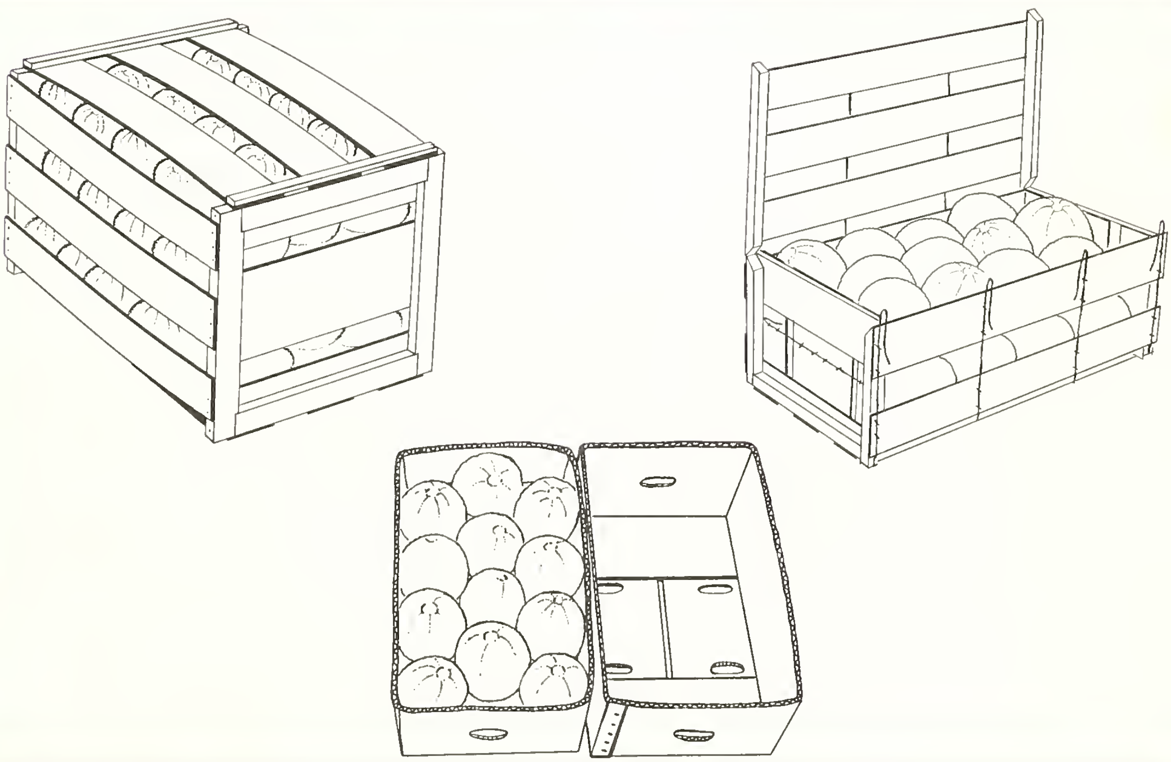
NEW SHIPPING CONTAINERS FOR CANTALOUPS

A STUDY OF WAYS TO REDUCE DAMAGE AND COSTS



UNITED STATES DEPARTMENT OF AGRICULTURE
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Growth Through Agricultural Progress

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PREFACE

Costs of containers and of loading, transportation, and other handling make up a substantial part of the total costs of marketing cantaloups and various other fruits and vegetables. The size, shape, construction, and other characteristics of containers affect to a large extent the efficiency and economy with which most perishable foods can be packed, handled, transported, and refrigerated during marketing. These same characteristics of containers also determine how well perishable commodities can be protected against physical damage and spoilage during marketing. Several different types of containers for cantaloups have been developed and introduced during the past three shipping seasons. This study was made to evaluate the new designs as well as methods of loading and handling the containers. The study is part of a continuing program of research conducted by the Agricultural Marketing Service to reduce costs and improve the efficiency of marketing agricultural products.

ACKNOWLEDGMENTS

The cooperation and assistance of many persons and organizations made this study possible. The Fresh Products Standardization and Inspection Service, Fruit and Vegetable Division, Agricultural Marketing Service; the Railroad Perishable Inspection Agency, the Wooden Box Institute, the Package Research Laboratory, the U. S. Forest Products Laboratory, the Western Growers Association, and individual cantaloup shippers and receivers, container manufacturers, and transportation agencies made their products, facilities, services, and technical assistance available for this research. The following personnel of the Transportation and Facilities Research Division of Agricultural Marketing Service performed field and statistical work: Kenneth Myers, Boris P. Rosanoff, Ronald A. Shadburne, Russell H. Hinds, Jr., Peter G. Chapogas, and Philip W. Hale.

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HIGHLIGHTS

Savings made possible by use of one or more of the new containers described in this report can be as much as $3 million a year. This amount is equivalent to about 6 percent of the average farm value of cantaloups for the 1957 and 1958 seasons. The savings are in reduced costs for containers, packing, loading, transportation, and refrigeration; also in less damage to containers and less bruising of melons. In addition to the savings in marketing costs, the melons will have greater shelf life and better quality for the consumer.

Tests of new shipping containers for cantaloups showed that three of the containers are cheaper to pack and ship and they protect the melons better than the jumbo wooden crate in general use at the beginning of this study. The three containers are: A nailed wooden crate--the WGA (Western Growers Association) jumbo crate (railroad tariff identification No. 1220), similar to the conventional crate but with wider slats and panel-end construction; a 2/3-capacity wirebound crate (two-thirds as large as the conventional crate), No. 5104; and a 2/3-capacity, full-telescope fiberboard box, No. 6560.

High costs and extensive container damage and melon bruising are associated with the use of conventional jumbo crates. In 1957, for example, the cost of loss and damage in transit to the rail carriers alone was more than $1,600,000, or almost $80 per car. These costs, together with the increases in costs of packing, transportation, and refrigeration in recent years, have led many cantaloup shippers, container manufacturers, and transportation agencies to seek improved containers. This research, in which 5 different designs of 3 major types of containers were studied, was conducted over a 3-year period and involved a total of 344 controlled test and check shipments and commercial trial rail shipments.

Shipments of 2/3-capacity fiberboard boxes had only one-twentieth as many damaged containers as shipments of conventional jumbo crates. Container damage in shipments of 2/3-capacity wirebound crates was only one-fourth that found in shipments of conventional crates. The WGA jumbo crate shipments sustained half as much container damage as control shipments of conventional crates. These reductions in the rates of container damage can lower the cost to the rail carriers alone by more than $1 million annually.

Melon bruising sufficient to affect the grade of the commodity averaged only 1 percent for the 2/3-capacity fiberboard boxes and 2 percent for the wirebound crates, compared with 6.7 percent for conventional jumbo crates. The new WGA jumbo crate shipments averaged only about half as much melon bruising as shipments of the conventional crates, 3.8 percent compared to 6.7 percent. Bruising was heavier in containers adjacent to bunker bulkheads at the ends of the cars than in containers in the quarter-length positions and in the doorway area in the center of the cars. Bruising was also greater in the bottom layer of containers and was progressively less in upper layers of each load.

A few test shipments with a 3/4-inch deeper WGA crate indicated that melon damage affecting grade might be reduced as much as two-thirds compared with the standard 13-inch depth.

Average pulp temperatures of the melons upon arrival at destination markets showed variations of only 1 to 2 degrees between the different designs of containers studied. Melon temperatures in almost all shipments were found to be within the desired range. Melon firmness upon arrival at destination markets, which is related to adequacy of precooling and transit refrigeration, did not show much variation between the different containers studied.

Comparison of production labor requirements to pack and load an equivalent number of cantaloups showed small differences between the different designs of containers studied. The new WGA crate required almost the same amount of production labor as the conventional crate. The 2/3-capacity fiberboard box had the lowest total labor requirements on a jumbo crate-equivalent basis. The wirebound crates required only slightly more production labor than the conventional or WGA crates for the same quantity of melons.

In 1958,the total cost of labor, materials, freight, and refrigeration required to pack and ship cantaloups from central California to New York, N. Y., was 26 cents less per standard crate equivalent for a 560-box load of 2/3-capacity fiberboard containers than for the usual 288-crate load of conventional crates. This saving was realized from the lower incentive freight rate which applied on the heavier four-layer loads of fiberboard containers and the resulting lower refrigeration costs per container. Standard 324-crate loads of WGA crates produced a saving of 5 cents per crate. The 432-crate loads of 2/3-capacity wirebound crates, however, cost 9 cents more to pack and ship on the same crate-equivalent basis than the conventional crates.

Even greater savings in transportation and refrigeration costs could be and now are being realized from the low freight rates on heavier loads of all three new containers. Total potential savings from this source ranged from 3 cents per jumbo crate equivalent or $8.81 per car for a 448-box load of 2/3-capacity fiberboard boxes, to as much as 59 cents per jumbo crate equivalent or $283.97 per car for a theoretical load of 720 2/3-capacity wirebound crates. The saving realized by using a four-layer load of WGA crates was $197.16 per car. The incentive rates for heavier loading also made possible a saving of as much as $123 per car on a four-layer load of conventional crates compared with the standard three-layer load. The potential savings in both freight and refrigeration costs varied directly with the size of the load and the distance the shipments were transported.

In the 1958 season, the first year the incentive freight rates on cantaloups were in effect, only 3 percent of the shipments unloaded in 39 eastern markets were heavy enough to take advantage of the rates. This proportion increased to 68 percent of the total shipments unloaded at the same points during the 1959 season. A comparison of standard and heavier loads during the 1959 season revealed little difference in rates of container damage between the different sizes of loads.

NEW SHIPPING CONTAINERS FOR CANTALOUPS

A Study of Ways to Reduce Damage and Costs

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BACKGROUND

In 1958, U. S. farm income from cantaloups totaled $47,558,000. The leading producing States were California with 46,100 acres, Arizona with 12,800 acres, and Texas with 15,000. It is estimated that damage to the melons after they leave the farm costs marketing agencies approximately $4 million annually, or about 9 percent of the farm value of the crop. These losses contribute substantially to the relatively high cost of marketing the melons, which in the long run tends to limit consumption and market outlets for the commodity.

A large part of the loss in the marketing of this crop occurs during rail transportation of the spring and midsummer crops of melons from California, Arizona, and Texas to many large eastern markets. This loss has been characterized not only by broken and demolished containers with the resulting loss of part of the contents, but also by considerable melon bruising. Although many severely bruised melons are discarded in the repairing of thousands of crates each year when the cars are unloaded, a considerable number of slightly and moderately bruised melons in undamaged crates reach the retail stores, resulting in losses and reduced shelf life at that point and after purchase by the consumer.

Damaged containers cost the railroads $1,610,637 in damage claims in 1957. Total claim payments covered 20,160 cars of cantaloups originated during 1957 by class I U. S. railroads, for which they received total freight revenue of approximately $13,200,000. The claims amounted to more than 12 percent of the revenue, or $79.89 per car. In 1957, loss and damage claims paid on rail shipments of cantaloups were higher than claims on all but two other commodities. At no time from 1950 to 1957 have total claim payments for this commodity been less than $1 million a year.

It was known for many years that the principal cause of this extensive economic loss during transportation was the inadequacy of the standard jumbo crates in which the melons were packed and of the conventional lengthwise-on-sides loading pattern used for rail shipments of the containers. Research conducted by the Department of Agriculture and the Western Growers Association in 1951 and 1952 revealed that container damage in transit could be reduced by two-thirds and melon bruising by half when the standard jumbo crates were loaded upright on end instead of lengthwise on sides. 1/ Cantaloup shippers, however, did not adopt the new loading method, and container damage and melon bruising remained high.

1/ Winter, J. C., and Masters, Bryce M. Loss and Damage in Transportation of Cantaloups, 1950-52. Prod. and Mktg. Admin., U.S. Dept. Agr. May 1953.

