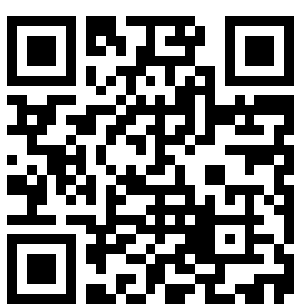

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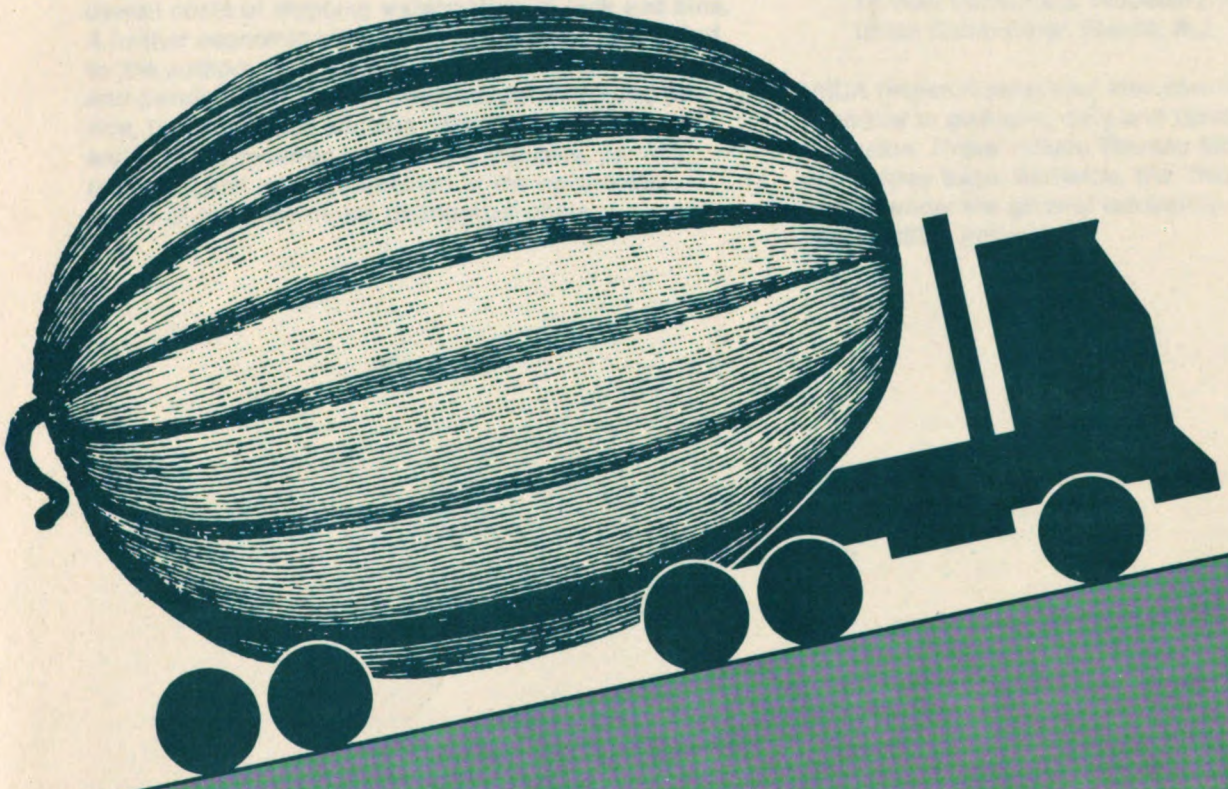
Transporting Watermelons in Bulk and Bins by Truck



Preface

This study was conducted in the spring of 1980 at the request of shippers and receivers of watermelons. In the fall of 1979, members of the various segments of private industry involved in distributing watermelons from the farm to the consumer asked researchers of the Transportation and Packaging Research Branch, Office of Transportation, to lead an initial research study to identify inefficiencies and possible areas needing improvement in watermelon distribution methods, specifically including the transport of melons in bulk and bins. The objectives of this study were to (1) Evaluate the present watermelon distribution system; (2) Identify areas of the system which could be improved to reduce in-transit losses; and (3) Determine related overall costs of shipping watermelons in bulk and bins. A further economic study is currently being conducted by the authors and researchers in the Market Research and Development Division, Agriculture Marketing Service, to identify and allocate specific detailed costs and benefits incurred by growers, shippers, carriers, receivers, and retailers involved in the various segments of the watermelon distribution chain.

