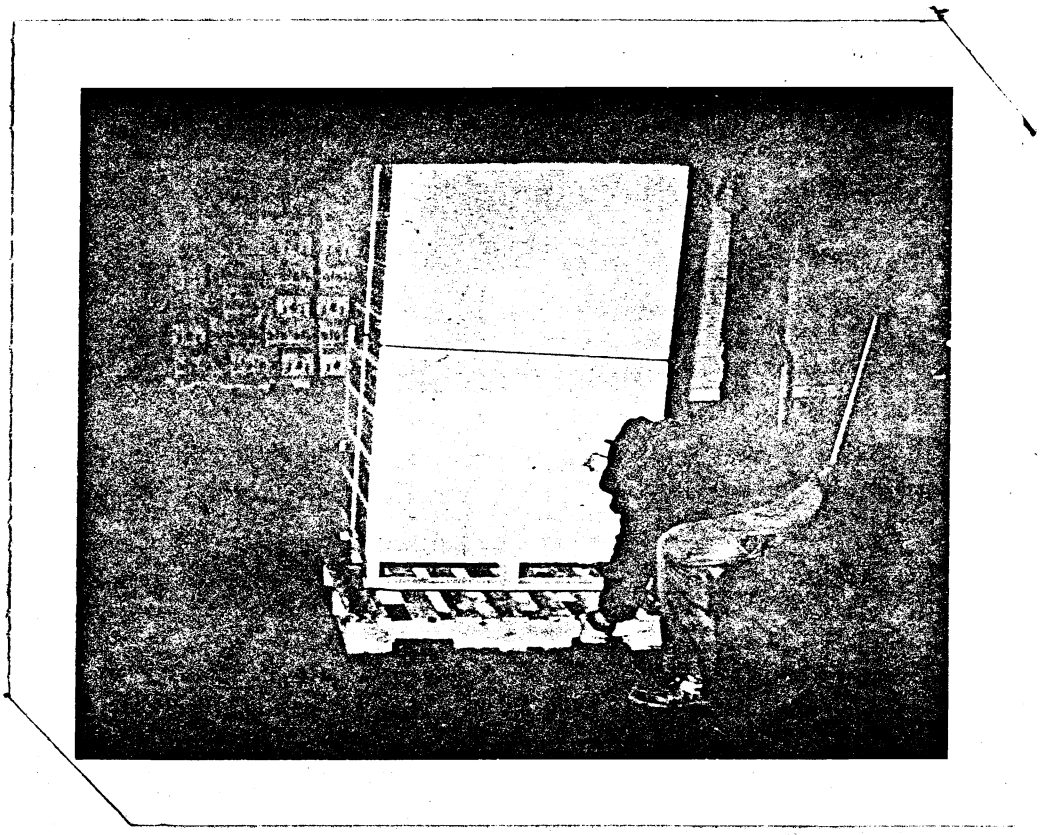

Figure 15. Placing 35 x 42 inch wood pallet on 40 x 48 inch warehouse pallet at receiver's warehouse.

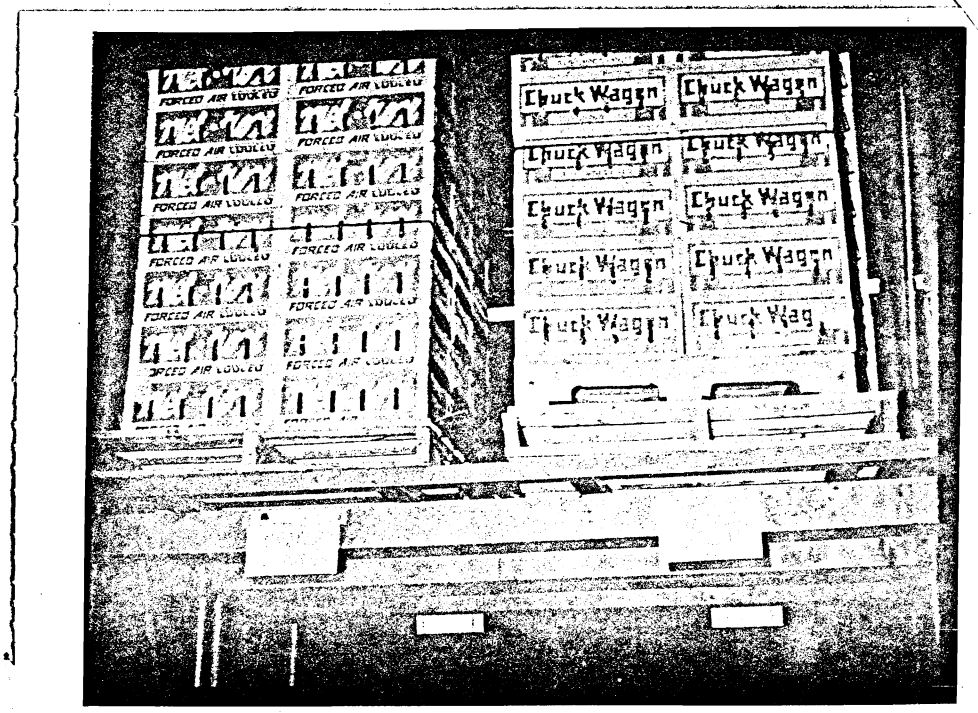

Figure 16. Unitized slip sheet on receiver's 40 x 48 inch warehouse pallet (left) in rack. Wood pallet (35 x 42 inch) on warehouse pallet (40 x 48 inch) in rack.