During the 1956 and 1957 shipping seasons several new types of cantaloup containers which showed promise of effecting a considerable reduction in container damage and melon bruising during transit were introduced in the west coast shipping areas. The new containers included (1) an improved nailed wooden container, known as the WGA (Western Growers Association) panel-end crate, (2) a full-telescope fiberboard container, and (3) a new type of wirebound container. This study was undertaken to (1) determine whether the new containers would significantly reduce container damage and melon bruising, (2) measure the economies that might be achieved from use of the new containers, and (3) assist shippers in developing and testing the most effective method of loading and bracing the new containers for shipment.

This study was begun late in the 1956 shipping season with shipments from California and was continued through the 1957 and 1958 cantaloup shipping seasons in California and Arizona. It covered 172 controlled test and check shipments and 172 commercial trial shipments. Container damage and melon bruising during packing, loading, transportation, and unloading were studied. Studies also were made of costs of labor and material for packing, loading, transporting, and refrigerating the melons packed in the four most popular types of shipping containers.

EXTENT AND TYPE OF TRANSPORTATION LOSSES

The increasing cost of damage to cantaloups shipped in conventional nailed wood jumbo crates, the principal containers for many years, was the primary factor which led to experiments with new containers and loading methods developed by the industry.

The high rate of damage to melons and containers can be attributed to the construction as well as the loading arrangement of the conventional crate. The narrow slats at sides, top, and bottom are just far enough apart to allow some melons adjacent to the slats to be slightly wedged between them in packing. Therefore, some degree of bruising occurs in the packing and lidding of the crates. However, most of the moderate to severe damage to melons resulted from the longitudinal flexing and failure of the containers in transit. The beveled top edges of the side slats offer some protection to the melons, but a considerable amount of damage, commonly referred to as "slat cuts and bruises," occurs when the melons are shipped in conventional containers.

Lengthwise loading subjects the weakest components of the crates--the narrow slats at top, bottom and sides--to the longitudinal impacts encountered in rail transportation. A further hazard is the fact that the slats are already bulged outward from the internal pressure of the tight pack. Consequently, a high number of damaged crates was found in practically every load of conventional jumbo crates received at destination, with buckled and broken slats, sprung end-frame joints, or broken posts and rails.

Total and average claim payments per car by class I railroads for loss and damage to cantaloups from 1946 to 1957 are presented in table 1. Total claim payments for the 12-year period averaged $1,302,748 a year, or $66.19 per car. The number of cars originated averaged 23,620 a year, and the average payment per car ranged from $36.99 in 1950 to $79.89 in 1957. Although the number of cars shipped in 1957 was 15 percent less than the 12-year average, the cost per car increased 17 percent over the average and 20 percent over the figure for 1956, based on 3,268 more cars than in 1957. For 1954, 1955, and 1956, cantaloups ranked third highest for a specific commodity among the railroads' total damage claim payments on all carloads of fresh fruits, melons, and vegetables shipped. In 1957, cantaloups ranked highest in total claim and third highest in claims per car.

Table 1.--Payments by class I U. S. railroads for loss and damage claims on shipments of cantaloups, 1946 to 1957

Year	Cars originated	Loss and damage	
		Total	Average per car
	Cars	Dollars	Dollars
1946....	21,877	$1,227,028	$56.09
1947....	22,519	1,407,846	62.52
1948....	22,115	1,622,825	73.38
1949....	22,044	1,476,572	66.98
1950....	24,386	902,038	36.99
1951....	24,413	1,011,919	41.45
1952....	23,136	1,282,447	55.43
1953....	25,431	1,249,624	49.14
1954....	28,651	1,268,444	44.27
1955....	25,290	1,072,675	42.41
1956....	23,428	1,500,918	64.07
1957....	20,160	1,610,637	79.89

Data from FCD Circulars 1300, 1340, 1390, 1431, 1468-R, 1503, 1554, 1589, 1620, 1655, 1689, and 1720, Freight Claim Division, Association of American Railroads. These circulars do not segregate claim payments by cause of damage.

Claim payments for cantaloups, by type or cause of damage, reported by class I railroads for 1948-52 and 1957 are shown in table 2. The Association of American Railroads did not publish this type of data from 1953 to 1956. Analysis of available data shows that claim payments for "unlocated loss and damage" increased from 60 percent of all claims in 1948 to 85 percent in 1957. This category involves principally damaged containers and spillage, and the resultant visible damage to the fruit in the form of bruised, cut, cracked, and split melons. Claim payments for "delay in transit" absorbed 28 to 30 percent of the total from 1948 to 1951, but declined to 12 percent in 1957 while only 3 percent was paid in that year for miscellaneous causes involving improper handling, defective equipment, temperature failures, theft, fire, and train accidents.

Seasonal studies of unloads by the Railroad Perishable Inspection Agency show that 30,966 cars of cantaloups in conventional crates were received at 38 markets for the three seasons of 1956, 1957, and 1958. In all cars the crates were stowed in the conventional lengthwise-on-sides pattern.

Table 2.--Loss and damage claim payments for cantaloups by class I U. S. railroads reporting payments by type or cause of damage, 1952-48, 1957 1/

Year	Unlocated loss and damage		Delay in transit		All other causes 2/		Total	
	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent
1957...	1,225,813	85	168,200	12	39,454	3	1,433,467	100
1952...	932,162	78	196,806	16	66,732	6	1,195,700	100
1951...	620,608	67	256,475	28	45,872	5	922,955	100
1950...	644,237	68	252,205	26	59,392	6	955,834	100
1949...	922,193	64	423,677	29	96,384	7	1,442,254	100
1948...	938,722	60	478,905	30	154,991	10	1,572,618	100
Total or average	5,283,735	70	1,776,268	24	462,825	6	7,522,828	100

1/ Number of railroads reporting: 42 (1957), 52 (1950-51-52), 58 (1949), 56 (1948), representing 93 percent of the carload proportion of total claims paid on fruit, melons, and vegetables. Data from FCD Circulars 1715 (1957), 1555 (1952), 1504 (1951), 1466 (1950), 1427 (1949), 1385 (1948), Freight Claim Division, Association of American Railroads. These circulars segregate claim payments by type or cause of damage.

2/ Includes train accidents, thefts, temperature failures, defective equipment, improper handling, errors of employees, fires, and other causes.

Figure 1 shows the average number of damaged crates per car requiring recooperage and the number per car in bad order. Container damage rates, as reported by the Railroad Perishable Inspection Agency, are presented in terms of the number of damaged crates or boxes requiring recoopering.

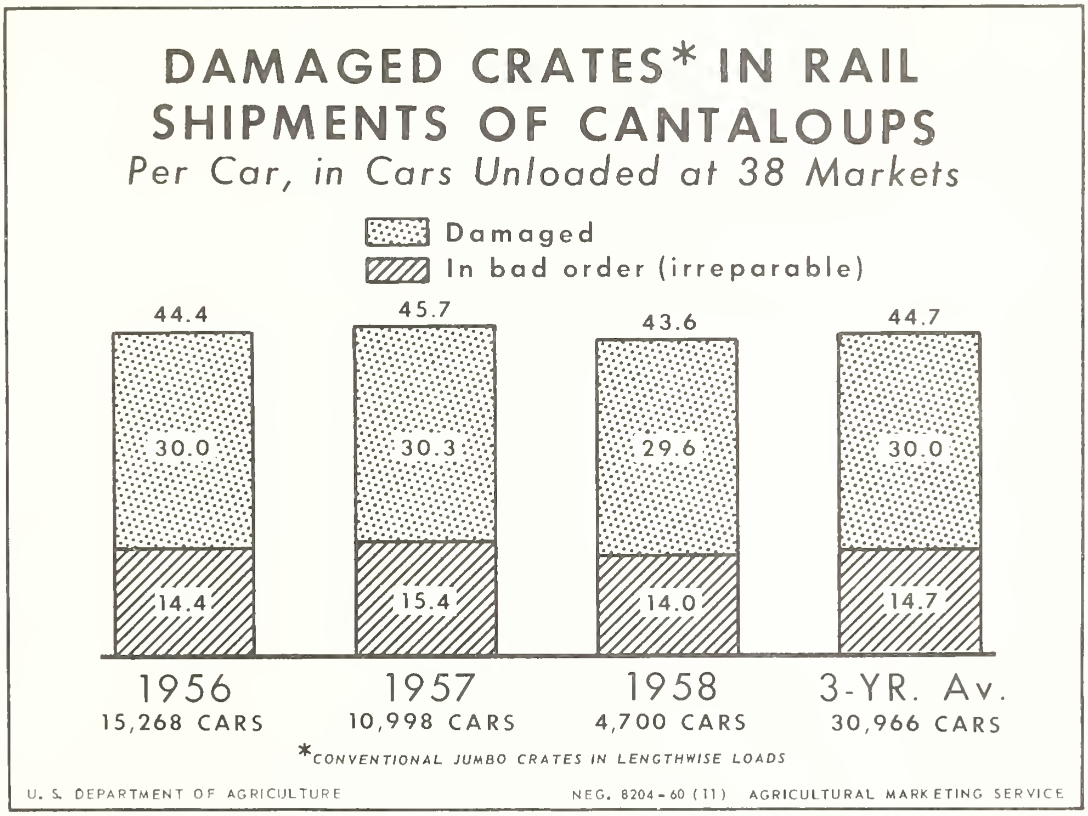

Figure 1.

Cooperage personnel repair as many of the damaged crates as possible through replacement of loose or broken container parts (figs. 2 and 3). Containers which are so damaged that they cannot be restored are classified as "bad order," including part-out (partially empty) and empty containers. Part-out and empty crates result from spillage or from replacement of damaged melons in making "good order" packages. Throughout this report, containers described as "requiring recooperage" include those in irreparable "bad order."

Total annual receipts of cantaloups in conventional jumbo crates at 38 principal markets decreased from 15,268 carloads in 1956 to 10,998 in 1957 and 4,700 in 1958, while the rate of container damage remained almost constant (fig. 1). The reduction in number of cars of conventional crates unloaded during the 1957-58 seasons is largely due to the increased use of new and improved shipping containers. In 1958, approximately 75 percent of western-grown melons were shipped in improved crates which were loaded by a new method.

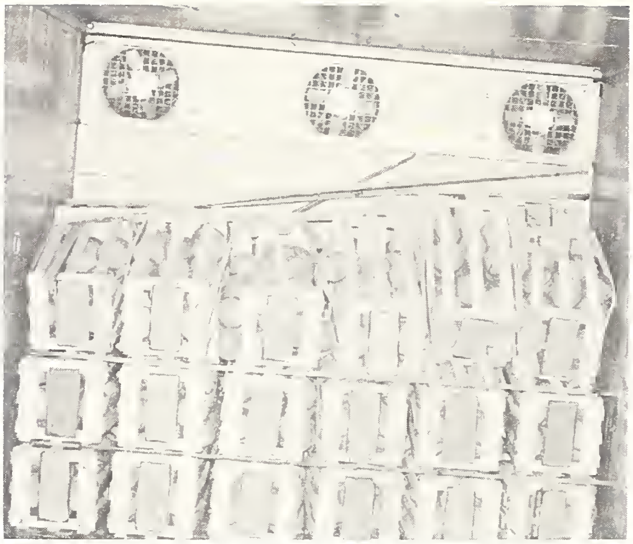

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Figure 2.--Cross section of a partly unloaded shipment of cantaloups in conventional jumbo crates showing container breakage in load at one end of car.

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Figure 3.--Top view of load of cantaloups in conventional jumbo crates in one end of car showing buckled and broken slats.

Test Procedure

A survey of cantaloup shippers in each major producing district of California and Arizona to develop information required to plan the study was made before any shipping tests were undertaken.

The melons in the test and check shipments were inspected at both shipping point and destination by the Federal-State and Federal fresh product inspectors. Information on the quality and condition of the melons, extent of bruising injury, number of cracked, split, rubbed, scuffed, or decayed melons, and location and cause of principal damage was recorded on special forms.

A random sample of containers in each shipment was taken at shipping point for melon inspection as the cars were being loaded. At destination the melons in randomly stratified samples from each layer in the quarter-length and doorway areas of the cars were inspected.

Information on the loading pattern, bracing method, cooling method, pulp temperatures, and protective service provided in transit was developed for each shipment. Type and extent of container damage and failure were also studied. Time studies were made to determine the production labor requirements for handling the four principal shipping containers used during the 1957-58 shipping seasons.