Acknowledgments

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Growers Marketing Service, Lakeland, Fla.
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Tri-Wall Containers, Woodbury, N.Y.
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USDA research personnel also contributed substantial expertise in gathering data and conducting the transport tests. These include Thomas Moffitt, Orlando, Fla., and Jeffrey Sage, Beltsville, Md. This project was conducted under the general leadership of Russel H. Hinds, USDA (retired).

Summary

The authors conducted a series of test shipments of watermelons from Florida to New Jersey to identify costs, handling procedures, and other factors that affect the melons' arrival condition. Two methods of distributing watermelons from harvesting to the retail level were studied. During the study, researchers observed three paired shipments of watermelons transported in bulk and bins at both origin and destination. In addition, they observed at receiving warehouses in New Jersey nine bulk and four bin shipments that were not paired at origin and did not originate at the same location.

Melons transported by the conventional bulk method were loaded in over-the-road tractor-trailers and stacked individually on a bed of straw to protect them during transit. Binned melons were transported in similar trailers. Bins observed during the study consisted of three types of corrugated fiberboard bins and two types of wooden bins. The bins carried about 45 to 60 melons each, depending on size of melons and whether the bin was stacked on top or bottom. The bins weighed about 1,000 to 1,200 lb (454 to 544 kg) when filled with melons, and were stacked two high in the trailers. The researchers recorded their observations on advantages and disadvantages of both the bulk and binned methods of watermelon distribution during the study.

Contents

October 1982

Transporting Watermelons In Bulk and Bins by Truck

By W. G. Kindya[1], E. Close[2], L. A. Risse[3], and R. C. Mongelli[4]

Introduction

Commercial watermelon production in the United States is about 22.6 million hundredweight per year. Most watermelons are sold domestically, with a small number exported. The major watermelon-producing States are Florida (30 percent), Texas (20 percent), California (12 percent), and Georgia (11 percent). The primary commercial harvesting period extends from March through October, with the largest portion (about 80 percent), distributed and marketed from June through August. The majority of watermelons are transported from growing areas to market in over-the-road tractor-trailer combinations. Melons transported in this manner are usually loaded into the transport vehicle by being placed on a layer of straw and stacked about five to seven melons high, with a cushion of straw at the front and rear of the vehicle to prevent damage to the melons. When transported by this "bulk method," melons are handled at least five times from harvest until they are displayed in the retail store.

Recently, receivers have expressed an interest in using bins that would each hold about 1,100 lb (499 kg) of melons to transport melons to market. One objective of using bins would be to reduce melon handling, which often results in bruising and scoring and a subsequent loss in quality. Additional benefits expected to accrue from using bins include reduced labor costs, more efficient vehicle use, and increased utilization of loading and unloading dock space. This study was undertaken to identify areas of the present watermelon distribution system that could be improved to benefit all segments of the watermelon industry and consumers.

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Methods

Watermelon truck-loading operations vary considerably at different locations. Most melons are harvested and placed in field trucks. In some cases they are loaded in bulk in over-the-road vehicles adjacent to the growing field. At other locations, the field trucks are driven to a centrally located packing site where the melons are unloaded, graded, and sized, then placed in over-the-road vehicles for long-distance transport to market.

For this study, watermelons from the same field were selected, graded, and paired for three shipments by bulk and three by bin. Harvesting operations and local transportation up to the point of delivery to the packing site also were identical for each paired shipment. Time studies of labor and handling procedures unique to either bulk handling or bin use were recorded at origin and destination. The three main segments of the distribution chain through which the melons were followed were (1) packing site operation, (2) long-distance highway transport, and (3) receiving-warehouse operation.