Impact recorders which measure the degree and frequency of longitudinal impacts received during transit were placed in as many shipments as possible to determine the handling received by shipments of each type of container.

Volume of Experimental Shipments

A preliminary study was begun in 1956 with rail shipments from the San Joaquin Valley of California to principal eastern markets. A total of 20 commercial trial shipments of cantaloups packed in fiberboard containers was originated. No attempt was made to establish controlled test conditions for the shipments nor to compare them with shipments of conventional shipping containers. The limited data from these preliminary shipments were used only to determine the practicability of fiberboard containers for hydrocooled and top-iced melons and to plan controlled tests which were made during the 1957 and 1958 seasons.

In the 1957 season 76 controlled test and check shipments and 10 commercial trial shipments were made. From 1 to 32 shipments were made with each of 7 designs of experimental containers.

During the 1956-57 shipping seasons, no experimental tests were originated from the desert regions of southern California and Arizona. New or improved containers and loading methods were not adopted in the desert area until they had been successfully used for one season in central California. This was due primarily to the greater length of the shipping season in the central California producing area which permitted more time for experimentation.

In 1958, from May to September, a total of 86 controlled test and check shipments and 152 commercial trial shipments were made. The study was confined to containers which had given best results in the previous season.

Consideration of Marketing Requirements

After conducting a survey in 1957, the National Association of Food Chains reported that "food chain produce operators are generally of the opinion that shippers are attempting to cram too many cantaloups into the present slat-type container. 2/ Principal reason for dissatisfaction was excessive damage, bruising, and crushing by slats when bulge-packed. They recommended either that fewer cantaloups, specially padded, be shipped in the present type containers, or that a new type of container be designed which will permit all-around protection for the fruit. A number suggested a new two-row crate. Some suggested use of excelsior packing material. Others suggested a very sturdy carton instead of slatted crates." 3/

Shipments handled by chainstores are generally shipped directly to the chain-owned warehouse distribution center, where the contents are promptly unloaded for storage or for distribution to retail stores. The food chain's primary interest is in receiving shipments with a minimum of bruised melons and damaged containers. It is important that the containers permit heavy loading of cars without jeopardy to the product or containers. Maximum loads reduce the transportation cost per container because of multiple-minimum incentive freight rates, which are progressively lower on heavier loads. The design of a container to provide maximum visibility of the contents is of secondary importance.

In the terminal market, handling by wholesalers differs from that of the chainstore. The wholesaler must resell the products and satisfy numerous jobbers and independent retail stores before the products are made available to the ultimate consumer.

In view of the varied marketing requirements, the melon industry has endeavored to develop a new or improved nailed wood shipping container and loading method which would satisfy the needs of both wholesale and chainstore systems of marketing. Several types of fiberboard and wirebound containers were developed and tested, with satisfactory results.

Containers and Shipping Methods Studied

A total of 172 test shipments, ranging from 1 to 49 tests for each of 8 different experimental containers, was studied during the 1957 and 1958 shipping seasons. Concurrently, supplementary observations were made on 172 commercial trial shipments of these and other containers.

Four of the experimental containers studied in this report are identified with two container numbers, a different one for each year. During the experimental period, in 1957, they were identified by permit numbers which were assigned by the National Container Committee. Based upon the favorable result of the 1957 shipments, these containers were authorized in the governing freight container tariff and were assigned new numbers.

2/ The conventional nailed wood crate.

3/ Article from "United Fresh Outlook," United Fresh Fruit and Vegetable Association, April 11, 1959.

Descriptive information on all containers included in this study is presented in table 3.

Table 3.--Railroad tariff identification numbers and dimensions of cantaloup containers studied during 1957 and 1958 shipping seasons

Container, identification number, and cooling method 1/	Inside dimensions			Outside length	Capacity
	Depth	Width	Length		
	Inches	Inches	Inches	Inches	Cubic inches
Nailed wood (top iced):					
No. 1152, conventional jumbo crate	13	13	21-7/8	23-1/4	3,697
No. 1220 or 85-39, improved jumbo crate	13	13	21-7/8	24-1/2	3,697
No. 85-75, improved jumbo deep crate	13-3/4	13	21-7/8	24-1/2	3,910
Fiberboard:					
No. 6560 or 85-972, 2/3-capacity box (hydrocooled)	10	13	21-7/8	-	2,844
No. 85-270, 2/3-capacity full-telescope box (top-iced)	9-3/4	13	22	-	2,789
No. 85-308 or 85-52, 2/3-capacity full-telescope box (forced air)	9-1/2	13	22	-	2,717
No. 85-308 or 85-52, 1/2-capacity full-telescope box (forced air)	9-3/4	13	17-1/4	-	2,186
Wirebound (top-iced):					
No. 5104 or 85-93, 2/3-capacity crate	9	13	22-1/2	24-3/4	2,633

1/ Container numbers are those assigned by the National Container Committee. Where more than one identification number is shown, the first number was the one used in 1958 and the second number was the one used in 1957.

Nailed Wood Crates

No. 1152, Conventional Jumbo Crate

For many years, the conventional jumbo crate has been the principal shipping container for cantaloups. For a short time, at the beginning of harvest in each area, a number of the first melons harvested are packed into the so-called "standard" and "pony" wood crates. These two containers have a smaller capacity, 3,150 and 2,647 cubic inches, respectively, than the jumbo crate with 3,697 cubic inches. However, the container design and loading method used for all three containers are the same. The two small crates are used only at the beginning of harvest when most of the melons are too small for packing into the large jumbo crate. No test shipments were conducted with the small containers.

The nailed wood jumbo crate No. 1152 is constructed with fairly substantial end-frame units, but with narrow side, top, and bottom slats. The end-frame structure consists of two triangular posts, two rails 11/16 inch thick by 2-5/8 inches wide, and one end panel 5/16 inch thick by 4-7/8 inches wide. Twelve slats (3 for each side, top, and bottom), 3/8 inch thick by 1-7/8 inches wide, complete the container.

The net weight of the conventional crate varies with the number of melons packed in it. Shippers and receivers refer to the size of pack by the number of melons in the crate--18, 23, 27, 36, and 45. Figure 4 shows a conventional crate packed with 27-size melons. All sizes of pack in the conventional crate are shipped under a railroad tariff estimated billing weight of 88 pounds.

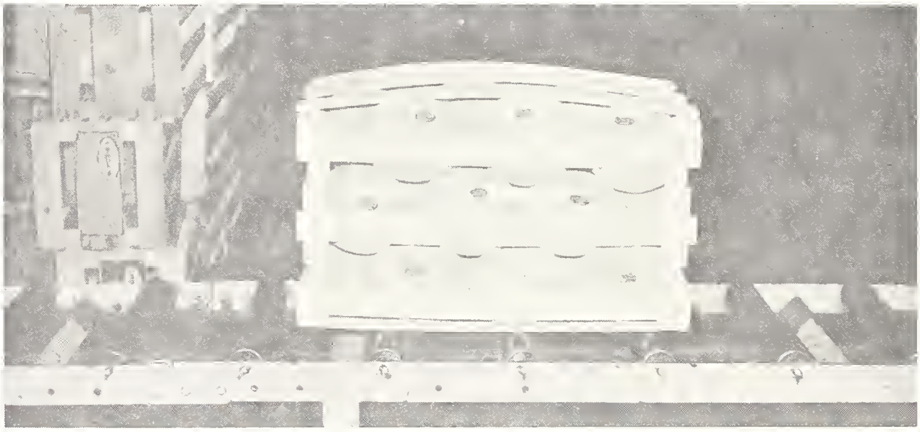

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Figure 4.--A 27-size pack of cantaloups in a conventional nailed wood jumbo container (No. 1152), showing the narrow slats.

Method of loading and refrigeration.--Conventional crates are loaded in a standard refrigerator car in an on-sides, lengthwise divided and stripped loading arrangement; 3 layers high, 6 rows wide, 16 stacks long, with 8 stacks in each end of the car, making a load count of 288 crates. 4/ Figure 5 shows a partly completed load in one end of the car. Each layer of crates in each stack is stripped crosswise of the car with two car strips measuring approximately 3/4-inch by 1-1/2 inches by 8 feet, one butting one sidewall of the car and the other butting the opposite sidewall to prevent crosswise movement of the crates. All space lengthwise of the car, not occupied by containers, is taken up by a centergate (type A in the Freight Container Tariff) which is installed in the doorway area of the car. The type A centergate is constructed with 2- by 4-inch uprights and joined by 2- by 4-inch spreaders, with 1- by 4-inch crosspieces facing the containers adjacent the doorway area. The top of one upright on each side of the centerbrace is capped with a small piece of 2- by 4-inch material, which

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4/ Layer: A course of stratum of the load, parallel to the floor of the car and one container in height.
Stack: A pile of containers extending from one side of the car to the other, parallel to the end of the car, and one container in length.
Row : A pile of containers extending lengthwise of the car, parallel to the sides of the car, and one container in width.

extends them to within 1 inch of the car ceiling. This prevents the centergate from moving up and out of place from its position between the two ends of the load, if the load should develop lengthwise slack and loosen in transit.

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Figure 5.--The standard loading pattern and method of stripping conventional jumbo crates No. 1152 in a standard refrigerator car.

Figure 6 shows the doorway area of a car with the centerbrace installed. The space between the two ends of the load in the doorway ranges from 21 to 28 inches, depending upon the inside dimensions of the car being loaded and the condition of the floor racks and bunker bulkheads.

Most conventional crate loads are top-iced and fan-cooled in the car by the shipper (Rule 242 of the Perishable Protective Tariff), with approximately 5,000 pounds of crushed ice. The top ice must be melted in cooling or removed from the body of the car before delivery of the shipment to the initial carrier. Some loads are not fan-cooled at origin prior to shipment. These are initially top-iced with 10,000 pounds of ice applied by the shipper. The ice remains on the load and melts in transit. Under both types of protective service, the cars are shipped under Standard Refrigeration which provides for initial bunker ice and re-icing of bunkers at regular icing stations in transit.

<u>WGA Jumbo Panel-end Crate</u>

The WGA panel-end crate was first used on a limited experimental basis during 1957, under National Container Committee permit No. 85-39. Several shippers used it in central California during the entire season and a few shipped from 10,000 to 20,000 crates to test the new container. Early in 1958 the new crate was authorized and identified as No. 1220 in railroad Freight Container Tariff 1-E. 5/ Most shippers in central California began using the WGA crate in 1958. Approximately 75 percent of all cantaloups shipped from California and Arizona during 1958 were packed in the new WGA crates.

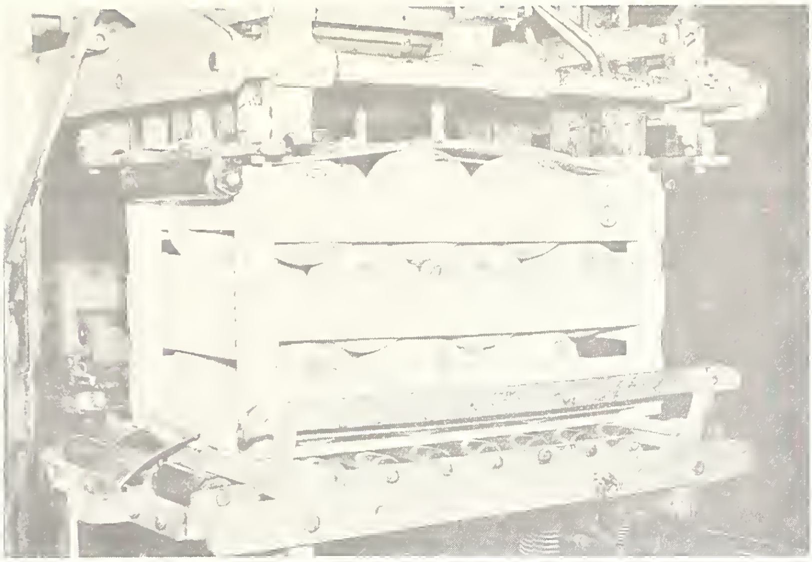
BN-11690

Figure 6.--Doorway area of a completed load of conventional jumbo crates (No. 1152) with type A centergate installed.

The improved jumbo WGA crate is constructed with sturdy end-frame units and wide slats at sides and bottom (fig. 7). Inside dimensions are the same as the conventional jumbo crate (table 3). However, the outside length of the improved crate, due to the thickness of the panel-end frame units, is 24-1/2 inches instead of 23-1/4 inches for the conventional crate.

The end frame consists of two rectangular posts and two rails with cross-section dimensions of 1-1/8 inches; and three panel pieces with an average minimum thickness of 3/16 inch and a minimum total width of 10-1/4 inches. The 1-1/8-inch surfaces of the posts are notched at the ends 1/4 inch deep and 1-3/8 inches long to accommodate the rails, providing a strong joint at the corners of the end frames.

5/ Pacific Coast and Trans-Continental Territories, Freight Container Tariff.



BN-11691

Figure 7.--A 27-size pack of cantaloups in the WGA jumbo nailed wood crate (No. 1220). Note the wide slats and panel-end frame of the crate which is being lidded in a semi-automatic nailing machine.

Nine slats, 5/16 inch thick and 2-7/8 inches wide (three on each side and three on the bottom), make up the base container. The top is a unitized cover consisting of three veneer slats joined together at each end by two cleats.

The same numbers of melons of the various sizes are packed in the WGA crate as in the conventional crate. The estimated billing weight for the WGA crate is 88 pounds, the same as for the conventional crate.

Method of loading and refrigeration.--Improved WGA jumbo crates are loaded on bottoms, crosswise of the car in a divided, nonstripped loading arrangement, 3 layers high, 4 rows wide, 26 or 27 stacks long, making a load count of 312 or 324 (fig. 8). The 26-stack loads were generally straight carloads of 27-size melons or loads consisting of mostly 27's and larger sizes. The greater side bulge of packs having melons larger than size 36 resulted in the loss of one full stack lengthwise of the car. A type B endgate was placed at one or both ends of some of the cars with 26-stack loads. Endgates or a spacing frame between the last stack and the bunker bulkhead at one end of the car are sometimes desirable to reduce the width of the doorway space where the centergate is installed.

All space lengthwise of the car, not occupied by containers, is squeezed out of the load by a mechanical squeeze machine. Upon completion of loading the squeeze machine is inserted between the two ends of the load in the doorway area of the car. After sufficient pressure has been applied to squeeze the load back toward each end of the car, the squeeze machine is removed and a type C centergate is placed in the doorway space (fig. 9).

BN-11692

Figure 8.--Cross section of a load of WGA crates, No. 1220, in a standard refrigerator car.

The difference between type A and type C centergates is in the construction material of that part of the gate which faces the load. Each side of the type A centergate, used in loads of conventional crates, is constructed with crosspieces of 1-inch by 4-inch by 8-foot lumber which is placed horizontally against the load. One crosspiece is placed opposite each intersection of the layers of containers so that it contacts the top of the containers in one layer and the bottom of the containers in the adjacent layer.

Each side of the type C centergate, used in loads of WGA crates (No. 1220), is constructed with uprights of 2- by 4-inch material placed vertically against the load. One upright is placed opposite the outer side of each outside row of containers and one directly opposite each intersection of two rows of containers. The other details of construction of the type C centergate are the same as those for the type A gate (fig. 6).

The same methods of top-icing, cooling, and in-transit refrigeration were used for loads of WGA crates as for loads of conventional crates.

Experimental Container No. 85-75, Deep Panel-End Jumbo Crate

This modified container was identical in every respect to the WGA No. 1220 crate, except that it was 3/4 inch deeper. Methods of assembling, packing, lidding, loading, bracing, and refrigeration were the same as for the WGA crate (No. 1220).

The purpose of a deeper crate was to lower the cover bulge so that the crates, when stacked on bottoms, would rest upon the cover cleats instead of resting partly on cover bulge of the crates of the lower layers, thereby reducing the amount of serious melon bruising in lower crates. Only three tests with the deep panel-end crate were originated during this study.

BN-11693

Figure 9.--Doorway of a completed load of WGA crates (No. 1220), showing the type C centergate installed.

Fiberboard Boxes

No. 6560 (85-972), 2/3-Size Box

More than 50,000 of these containers were shipped during each of the 1957-58 shipping seasons from the San Joaquin Valley of California.

Container No. 6560 has two pieces, each of half-slotted construction, one piece forming a full-depth bottom section and the other forming a full-telescoping cover (fig. 10). The inside dimensions are depth 10 inches, width 13 inches, length 21-7/8 inches. The capacity is 2,844 cubic inches.

An inner liner, made of one piece, is scored to form two full-dimensioned side panels scored lengthwise at the center. The liner is inserted in the bottom section of the container and the first layer of melons is packed with the side panels of the inner liner bearing against the side panels of the bottom section. The side panels of the liner are then folded at the center score line over the first layer of melons, forming a separating pad between the first and second layers of melons.

BN-11694

Figure 10.--The 2/3-capacity fiberboard box, container No. 6560. From L to R: Filled box with cover section in place; open pack of 24 melons; inside of cover section showing ventilation and hand-hold slots.

Ventilation is provided by two slots in each outer flap of the cover and the bottom section, with four slots in the bottom of the liner positioned to coincide with those in the outer bottom flaps. Each end of the cover and the bottom section is provided with a hand-hold opening positioned so that they match when the container is closed.

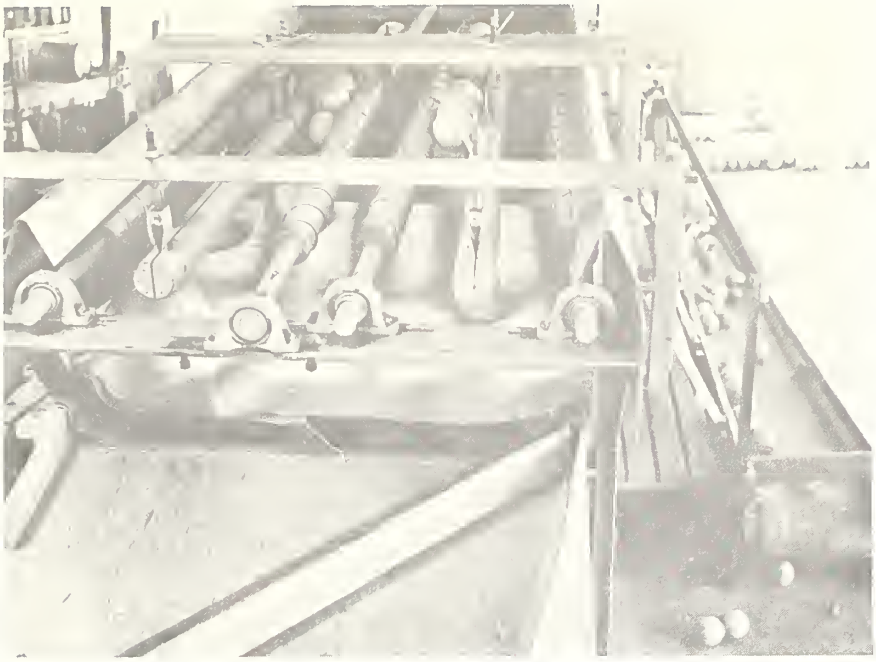
No more than two layers of melons are packed in the 2/3 box. The number of melons in a box may be 30, 24, or 18, corresponding to two-thirds of the size 45, 36, and 27 melons in a standard jumbo crate. Melons larger than size 18 (based on jumbo count size) are usually packed in jumbo wood containers.

All sizes of pack in No. 6560 fiberboard containers were shipped subject to actual gross weights, as no estimated billing weight was published in the governing freight tariffs for this container.

Packinghouse operation.--Before the melons were packed in No. 6560 fiberboard containers, they were moved through an ice-water bath. This method of precooling is known as hydrocooling. From the hydrocooler they were graded by hand as they moved along a conveyor belt, on the way to the automatic sizing machine (fig. 11).

The spiraled roller sizing machine operated on the same principles as similar sizers used for citrus and other commodities (fig. 11).

A series of conveyors, directly under the sizer, carry the different sizes of melons (45, 36, 27, 23, and larger) to the packing bins. Melons too small for packing are conveyed to a cull chute.



BN-11695

Figure 11.--An automatic sizing machine used to presize cantaloups before they are packed.

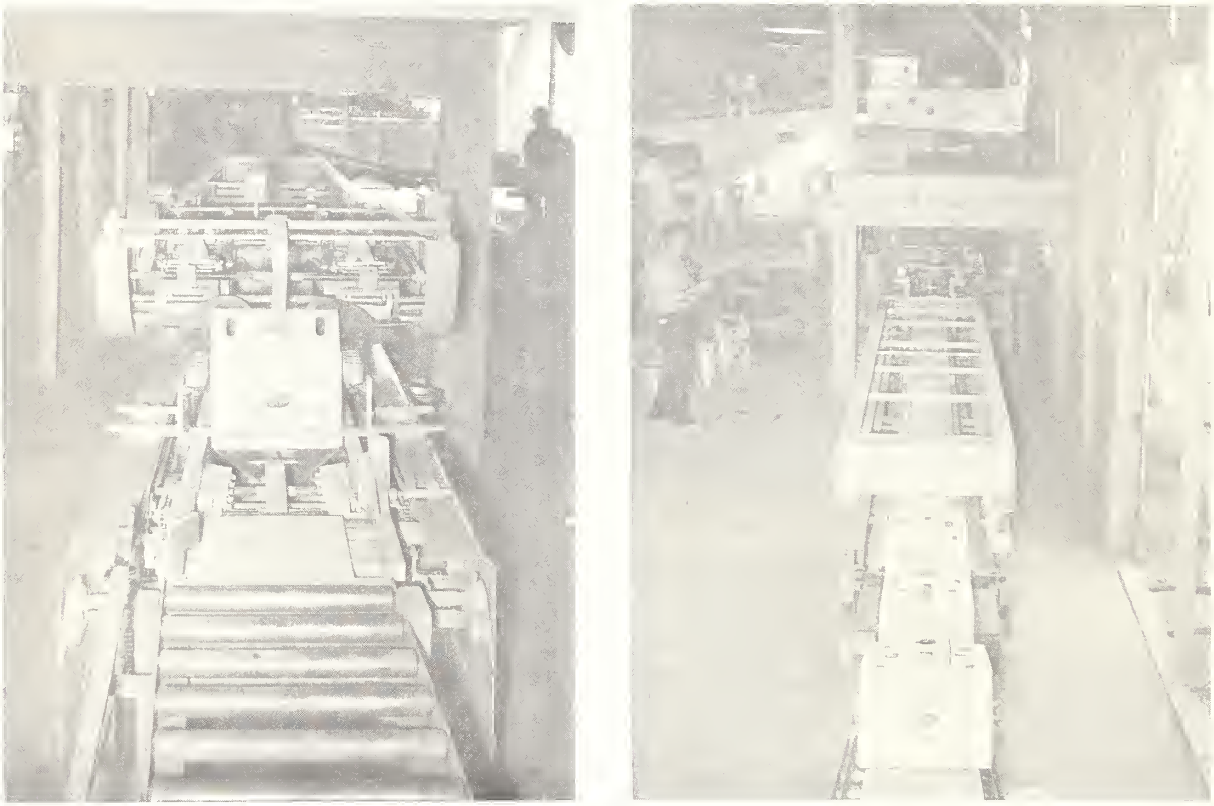
This packing procedure eliminates the necessity of having skilled packers to select the various sizes of melons by sight, from a bin of field-run melons of mixed sizes. However, since this entire packinghouse operation was being conducted experimentally and was still being improved during the 1957 and 1958 seasons, the overall production rate was similar to that found in plants where no sizing machines were used.

As each container was filled, it was set off on a conveyor for movement to an automatic case-sealing machine (fig. 12). Just before the packed bottom unit of the box entered the sealing machine, a full-telescope cover unit was placed on it.