Packing site operations—The authors conducted time studies on the transfer of melons from field trucks, through the packing site operation, and into over-the-road trailers for transport to northern markets. Particular emphasis was placed on the differences in labor requirements and handling procedures between melons loaded in bulk and those loaded in bins for transport.

Long-distance highway transport—Bin costs, loading and unloading methods and procedures, and melon transport requirements such as stacking and cushioning materials were evaluated.

Receiving-warehouse operation—Differences in amount of time required for dock space usage and special unloading procedures or equipment were evaluated at the receiving distribution center. Melons were inspected on arrival to detect defects attributable to form of shipment, whether bulk or experimental bins.

Type and Assembly Characteristics of Bins Studied

The authors observed the following five types of bins during the study:

1. Bin of fiberboard single-piece construction with nominal dimensions of 47 in (119 cm) (L) by 39 in (99

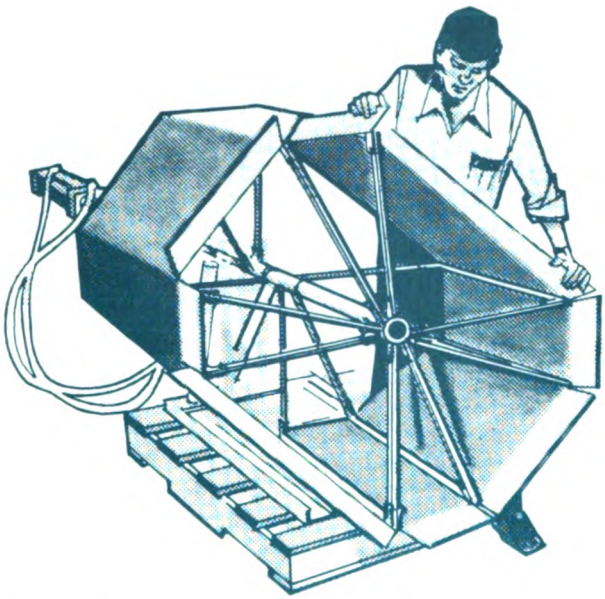

Figure 1.—Assembling type 1 bin, with bin erector supplied by bin manufacturer.

cm) (W) by 36 in (91 cm) (H) including pallet when assembled. This octagonal bin was stored and shipped flat and was set up at the packing site by one person with the assistance of a required bin erector (fig. 1). A crown-type staple gun and supply of compressed air were required to drive the staples during assembly. The bin had flaps along the top and bottom wall perimeters that were secured by 32 staples during assembly. Assembly time was about 4.25 minutes per bin. The forklift operator took 2.5 minutes to stack bins two high and load them into the over-the-road trailer. Bins stacked on the bottom layer contained 55 medium-sized melons, and bins stacked on top contained 60 medium-sized melons.

2. Bin of fiberboard tube and cap configuration with nominal outside dimensions of 47 in (119 cm) (L) by 39 in (99 cm) (W) by 36 in (91 cm) (H) including pallet when assembled (fig. 2). The bins were stored and shipped flat and were assembled at the packing site. Assembly required a crown-type staple gun and supply of compressed air on a strapping tool, depending on whether the bin was held together with staples or strapped. Assembly involved opening the octagonal body tube and placing it into a self-locking bottom cap. If necessary, a top cap was used to provide support for the upper bin; a top cap was used on the bottom bin when bins were stacked two high. No top cap was used on the bin stacked on top. This bin was usually assembled by one person; assembly time was 1.5 worker-minutes per bin. When used for transporting watermelons, the bottom cap of the top bin is stapled to the bin body, or straps are used to secure the bottom cap to the bin body to prevent the bin body from riding up during transit. Strapping also makes bin knockdown at the receiving warehouse easier. Strapping bottom bin to pallet required about 2.88 worker-minutes per bin. Generally, two straps, each about 14 ft (4.27 m), and two strapping clips were used. Stapling of the bottom cap to the bin body required 16 staples and 23 seconds per bin. The forklift operator took 2.5 minutes to double stack and load two bins into the over-the-road vehicle. Bottom-stacked bins contained 55 medium-sized melons, and top-stacked bins contained 60 medium-sized melons each.