In the first stage of the closing operation, the sealing machine applied glue to the top and bottom flaps and folded them in place. The closed containers were then conveyed directly into the second stage of the closing operation. Here they spent several minutes in a lineup where constant but light pressure was applied to the top and bottom flaps to allow the glue to set before the closed containers were handled further.

Loading and refrigeration.--During 1957, the No. 6560 fiberboard containers were loaded in a crosswise-on-bottoms, solid load (no centergate) with no strips between layers; 4 layers high, 4 rows wide, 28 stacks long. The total load count was 448 boxes. In 1958, with multiple-minimum freight rates in effect to encourage heavier loading, the loading was increased by 1 complete layer, making a load count of 560 (fig. 13).

Before the last few doorway stacks are loaded, the load in both ends of the car is tightened by use of the conventional squeeze machine. After sufficient pressure is applied to squeeze the stacks in each end of the car tightly together the squeeze machine is removed from the doorway area of the car. There usually is just enough lengthwise space remaining in the doorway, after squeezing, to permit loading of the last few stacks and make a tight, solid load.



BN-11696 BN-11697

Figure 12.--An automatic case-sealing machine. Left: Top and bottom flaps of a filled container are automatically positioned, glued, and closed. Right: Closed containers being conveyed out of the pressure line after the glue has set.

The railroad tariff load rules for this container specify that all lengthwise space in the car not occupied by containers must be taken up by endgates at one or both ends of the load. No cars with endgates were observed during the 1957-58 shipping seasons. All shipments in standard refrigerator cars were loaded tightly enough that no endgate space fillers were needed (fig. 14).

Temperatures of the melons, having been reduced by hydrocooling, were further reduced by fan-cooling in the car after loading (Tariff Refrigeration Rule 246). The shipper initially supplied 2 percent rock salt to the ice bunkers of the car to facilitate fan-cooling. All shipments moved under standard refrigeration (Tariff Refrigeration Rule 200), with special instructions to the carriers to supply 2 percent additional bunker salt at the first and second re-icing in transit.

BN-11698

Figure 13.--Cross section of the 5-high load used during the 1958 season for 2/3-capacity fiberboard boxes (container No. 6560).

The percentage of rock salt supplied is based on the total chunk-ice capacity for both bunkers of a standard refrigerator car, which is 10,000 pounds. Thus, 2 percent salt would amount to a total of 200 pounds (100 pounds to each bunker) when the bunkers are initially iced, or 2 percent of the amount of ice supplied during re-icing in transit.

To reduce absorption of moisture by the containers, the shipper distributed from 25 to 50 pounds of rock salt under the floor racks of each car of fiberboard containers. The salt absorbed water accumulating at this location from condensation or overflow from the ice bunkers.

Experimental Container No. 85-270, 2/3-Size Box

A number of containers similar to experimental container No. 85-270 were used on a limited scale during the 1957 season, along with different methods of loading. All shipments were top-iced and fan-cooled in the cars after loading. During 1958, approximately 15,000 boxes, which were basically the same design as experimental container No. 85-270, were shipped on a trial basis to principal eastern markets.

The container consisted of two pieces, each half-slotted construction, one piece forming a full-depth bottom section and the other forming a full-telescope cover section. The outer top and bottom flats lacked 1 inch of meeting when they were closed. The top edge of the body section had 3-inch-long flaps to prevent bulging of the sides during packing and transit. For protection against moisture from the top ice, the outside of the top section of the box was treated with a protective coating of polyethylene and wax.

BN-11699

Figure 14.--Doorway area of a completed solid load of 2/3-capacity fiberboard boxes (container No. 6560). No centergates or space fillers were used in these loads.

A flat one-piece corrugated pad was placed in the bottom section of the box. A one-piece corrugated inner liner, scored to form two full-dimensional side panels and a cover, was used in the cover section of the box. The liner, like the cover, fitted down over the outside of the bottom section of the container when closed. The component units of the container are shown in figure 15.

Like the other fiberboard boxes, only two layers of melons were placed in experimental container No. 85-270. Also, as in the other fiberboard boxes, the sizes packed, determined by the number of melons, were 15, 18, 24, and 30, which correspond to jumbo pack sizes of 23, 27, 36, and 45.

No melon sizing machine was used. Melons of different sizes were selected by sight from bins of unsized field-run melons. All freight charges were assessed on the basis of the actual gross weight, as no estimated billing weight for this new experimental container was published in the governing freight container tariff.

BN-11700

Figure 15.--Component units of the 2/3-capacity fiberboard experimental container No. 85-270. At top, outside view of cover section; left, inside view of bottom section showing lock flaps around top outside edge; right, inside view of cover section with inner liner inserted; bottom, one-piece pad used in bottom section.

Method of loading and refrigeration:--The standard loading pattern for experimental container No. 85-270 was the same as for the 2/3-size fiberboard container No. 6560: a crosswise-on-bottoms, solid, nonstripped load. However, all shipments were stacked only 4 high, making a 448-box load.

All shipments were initially top-iced with an average of 3,900 pounds of ice per car. After icing, the loads were fan-cooled under Tariff Refrigeration Rule No. 242 and moved in transit under standard refrigeration (Rule 200) with special instructions (Rule 202) to supply 2 percent salt to the bunkers at the first and second icing stations in transit, calculated on the basis of the amount of ice supplied at time of re-icing.

Experimental Containers No. 85-52 (83-308), 1/2- and 2/3-Size Boxes

Two other fiberboard boxes used on a limited basis during 1957 and 1958, one a 1/2-size and the other a 2/3-size container, were identified by the same National Container Committee test permit numbers: 85-52 in 1957 and 83-308 in 1958. Both containers consisted of two pieces, each of half-slotted construction, one piece forming a full-depth bottom section and the other forming a full-telescoping cover section. The containers were designed for use with forced-air cooling of the melons in the rail cars after loading.

Each side panel of both sections of the 1/2-size box had 3 matching 1/2- by 4-inch ventilation slots and matching hand-hold openings in each of the end panels. The manufacturer's joint was taped.

Ventilation slots and hand-hold openings of the 2/3-size box were positioned the same as the 1/2-size box, except that there were four ventilation slots instead of three, and the manufacturer's joint was stitched instead of taped. Most containers were assembled with the top and bottom flaps stapled before packing. A few boxes in one test, however, had the flaps glued and closed in an automatic case-sealing machine.

Melons in both containers were packed two layers deep. The pack sizes, determined by the number of melons, were 18, 24, and 30 for the 2/3-size box and 15, 18, and 24 for the 1/2-size box, corresponding to jumbo crate sizes 27, 36, and 45. The packers sized the melons by sight and hand as the melons were packed.

Freight charges on shipments of both containers were assessed on the basis of the actual gross weight, as no estimated billing weight was published in the governing freight container tariff for these experimental containers. Only a few experimental shipments of these containers were originated.

Method of loading and refrigeration.--Specially designed fiberboard separators, or row spacing strips, were used to hold the containers in row alinement to facilitate the forced-air cooling. Before loading, strips of fiberboard running lengthwise of the car were stapled to the floor racks between the rows of containers. In manufacture, the strips were die-cut so that tabs or extensions could be raised between the rows of containers to hold them in place and thereby maintain row and stack alinement. The tabs also served to close or open the channel space between alternate rows of containers. Floor layer strips were placed with the tabs upright between rows. The tabs on strips in the upper layers of the load extended down between the rows of containers (fig. 16).

Top layer strips were applied to alternate rows so that when a channel was blocked at the bottom it was open at the top, and vice versa. Cool air from the ice bunkers entered the open channels from the top. These channels were blocked at the floor. The buildup of pressure forced air through the vents in the sides of the containers to an adjacent row channel where it passed through the floor racks for recirculation through the ice bunkers.

As an additional aid in maintaining row and stack alinement, the boxes loaded in the second, third, and fourth layers were moved through a double-wheel applicator which applied two strips of glue to the bottoms of the boxes. The boxes were then stacked in place in the load (fig. 17).

BN-11701

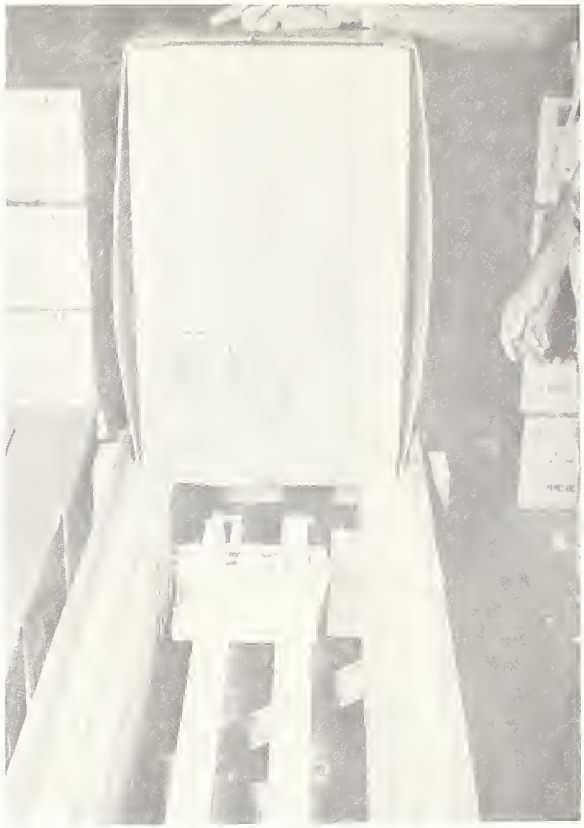
BN-11702

Figure 16.--Load of experimental fiberboard containers, No. 85-52. Left, guide row against one car wall. Note that the right-hand wall channel at the floor is open while the channel on the left adjacent to the space where the next row of containers will be loaded on the left is blocked at the floor rack. Right, top layer of load. Open channels at the top are closed at the bottom and vice versa between alternate rows of boxes.

The glue used for this purpose resisted horizontal movement of the layers of containers in transit (high-shearing resistance) but permitted easy vertical separation of the boxes without tearing (low-tensile bond).

The loading arrangement used for the containers was lengthwise-on-bottoms, four layers high and five rows wide. The loads were solid from one end of the car to the other with no spacing frames or centergates. Only two shipments were tested during this study. One car consisted of a mixed load with 280 of the 2/3-size and 80 of the 1/2-size boxes, making an 18-stack load of 360 boxes. The other car was a straight load of 1/2-size boxes making a 22-stack, 440-box load.

Before cooling the shipments of these containers by the forced-air method, 2 percent (200 pounds) of rock salt was equally distributed in the ice bunkers. After 2 hours of fan-cooling, an additional 2 percent (200 pounds) of salt was added to the bunkers. No more salt was added in transit. The shipments moved under standard refrigeration (Tariff Rule 200).



BN-11703

Figure 17.--Applicator used in applying glue to experimental fiberboard container No. 85-52. Note white strips of liquid adhesive on bottom of box.

Wirebound Crates

No. 5104, 2/3-Size Wirebound Crate

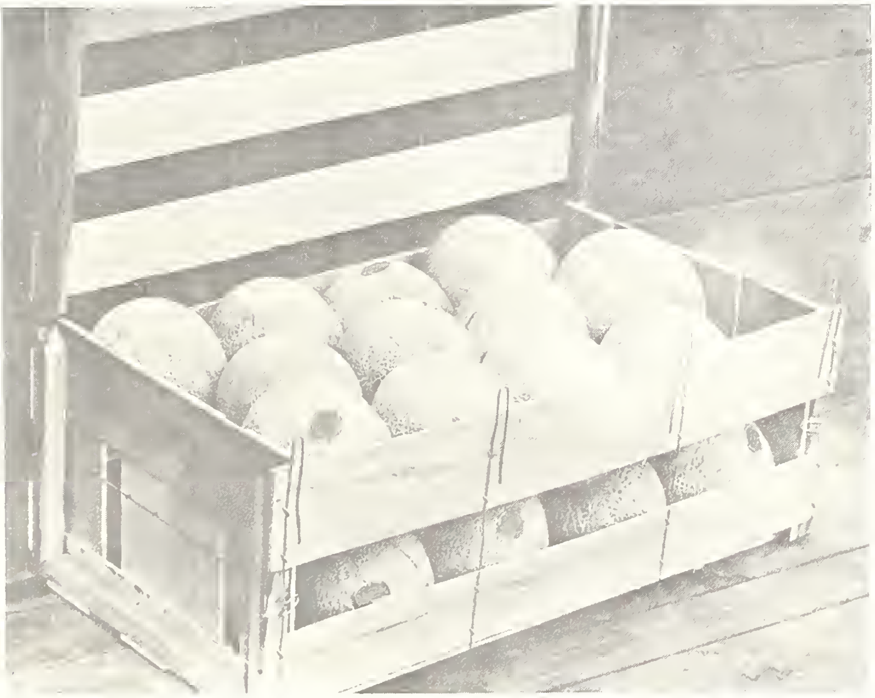
This container was shipped experimentally in 1957 under special permit, identified as experimental container No. 85-93. In 1958 it became authorized in the Pacific Coast Freight Container Tariff as container No. 5104.