3. Bin of single-piece corrugated fiberboard construction, rectangular in shape when assembled, with flaps along the top and bottom wall perimeters. This bin is shipped and stored flat (fig. 3). The nominal outside dimensions of this bin are 44 in (112 cm) (L) by 37 in (93 cm) (W) by 42 in (107 cm) (H) including pallet. During the packing site operation at origin, this bin was usually

Figure 2.—Type 2 bin assembled and self-locking cap partially assembled.

Figure 3.—Type 3 bin (right) and type 4 bin (left) in trailer during unloading at destination warehouse.

assembled by one person. A crown-type staple gun and supply of compressed air are required for assembly. Time required to assemble the bin was about 1.5 minutes per bin. Sixteen staples were required per bin to secure top and bottom flaps. Filled bins were then double stacked on the loading dock and placed in the over-the-road vehicle with a forklift. The forklift operator took 3.44 minutes to double stack and load two bins into the over-the-road vehicle. Bottom-stacked bins contained 55 medium-sized melons, and top-stacked bins contained 60 medium-sized melons.

4. This bin (a hinged-corner pallet adapter) is stored and shipped flat. It is constructed of wood with vertical faceboard of about 1/8-in (3.2-mm) thickness. Nominal outside dimensions are 48 in (122 cm) (L) by 40 in (102 cm) (W) by 36 in (91 cm) (H) including the pallet base. This bin was usually assembled by one person with an assembly time of 1.25 minutes per bin, which included insertion of a corrugated liner to protect melons during transit (fig. 3). The forklift operator took 3.54 minutes to stack bins two high and load them into the over-the-road vehicle. Bottom-stacked bins contained 48 medium-sized melons, and top-stacked bins contained 56 medium-sized melons.

5. A wooden bin (banded collapsible pallet adapter) constructed of vertical faceboards three-eighths of an inch (9.53 mm) thick and nominal outside dimensions of 48 in (121 cm) (L) by 40 in (102 cm) (W) by 36 in (91 cm) (H) including the pallet base (fig. 4). Side panels are held together with strapping that serves as hinges while the bin is being prepared for use. The bin is shipped and stored flat and can be prepared for use at a packing site by placing on a suitable pallet base. No tools are required for assembly, and the hinges are in place when delivered. Bin assembly time was 1.25 minutes, which included insertion of a corrugated liner to protect melons in transit. The forklift operator took 3.54 minutes to double stack and load two bins into the trailer. Bottom-stacked bins contained 48 medium-sized melons, and top-stacked bins contained 56 medium-sized melons.

Results

The authors observed a total of 12 bulk and 7 bin loads of watermelons at a destination warehouse. The first three loads were paired shipments consisting of bulk and bin loads with melons originating from the same field and transported to the packing site under similar conditions. They were loaded into vehicles, transported over the highway, and delivered to the receiving warehouse on the same day. The remaining nine bulk and four bin loads were harvested and traveled through the distribution system to the destination warehouse under normal commercial conditions. The authors observed and sampled them at the receiving warehouse in the same manner as the paired loads.

Loading Operation

Melons brought to the packing site in field trucks were unloaded, graded, and weighed. Two workers unloaded field trucks at the packing site and one worker graded melons. The melons then were weighed either manually by one worker or on automatic scales. Melons were separated according to size: large—over 24 lb (10.9 kg),

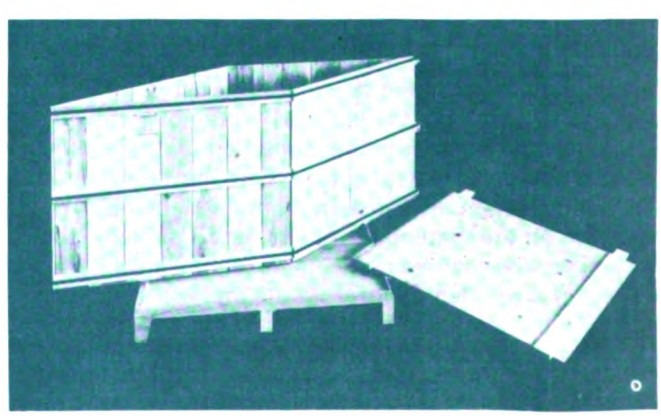

Figure 4.—Type 5 bin during assembly on pallet base.