Approximately 20,000 wirebound crates of melons were shipped by rail during the 1957-58 season. During this period, 20 test shipments to principal eastern markets were originated.

The blank section of the 2/3-size wirebound crate consists of four veneer side slats (two each side), three veneer bottom slats, three veneer top slats, three side cleats, four top and bottom cleats, and four 15-gage binding wires. Each of two cleated end units consists of three veneer slats, one veneer top strip, one veneer bottom strip, and one 16-gage wire. All of the parts of the container were assembled by the manufacturer with 20-gage staples. The end units were fastened only on one side so the empty containers might be shipped knocked-down in flat bundles. The final container assembly was made at the packinghouse by the shipper.

Two layers of melons were packed in the crates. The sizes packed, determined by the number of melons, were 12, 15, 18, 24, and 30, which correspond to jumbo sizes 18, 23, 27, 36, and 45. There were only a few size 12 packs. Most packs were 18, 24, and 30 (fig. 18). Freight charges on all shipments were assessed on the basis of actual gross weight, as no estimated billing weight was published in the governing freight container tariff for this container.

The filled containers were closed by a fully automatic closing machine.



BN-11704

Figure 18.--A pack of 24 cantaloups in a 2/3-size wire-bound crate (No. 5104).

Method of loading and refrigeration.--The standard loading arrangement was lengthwise-on-sides, solid, nonstripped, 3 layers high, 9 rows wide, 16 stacks long, making a load count of 432 crates. Alternate layers were crosswise offset against opposite car walls in straight lengthwise alinement throughout the load. The containers in the first and third layers were loaded against one car wall, and the containers in the second layer were offset crosswise of the car from the layers against the opposite car wall, directly in front of and in line with containers in the preceding stack. A cross section of the standard loading pattern is shown in figure 19.

BN-11705

Figure 19.--The standard loading pattern for a 432-crate load of 2/3-size wirebound containers (No. 5104).

All loads were fan-cooled in the car after application of top-ice (Perishable Protective Tariff Refrigeration Rule 242), and moved under standard refrigeration (Rule 200) with no salt added to the bunker ice in transit. The amount of crushed top-ice applied for precooling ranged from 3,600 pounds to 7,200 pounds, averaging 4,800 pounds per car.

Production Labor

Time studies were made in six California packing plants to determine the amount of production labor required to pack and load cantaloups in four different shipping containers. The four containers were the conventional jumbo crate (No. 1152), WGA jumbo crate (No. 1220), 2/3-size fiberboard box (No. 6560), and the 2/3-size wirebound crate (No. 5104).

Handling of cantaloups before packing was about the same in each of the packing plants. Therefore, studies were made of only those operations which varied by type of container: assembling, packing, closing, and carloading the containers, and hydrocooling or top-icing the loads. Only direct labor was recorded for each of these operations. Supervisory, clerical, and other miscellaneous labor which did not vary with the type of container used was not included.

RESULTS

A number of factors determine the suitability and relative efficiency of different containers for transporting and marketing cantaloups. Probably the most important of these factors, for long-distance rail shipments of western-grown melons, are (1) the degree of protection against melon bruising afforded by the container, (2) the amount of container damage and related melon bruising occurring in transit, and (3) the total costs of using a particular design of container, including the delivered cost of containers and of labor and material for assembling, packing, closing, handling, and carloading. Other factors include (1) trade acceptance of the containers, (2) relative ease and cost of precooling and refrigeration, and (3) the extent to which each design lends itself to heavier loading in refrigerator cars. Information developed on these factors for each of the major designs of containers covered by this study are presented in this section.

Container Damage

The total amounts of container damage found in rail shipments of cantaloups packed in each of five designs of three different types of containers are presented in table 4. This comparison is made on the basis of (1) total damaged containers (packages requiring recoopering or repair), and (2) irreparable (bad order) packages. The difference between these two figures for each container is the number of containers repaired and accepted by the consignees of the shipment.

These data show that twice as much damage was found in shipments of conventional jumbo crates as in shipments of the improved WGA crates (No. 1220). Container damage in shipments of the wirebound crates was only one-fourth that found in conventional jumbo crate shipments and only half as much as was found in shipments of WGA crates. The full-depth telescope fiberboard boxes (No. 6560), used for shipments of hydrocooled cantaloups, had the least amount of container damage, with only about one-twentieth as many damaged containers per car as the conventional jumbo crates. Experimental containers No. 85-270, which were precooled with top-ice on the loads, averaged about the same amount of container damage as the wirebound crates. WGA crates averaged less than one-third as many bad-order irreparable containers per car as the conventional crates. Shipments of the fiberboard and wirebound containers had even fewer bad orders per car.

From the standpoint of total costs of damage and loss of marketable melons, the reductions achieved in bad orders by all the new containers are more significant than the reductions in total numbers of damaged containers including those requiring recoopering. Bad-order containers are those on which loss and damage claims are paid. Moreover, they include full containers, most of which hold severely bruised and damaged melons, as well as many empty and partly empty containers, from which both damaged and undamaged melons have been spilled, lost, or discarded.

Types and Causes of Container Damage

In addition to determining the total amount of container damage in test and control shipments, Agricultural Marketing Service personnel checked out all containers from as many shipments as possible as they were unloaded to determine the type and apparent cause of damage. In 22 shipments of conventional jumbo crates, 89.5 percent of all container damage consisted of loose and broken slats at sides, top, and bottom. This high proportion of slat breakage was due primarily to lengthwise loading of the containers. In this position the end thrusts of the load resulting from coupling impacts to the cars were transmitted directly to the slats, the weakest parts of the containers. Breakage of the comparatively heavy end frames of these crates was insignificant, with only 1.6 percent of the posts broken and 0.6 percent of the rails broken. The remainder of the damage, 8.3 percent, was not specified as to type.

Table 4.--Damaged containers in rail shipments of cantaloups by type of container, 1956, 1957, 1958 seasons

Container and identification number	Number of cars	Container damage: Requiring recoopering		Container damage: Bad order (irreparable)	
		Containers	Percent of Total	Containers	Percent of total
Nailed wood (top-iced):					
No. 1152, conventional jumbo crate 1/	30,984	461,439	15.5	151,555	5.1
No. 1220, WGA jumbo crate 2/	8,566	203,569	7.3	38,825	1.4
Fiberboard:					
No. 6560, 2/3-capacity full-telescope box (hydrocooled) 3/	42	96	0.41	5	0.0
Experimental container No. 85-270, 2/3-capacity full-telescope box (top-iced) 4/	16	166	2.4	64	0.9
Wirebound (top-iced):					
No. 5104, 2/3-capacity crate 5/	44	497	2.6	148	0.8

Data from Railroad Perishable Inspection Agency, Figures and Test Data.

1/ RPIA figures for 1956-58.
2/ RPIA figures for 1957-58.
3/ Test shipments for 1957-58.
4/ Test and observation shipments for 1958.
5/ RPIA figures for 1958.

NOTE: The number of packages requiring recoopering includes bad-order packages.

A total of 49 test shipments of crosswise-loaded WGA crates were examined for type and cause of damage. In these shipments 62.1 percent of all container damage consisted of loose and broken slats. Breakage of various components of the end frames, however, was considerably greater in these containers than in the conventional crates. Broken posts accounted for 11.9 percent of the damage, loose end frames 5.7 percent, loose or sprung corner joints 1.9 percent, and broken rails 1 percent. Broken end panels and cover cleats accounted for less than 1 percent of the damage, while 17 percent of the total damage was unspecified as to type. Most of the broken end frames of the WGA crates were due to crosswise loading, in which the heavy lengthwise thrusts of the load were borne by the end frames. However, the WGA crates were specifically designed for this method of loading, and so total container damage was reduced.

Only 602 boxes, or approximately one carload, of No. 6560 fiberboard containers were studied in detail to determine the type and cause of damage. Most of the damage was found to be slight, affecting only the appearance of the box and not its strength or its ability to withstand further handling after removal from the load. Of the 602 boxes examined only 9 were found to be damaged seriously.

Creasing of these containers, which resulted from load compression due to slight shifting, accounted for 49 percent of the relatively light damage. Compressed or squeezed boxes resulting from the same cause amounted to 27.1 percent of the total damage. Other types of damage observed were: bulged and buckled boxes, 7.6 percent; loose and open flaps, 7.5 percent; punctured, cut, and torn boxes, 5.1 percent. Only 3.7 percent of the total damage was unclassified as to type.

No detailed study of the type of damage was made on shipments of No. 85-270 experimental containers. One of the major causes of damage observed in shipments of these containers was the weakening of boxes by moisture absorbed from the top ice used for precooling the load. This was particularly true for the few shipments in which all the ice on the load was not melted in precooling by forced circulation of air in the car before shipment. More bulged, buckled, and compressed boxes resulting from overhead weight of the load and the top ice and from load shifting were found in shipments of these containers than in shipments of No. 6560 fiberboard containers.

Damage in shipments of 2/3-size wirebound crates was not classified as to type. Although these loads were top-iced for precooling of the melons in the car, the wirebound construction was resistant to damage from the moisture and from the weight of the ice. The resiliency of the wirebound crates enabled them to resist lengthwise thrusts of the load although they were loaded in a lengthwise position.

A comparison of the number of bad-order containers found in the test and check shipments and the impact-force index for the same shipments of the different containers studied is shown in figure 20. The impact-force index was developed from data obtained from impact registers placed in as many shipments of each kind of container as the available supply permitted. It is the summation of squares of the striking speeds of all impacts over 4 miles per hour. 6/

6/ Findings of railroad research technicians indicate that the force of the impacts received by the load increases in approximately the same ratio as the squares of the striking speeds.

As is shown in figure 20, a high impact-force index was not always associated with a high rate of bad-order containers. Some of the containers studied were more resistant to damage, even under more adverse conditions, than others. Shipments of conventional jumbo crates, for example, had the most bad orders (4.5 crates per car), but the impact-force index for these particular shipments was considerably lower than that for shipments of No. 6560 fiberboard containers, which had no bad orders. The impact-force index for shipments of WGA crates, on the other hand, was fairly high, but the number of bad-order containers was considerably lower (1.8 per car) than shipments of conventional crates.

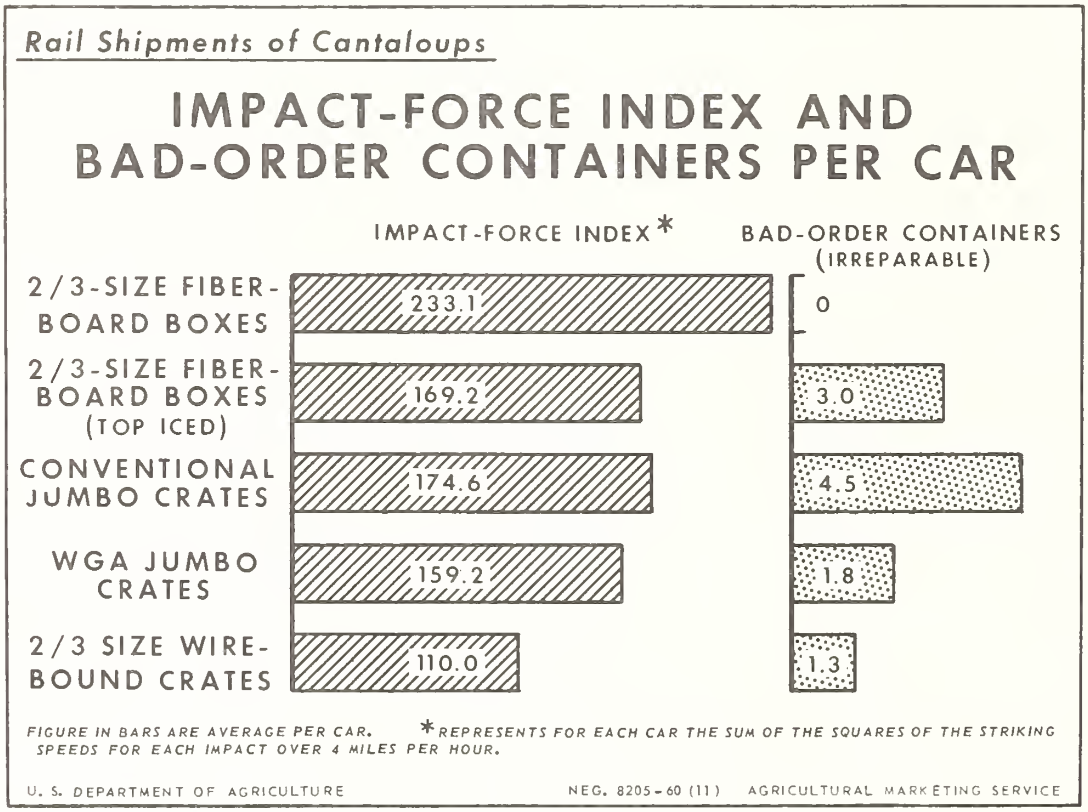


Figure 20.

Melon Bruising

As the appearance and shelf life of melons are affected by the amount of physical damage sustained in transportation and handling, the comparative amount of melon bruising is a good measure of container efficiency. Percentages of bruised melons found in the major types of containers in this study are shown in table 5. The data were developed in 1957 and 1958, except for the conventional jumbo crates (No. 1152), some of which were inspected in a previous study made in the 1950, 1951, and 1952 shipping seasons. Only melons injured seriously enough to affect their grade are represented in the table. Melons are classified as damaged when the extent of bruising affects only the grade. When the bruising is extensive enough to affect both grade and salability, the melons are considered to be seriously damaged.

Table 5.--Percentage of cantaloups damaged during rail shipments in specified types of containers, 1950, 1951, 1952, 1957, and 1958

Type of container and identification number	Number of cars	Date of shipping tests	Melon injury affecting grade: Damage	Serious damage 1/	Total damage
			Percent	Percent	Percent
Nailed wood (top-iced):					
No. 1152, conventional jumbo crate	40	1950-52	5.0	1.7	6.7
No. 1220 (85-39), WGA jumbo crate	42	1957-58	2.9	0.9	3.8
Fiberboard:					
No. 6560 (85-972), 2/3-capacity full-telescope box (hydrocooled)	40	1957-58	0.6	0.4	1.0
Experimental container No. 85-270, 2/3-capacity full-telescope box (top-iced)	10	1958	3.1	1.1	4.2
Wirebound (top-iced):					
No. 5104 (89-93), 2/3-capacity crate	19	1957-58	1.6	0.4	2.0

1/ Affecting both grade and salability.

Shipments of conventional jumbo crates had almost twice as many bruised melons as the WGA crates. Of the 40 cars of conventional crates shown in table 5, only 11 were shipped during 1958. An average of 7.3 percent of the melons in these 11 cars were damaged, compared with 6.0 percent for the 29 cars shipped in 1950 and 1951. The experimental 2/3-capacity fiberboard boxes (No. 85-270) had the next highest percentage of damaged melons. The fiberboard containers (No. 6560) and wirebound containers (No. 5104) had the lowest percentages of melon damage by bruising. All of the new containers studied were significantly better at protecting the melons from bruising than the conventional jumbo crates (No. 1152).

A comparison of melon bruising found in each type of container by different positions in the load lengthwise of the car body is presented in table 6. These data, based on 11 cars inspected in 1958, also reveal some reduction in total fruit bruising for all new containers studied compared with the conventional jumbo crates. Melon bruising was heaviest in containers adjacent to

Table 6.--Percentage of cantaloups damaged, and kinds of damage, in specified types of containers during rail shipping tests, by position of containers in load, shipped in 1957 and 1958

Kind of damage, and type and identification number of container	Load position in the cars (all layers)			
	Bunker	Quarter length	Doorway	All positions
	Percent	Percent	Percent	Percent
Damage not affecting grade				
Slight bruising:				
Conventional jumbo crate No. 1152....	26.8	26.4	28.7	27.2
WGA jumbo crate No. 1220.............	38.0	36.0	35.2	36.4
2/3-capacity wirebound crate No. 5104	15.1	10.6	9.5	11.7
2/3-capacity fiberboard box No.85-270	10.6	7.7	7.7	8.7
2/3-capacity fiberboard box No. 6560.	12.4	9.0	8.3	9.9
Slight rubbing or scuffing:				
Conventional jumbo crate No. 1152....	1.4	2.25	2.4	2.0
WGA jumbo crate No. 1220.............	0.3	0.5	0.2	0.3
2/3-capacity wirebound crate No. 5104	0	0.7	0.4	0.5
2/3-capacity fiberboard box No.85-270	0.1	0	0.2	0.1
2/3-capacity fiberboard box No. 6560.	0.1	0.1	0	0.02
Damage affecting grade				
Bruising:				
Conventional jumbo crate No. 1152	6.5	4.8	4.2	5.2
WGA jumbo crate No. 1220.............	3.5	3.0	2.3	2.9
2/3-capacity wirebound crate No.5104.	2.9	1.5	0.4	1.6
2/3-capacity fiberboard box No.85-270	5.7	1.5	1.9	3.1
2/3-capacity fiberboard box No. 6560.	1.5	0.2	0.1	0.6
Rubbing or scuffing:				
Conventional jumbo crate No. 1152....	0	0	0.2	0.003
WGA jumbo crate No. 1220.............	0	0	0.03	0.01
2/3-capacity wirebound crate No.5104.	0	0	0	0
2/3-capacity fiberboard box No.85-270	0	0	0	0
2/3-capacity fiberboard box No. 6560.	0	0	0	0
Serious bruising: 1/				
Conventional jumbo crate No. 1152....	1.5	1.6	0.2	1.2
WGA jumbo crate No. 1220.............	0.3	0.3	0.1	0.25
2/3-capacity wirebound crate No.5104.	0	0	0	0
2/3-capacity fiberboard box No.85-270	1.2	0.2	0.2	0.5
2/3-capacity fiberboard box No. 6560.	0.3	0.03	0.03	0.1
Cracking or splitting:				
Conventional jumbo crate No. 1152....	0.3	1.6	0.3	0.8
WGA jumbo crate No. 1220.............	0.7	0.7	0.5	0.65
2/3-capacity wirebound crate No.5104.	0.6	0.3	0.1	0.4
2/3-capacity fiberboard box No.85-270	0.6	0.9	0.3	0.6
2/3-capacity fiberboard box No. 6560.	0.1	0.3	0.4	0.3

1/ Affecting both grade and salability.

the bunker bulkheads at the ends of the cars, particularly in shipments of conventional crates and of experimental fiberboard containers (No. 85-270). At the ends of the cars immediately over the car trucks, the force of lengthwise shifting in the entire load is concentrated. Melon bruising also averaged somewhat greater at the quarter-length positions in the cars (midway between the doorway and the ends of the car) than in the doorway area.

Melon bruising was also studied in relation to the vertical position of the containers in the loads. Melon damage in all containers studied was consistently greater in the floor layer of containers and was progressively less in the upper layers of the load.

The cover cleats of the WGA crates did not completely protect the melons when the crates were stacked on bottoms, one on top of the other. The accumulation of overhead weight bearing on the top bulge of crates on the floor resulted in a greater amount of serious bruising in floor layers than in any of the upper layers.

Three experimental tests with a 13-3/4-inch-deep WGA crate (experimental container No. 85-75) showed no significant difference in the percentage of slight bruising. However, the total percentage of melons sustaining damage and serious damage by bruising was two-thirds less than in the 13-inch-deep WGA crates.

While the results are based on only a few shipments, the data do indicate that melon damage affecting grade might be reduced with deeper crates.

Temperatures and Firmness of Melons

Melon temperatures.--Transit temperatures are important in the maintenance of cantaloup quality. With adequate precooling before shipment and maintenance of the transit temperatures at about 40° F., melons of good quality and condition at time of shipment should reach market at the proper stage of firmness. Immediate and adequate precooling and transit refrigeration also help to control decay.

Adequate circulation of air in the vehicle, design and material of containers, and the kind of loading pattern affect the maintenance of transit temperatures.

Table 7 presents a summary of the average pulp temperatures recorded when the shipments were loaded and when they were unloaded, by load position and type of container. Some temperature variation was noted between the different container types, but all are too small to be of any significance.

Melon temperatures in the improved WGA crates at time of unloading were roughly 1.5° F. higher in the top layer next to the bunkers than in the doorway area. In the conventional crate loads, temperatures in all top-layer crates were about the same. The average temperature of top-layer crates ranged from 1 to 2.5° F. warmer in the improved WGA crates than in the conventional crates, but only about 1° F. higher in the middle and bottom layers. Temperatures in bottom layers at the doorway were about the same in both types of wood crates.

Table 7.--Average temperatures of cantaloups at shipping point and at destination, by load position and type of container, rail shipments in standard bunker cars, 1957-58

Type of container	Number of cars	Average at shipping point	At destination: Bunker			At destination: Quarter length			At destination: Doorway			Average all positions
			Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	
		° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
Conventional jumbo crate No. 1152......	22	85.6	40.3	37.8	36.0	40.3	38.5	37.5	40.4	38.5	38.7	39.1
WGA jumbo crate No. 1220...........	42	81.0	42.7	38.5	37.4	42.2	38.9	37.9	41.3	39.2	38.5	40.0
2/3-capacity wire-bound crate No. 5104	19	85.0	40.0	38.0	37.2	40.0	38.2	37.7	40.0	38.5	38.3	38.7
2/3-capacity fiber-board box No.85-270.	40	67.3	39.3	38.6	37.5	40.6	39.4	38.7	40.6	39.9	39.6	39.5
2/3-capacity fiber-board box No. 6560..	12	77.9	39.2	38.2	38.0	39.2	39.2	38.9	40.4	39.0	39.0	39.1

At destination, pulp temperatures of melons shipped in 2/3-capacity wirebound crates were about the same as those of melons in conventional jumbo crates, being higher at the top of the load than in lower layers.

Temperatures in all layers of the 2/3-capacity fiberboard boxes were progressively lower toward the bunkers. The overall variations in commodity temperatures in loads of both types of fiberboard containers appeared less than in the jumbo wood crates and fairly similar to the pattern for the wirebounds.

Pulp temperatures at destination of melons which were shipped in conventional crates averaged 39.1° F., nearly one degree cooler than melons in the WGA crates which averaged 40.0° F. Average temperatures were 38.7° F. in the 2/3-capacity wirebound crates, 39.5° F. for hydrocooled melons in the 2/3-capacity fiberboard boxes (No. 6560), and 39.1° F. in the top-iced, 2/3-capacity experimental fiberboard boxes (No. 85-270).

The average pulp temperatures of the melons at destination for all types of containers studied were within the desired ranges, and there were only minor differences. In general, pulp temperatures were highest in the top layer and lowest in the floor layer. The coldest location in the car was usually at the floor next to the bunkers.

Melon Firmness.--The degree of melon firmness found upon arrival of the shipments at destination is the result of several factors. First is the degree of firmness and maturity of the melons at the time they are packed. This condition varies between different shippers and different shipping districts at different times during the season. The second factor affecting firmness upon arrival is the adequacy of initial cooling and refrigeration of the melons during transit. Pulp temperatures of the melons upon arrival reflect to some extent the adequacy of refrigeration during transit.