Figure 5.—Bracing a load at rear of bulk trailer load of watermelons.

medium—17 to 24 lb (7.7 to 10.9 kg), and small—under 17 lb (7.7 kg). Generally, two people load each over-the-road vehicle when melons are transported in bulk and when a conveyor belt is used to move melons into the trailer.

Bulk- and bin-loading operations for each over-the-road truck required approximately the same amount of time. Bulk loading requires protection of melons from vibration and load shifting during transit. This is accomplished by placing a layer of straw on the floor of the trailer and between the melons and the front and side walls of the trailer. A suitable bracing wall is also constructed at the rear of the trailer between the melons and the rear door of the trailer (fig. 5). This bracing is usually fabricated from a sheet of plywood and upright posts. Straw is packed between the rear stack of melons and the plywood sheet to protect the melons during transit. Approximately five bales of straw are required to adequately protect a bulk load of watermelons.

When melons are transported in bins, two additional people are required: one person to operate a forklift and one to assemble the bins. To fill the bin, one person removes melons from the conveyor and hands them to a second person, who places them into the bin. Forklift operation involves positioning, stacking bins two high on the loading dock, and loading filled bins into the over-the-road vehicle. Bin assembly involves retrieving a wooden pallet from the storage area, setting up a bin, and placing it on the pallet. Data unique to bin loading operations are summarized in table 1.

Table 1.—Watermelon bin-loading operation time, cost, and materials required

Bin type	Bin cost[1]	Assembly time	Material required	Material cost	Forklift time[2]
	Dollars	Minutes		Dollars	Minutes
1[3]	9.00	4.25	32 staples	0.14	2.5
2	9.00	2.5 [4]	28-ft strap	.16	2.5
3	12.00	1.5	16 staples	.07	3.4
4	17.00	1.25[5]	corrugated liner	1.00	3.54
5	24.00	1.25[5]	corrugated liner	1.00	3.54

[1] All costs are approximate and may vary in different locations and times. See section on Bin Reuse Potential.

[2] Forklift time includes stacking bins two high and carrying them from loading dock into trailer. Variations in this time were attributable to alinement and resting top bin into lower bin.

[3] Bin type 1 requires a bin erector at a cost of about $3,000.

[4] Assembly time includes: 23 seconds for 1 worker to assemble 1 cap, 23 seconds for 1 worker to assemble 1 body, and 22 seconds for 1 worker for strapping. Times are actual assembly times and do not include employee's personal time.

[5] Includes insertion of corrugated liner.

Field Harvesting and Loading

Bulk shipments also were loaded during harvesting adjacent to the watermelon-growing field. Nine people were required during the loading operation in the field: one field truck driver, six loaders, and two stackers. The six loaders picked up melons from the field and placed them in a field truck. The field truck was driven a short distance to an over-the-road tractor-trailer. The same six workers transferred the melons from the field truck to the tractor-trailer. The two stackers then stacked the melons into the tractor-trailer. Actual loading of a trailer in the harvesting field required approximately 1,100 worker-minutes for 2,100 melons weighing 41,280 lb (18,724 kg), excluding loading of field trucks.

Truck Transportation

Watermelons may be transported from growing areas to a centrally located packing site for loading into over-the-road vehicles in open staked-body field trucks, or melons may be loaded into over-the-road vehicles adjacent to the growing field. Watermelons transported by the bulk method are more likely to be loaded adjacent to the growing field than are melons transported in bins, because less mechanized equipment is required for the bulk-loading method. However, mechanized harvesting equipment is now available for bin loading in the field.[5] The amount of melons that can be

[5] System combines automation, bulk for watermelons. *The Packer*, Vance Publishing Company, Shawnee Mission, Kans. Sat., July 19, 1980, p. 9A.

Table 2.—Typical net weight of melons transported by bulk and bin methods in trucks

Item	Bulk shipment	Bin shipment
	Pounds	Pounds
Maximum gross vehicle weight	80,000	80,000
Vehicle tare weight	30,000	30,000
Lading (bid, pallets, straw, bracing)	330	3,000
Net weight of melons	49,670	47,000

transported over the highways from growing areas in the Southeastern States to markets in the Northeastern States is presently limited to a gross vehicle weight of 80,000 lb (36,287 kg) or less in some States. Costs of transporting watermelons in trucks by bulk and bin methods, assuming a vehicle tare weight of 30,000 lb (13,608 kg), would be based on a melon net weight derived as illustrated in table 2.

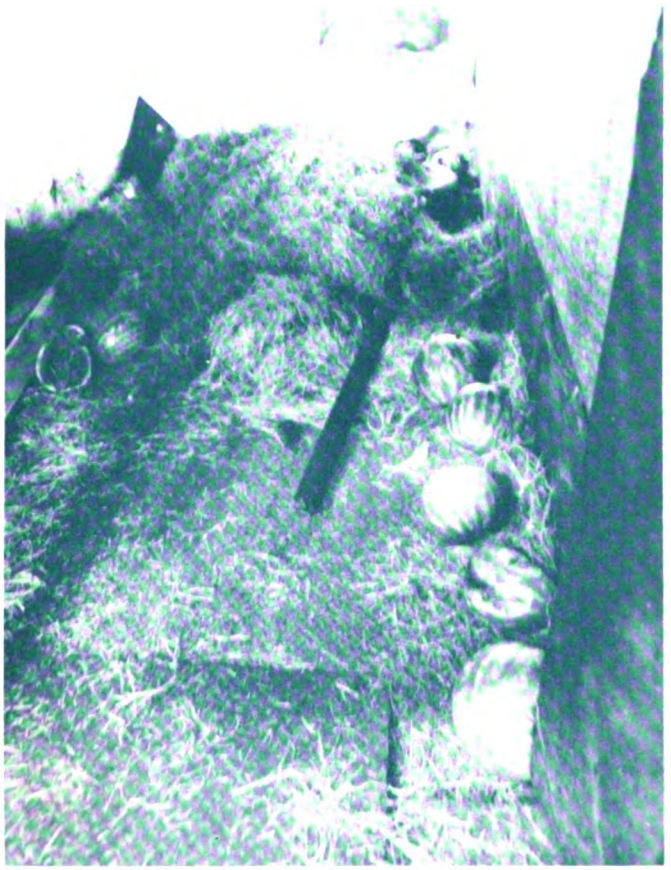

Figure 6.—Straw, cracked melons, and bracing material in trailer after unloading of bulk load of watermelons.

Warehouse Receiving Operation

When the over-the-road vehicle arrives at the receiving warehouse, it is parked in a lot until it is assigned a specific space at the unloading dock. Waiting time varies considerably, depending on factors such as available dock space, warehouse operating hours, available commodity storage space, and number of personnel available for assignment to the unloading procedure. Unloading melons from the truck to the loading dock is the responsibility of the truck driver. The truck driver either unloads the melons or hires someone to unload them. It takes about 3 hours for two experienced workers to unload each truck when watermelons are transported in bulk. Current unloading rates in the Northeast are about $130 per load for bulk melons. The charge to unload a bin load of melons is about $20 to $30. Unloading usually is accomplished with the use of a pallet jack which is provided by the receiving warehouse.

Straw, cracked melons, and wood bracing are left in the trailer after bulk melons are unloaded (fig. 6). The truck driver must find a place to dispose of this trash. Trash disposal at a dump costs about $20 and takes about 1 hour. Warehouse personnel also spend about 30 minutes in cleaning up straw dropped on the warehouse floor during unloading the melons transported by the bulk method.

An estimate of the amount of loss that would occur at retail was made by the authors in the receiving warehouse. This was done by visually inspecting a sample of about 20 to 25 percent of each load and estimating the amount of melons that would be discarded because of bruising, splitting, transit scarring, or other defects caused during transit (table 3).

Table 3.—Estimated percentage of watermelon loss per truckload at retail

Shipment type	Paired shipments	Nonpaired shipments	Average loss
	Percent		
Bulk	6.0 8.9 1.8	2.3 2.1 5.0 2.8 2.5 1.5 2.0 1.5 2.8	3.27
Bin	4.0 5.0 2.5	1.0 1.5 .6 .4	2.14

Bin Reuse Potential

In actual practice, a bin may be reused. The number of times a bin can be reused depends on a number of factors, including construction material, bin-handling procedures, and contamination from either the product carried or outside sources such as weathering. The two points at which bins were introduced into the watermelon distribution system were at the location where melons were transferred from field trucks to over-the-road tractor-trailers during bin shipment and at the receiving warehouse during transfer from over-the-road semitrailers into the warehouse during bulk transport. The cost of bins, as shown in table 1, was incurred at these times. This table illustrates only the initial cost of the five bins used in this study. In actual practice initial bin costs would vary considerably depending on the type of bin used. Also, the initial cost of a bin could be allocated among a number of shipments if bins could be reused.

For bins to be reused in shipping melons by the bin method, they must be returned to the point of origin from the retail store. When melons are shipped by the bulk method they are transferred into bins at the receiving warehouse for shipment to the retail store. For these bins to be reused they have to be cycled between the receiving warehouse and the retail store. The detailed costs involved in returning bins for reuse and the number of times a bin can be reused may be the next step in any future studies. Also, the authors recommend that the loading of bins in the harvesting field be the subject of future study.

Discussion

Distribution of watermelons is highly dependent on changing market conditions throughout the season. Watermelons have traditionally been transported bulk-stacked in closed or open-top trailers from growing areas to market. The trend toward unitization in the produce industry has caused watermelon shippers, carriers, and receivers to consider unitized bin shipment of watermelons.

The limited number of shipments that the authors observed during these tests and the variety of conditions that the melons encountered during the distribution process preclude any meaningful statistical comparison of data. However, correcting many adverse transportation and handling procedures revealed during shipment observation could lead to significant reduction in losses at the retail level.

Precautions to be observed in bulk-loading melons are as follows:

- Melons can be damaged if sufficient straw is not used for their protection, especially at front wall of trailer, at rear between melons and bracing, and on the floor. This is particularly the case when melons are transported in a trailer that does not have a flat floor. A minimum of four bales of straw should be used.
- Trailer should be adequately vented. An enclosed trailer should have two vent doors on the front and two on the rear; otherwise, overheating of melons can result in increasing decay and melon loss.
- Bracing at the rear of the load should be secure enough to withstand vibration during transit. Considerable melon loss can result at the rear of the load if bracing collapses or shifts.

Bruising and damage of melons can be minimized by observing certain precautions when loading bins, such as:

- Over-filling of bottom bin can result in damaged melons if bottom of top bin or bottom of pallet rests on top of melons in lower bin.
- Melons in bottom layer of bin can be damaged by pallet boards if melons are not protected.
- Any protective cover on pallet stringers used to protect bottom layer of melons from damage should have holes for air circulation.
- When bins are stacked two high, secure the body of the top bin to the pallet on which it is sitting to prevent vibration during transit causing the bin to ride up and allowing melons to fall out the bottom of the bin. Tube-type bins without bottom flaps extending under the melons can ride up, because melon weight does not hold them down during transit.
- To avoid telescoping of bins and/or leaning of top bins, use only undamaged pallets. Also, take care to place top pallets so that they are properly seated on the bottom bins.
- Use pallets of the correct size to match the particular bin to prevent top-stacked bins from falling into bottom bins and causing melon damage.
- Use pallets in good condition; damaged pallets used with top-stacked bins can break and damage melons in lower bins.
- Trailer should be adequately vented.

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