Agricultural Marketing Service inspectors reported the different degrees of melon firmness and pulp temperatures of the shipments at destination. Table 8 presents a summary of the information on melon firmness.

The 2-year average for the 1957 and 1958 shipments of the new WGA crates showed a somewhat smaller proportion of the melons in the ripe and ripe-firm classifications than the loads of conventional crates. There is no evidence that such slight differences in melon firmness influenced the amount of melon bruising in each type of container.

The 2/3-capacity wirebound crates averaged almost twice as many hard melons, with correspondingly fewer melons on the ripe side, as either of the jumbo wood crates. This fact may have contributed in some measure to the low rate of melon damage in the wirebound crates.

Hydrocooled melons in the 2/3-capacity fiberboard boxes (No. 6560) averaged more firm to hard melons than ripe and firm. On the other hand, shipments of the top-iced 2/3-capacity fiberboard boxes (experimental container No. 85-270) showed lower percentages for firm to hard melons and more ripe and firm. This difference in melon firmness is probably due to the fact that shipments of the two types of containers originated from widely separated shipping areas, and in part, at least, to the different handling and cooling methods used.

Table 8.--Firmness of cantaloups at destination, test shipments by rail in specified types of containers, 1957-58

Container type, number, and date of shipment	Number of cars	Melon firmness: Hard	Firm	Ripe and firm	Ripe
		Percent	Percent	Percent	Percent
No. 1152, conventional jumbo crate:					
1957	11	15.4	66.4	18.1	0.1
1958	11	23.2	41.4	34.1	1.3
Average	22	19.3	53.9	26.1	0.7
No. 1220, WGA jumbo crate:					
1957	28	20.2	55.7	24.0	0.1
1958	14	16.5	64.6	18.8	0.1
Average	42	18.9	58.7	22.3	0.1
2/3-capacity fiberboard box:					
No. 6560:					
1957	28	30.6	49.7	19.3	0.4
1958	12	18.6	57.7	23.2	0.5
Average	40	27.0	52.2	20.4	0.4
No. 85-270:					
1958	12	22.0	49.3	28.5	0.2
No. 5104, 2/3-capacity wirebound crate:					
1957	1	20.0	20.0	60.0	0
1958	18	37.2	46.0	16.8	0
Average	19	36.3	44.6	19.1	0

Production Labor Requirements and Costs

Time studies were conducted to determine the amounts of production labor required to pack and load cantaloups in several different shipping containers. The production labor requirements for assembling, packing, closing, carloading, and cooling the various containers are shown in table 9.

The conventional jumbo and improved WGA crates required approximately the same amount of production labor for packing and carloading. The methods of assembling, packing, closing, and cooling both types of crates were similar, and both containers had the same cubic capacity. Additional labor was needed for placing the conventional crates in the load since wood stripping was placed and nailed horizontally on each layer. Although it was not necessary to strip the layers in the WGA crate loads, this saving in production labor was offset by the labor required for squeezing the loads of these containers.

Table 9.--Production labor required for packing and loading cantaloups, by type of container, 6 plants, California, 1958 1/

Operation	2/3-capacity fiberboard box (No. 6560)	2/3-capacity wirebound crate (No. 5104)	Conventional jumbo crate (No. 1152)	WGA jumbo crate (No. 1220)
	Man-minutes per equivalent crate	Man-minutes per equivalent crate	Man-minutes per crate	Man-minutes per crate
Assembling container:				
Makeup	0.34	0.54	0.36	0.39
Labeling	2/	0.20	0.11	0.10
Total	0.34	0.74	0.47	0.49
Packing:				
Filling container	1.18	1.12	1.08	1.10
Labeling melons	0.36	0.41	0.48	0.48
Total	1.54	1.53	1.56	1.58
Closing container	0.22	3/	0.12	0.14
Carloading and related handling:				
Setting off in warehouse	0.10	0.10	0.07	0.08
Trucking into cars 4/	0.18	0.32	0.18	0.20
Loading containers in car	0.14	0.15	0.17	0.08
Squeezing the load	0.06	5/	5/	0.07
Bracing	6/	6/	0.16	0.14
Total	0.48	0.57	0.58	0.57
Cooling: 7/				
Hydrocooling	0.08	- -	- -	- -
Top icing	- -	0.09	0.07	0.08
Total	0.08	0.09	0.07	0.08
Total	2.66	2.93	2.80	2.86

(Footnotes on next page)

Table 9.--Footnotes

1/ Allowance was made for 25 percent personal and fatigue time for packing, setoff, trucking, loading, squeezing, bracing, and top-icing; and 15 percent for assembling, closing, and labeling.

2/ Fiberboard boxes were printed by the manufacturer and did not require labeling.

3/ Wirebound crates were closed by an automatic closing machine.

4/ Distance involved in trucking the containers from the packing line to the carloading platform was standardized at 54 feet--the average trucking distance in the plants studied.

5/ Wirebound and conventional jumbo crate loads were not squeezed.

6/ Fiberboard boxes and wirebound crates were not braced.

7/ Cantaloups in fiberboard boxes were hydrocooled before packing. All other plants top-iced the loaded wooden crates.

The 2/3-capacity fiberboard boxes required less production labor on a crate-equivalent basis than the conventional jumbo and the WGA crates. In general, handling and packing methods for the fiberboard and wooden crates were similar. However, the fiberboard boxes did not require labeling as the brand name was printed on the box by the manufacturer. The fiberboard boxes held fewer melons than the conventional and improved crates. Also the loads of the fiberboard boxes were solid throughout the length of the car as compared to the conventional and WGA crate loads which were divided with centergates in the doorway area.

The 2/3-capacity wirebound crates required only slightly more labor on a crate-equivalent basis to pack and load than the conventional and WGA crates. Three wirebound crates had to be assembled and labeled for every two conventional or improved crates for the same number of cantaloups. Also, additional labor was needed for hand-trucking an equivalent number of cantaloups packed in the wirebound crates compared to cantaloups packed in conventional or improved crates. For every trip to the carloading area, three 2/3-capacity wirebound crates (two equivalent crates) were transported to every three conventional or improved crates and to every five 2/3-capacity fiberboard boxes. In the plants observed, the carloads of wirebound crates were not squeezed or braced in the doorway area. This saving in labor, however, did not offset the increased requirement of production labor for assembling, labeling, and trucking the containers.

Using the data on labor requirements in table 9 and an hourly wage rate of $1.50, there would be a difference of 1/2 cent per crate in favor of the 2/3-capacity fiberboard box compared with the WGA jumbo crate, and the 2/3-capacity fiberboard box would cost 3/4 cent less than the 2/3-capacity wirebound crate. However, the overall differences in production labor requirements shown in table 9 are so small that they could easily be offset in whole, or in part, by differences in labor efficiency between different packinghouses in different producing districts. It may be concluded, therefore, that use of any of the four containers studied during the 1957 and 1958 cantaloup seasons will not result in substantial differences in the total labor requirements with the methods and equipment used at the time this study was made. Improvements in equipment, such as the automatic melon sizer, and in methods of assembling, packing, and closing containers could easily alter this situation. In this study, various other factors such as costs of materials and freight, adaptability to present physical plant and equipment, and the arrival condition and market acceptance of cantaloups shipped in these containers were found to be more important than the small differences in labor costs.

Table 10 presents a comparison of the total costs of material, labor, refrigeration, and freight for shipping a standard carload of each of the four different containers from central California to New York, N. Y., during September 1958. The term "standard load," as used here, means the type and size of load most commonly used for each type of container during the 1958 shipping season.

The cost data for materials, refrigeration, and freight shown in table 10 are based on prevailing costs in the 1958 season. This was the first season during which the multiple-minimum incentive rates on vegetables and melon shipments from West Coast origin points to eastern destinations were in effect.

Freight costs shown in table 10 for loads in use at that time for the different containers give an advantage to container No. 6560, the 2/3-capacity fiberboard box, as a four-layer load of these containers was heavy enough to obtain a lower rate than the lighter loads of the other containers. Also, because charges for standard refrigeration are assessed on a per car basis, the use of the heavier load for container No. 6560 gives it an additional advantage in lower refrigeration cost per container.

Labor costs for each job were estimated on the basis of the average number of packers employed in typical medium-sized packinghouses in the areas where this study was made. The estimated labor costs for the various jobs were based upon the union wage scale for melons, published in the 1958 Packinghouse Agreement. 7/ Where piece rates were applicable, the sum of the piece rate designated for a given job was multiplied by the average hourly output of packed containers. The labor figures shown in table 10 do not represent the total labor cost of handling and packing because they do not include the cost of administration, supervision, packinghouse overhead, and maintenance. Nor do they include the cost of performing all the different operations associated with packing. These costs cover only those operations whose labor and material requirements are affected by the type of containers used to pack and ship the melons.

7/ 1958 Packing House Agreement, Imperial Valley, Calif., San Joaquin Valley, Calif., Blythe, Calif., Yuma Valley, Ariz., Shippers Labor Committee and United Packinghouse Workers of America and its Local 78, AFL-CIO.

Table 10.--Estimated cost of material, labor, refrigeration, and freight, for a medium-sized plant to pack and load a standard carload of cantaloups and ship it from central California to New York, N. Y., by type of shipping container, September 1958

Item of cost	Conventional jumbo crate: No.1152 (288-crate load)		WGA jumbo crate No. 1220 (324-crate load)			2/3-capacity wirebound crate No. 5104 (432-crate load)			2/3-capacity fiberboard box No. 6560 (560-crate load)		
	Cost per car	Cost per crate	Cost per car	Cost per crate	Differential 1/	Cost per car	Cost per crate equivalent	Differential 1/	Cost per car	Cost per crate equivalent	Differential 1/
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Containers:											
Materials, assembly, labeling	2/ 151.93	0.5275	3/ 185.04	0.5711	+0.0436	198.07	0.6877	+0.1602	4/ 251.07	0.6725	+0.1450
Packing and handling:											
Filling and closing containers, labeling melons	43.04	0.1494	48.10	0.1485	-0.0009	5/ 37.62	0.1306	-0.0188	49.27	0.1320	-0.0174
Carloading:											
Setoff, truck and load filled containers, squeeze and brace the load, bracing material	6/ 26.07	0.0905	23.42	0.0723	-0.0182	7/ 11.11	0.0386	-0.0519	8/ 16.11	0.0432	-0.0473
Refrigeration:											
Top-icing or hydrocooling ice, cooling and standard refrigeration	9/ 195.59	0.6791	9/ 195.59	0.0637	-0.0754	9/ 195.70	0.6795	+0.0004	9/ 187.47	0.5022	-0.1769
Freight	658.94	2.2880	741.31	2.2880	- -	10/658.97	2.2880	- -	11/ 792.00	2.1216	-0.1664
Total	1,075.57	3.73	1,193.46	3.68	-0.05	1,101.47	3.82	+0.09	1,295.92	3.47	-0.26

1/ Difference compared with the unit cost for the conventional jumbo crate No. 1152.

2/ Material cost includes shook, cover slats, nails, printing on two side slats and one end panel, and one label. Assembly includes machine rental of ½ cent per crate for framer.

3/ Material cost includes all shook, unitized veneer covers, nails, printing on two side slats and one end panel, and one label. Assembly cost includes machine rental of ½ cent per crate for framer.

4/ Material cost includes top and bottom sections, liners, glue used in closing flaps, and printing on outside of top section. No labels required as boxes are printed.

5/ Cost of closing containers includes rental of automatic closing machine estimated at ½ cent per crate.

6/ No labor cost for squeezing the load as conventional crates do not have to be squeezed. Bracing materials cost includes cost of strips between layers.

7/ Solid loads, no labor cost for squeezing and bracing the load or bracing materials cost.

8/ Solid loads. Loads have to be squeezed, but there are no labor costs to install bracing or for bracing materials.

9/ Includes a cooling charge of $10 for portable equipment and labor required to fan-cool a load prior to shipment. In fiberboard shipments, does not include cost of rock salt when used in bunkers and under floor racks as this practice is optional.

10/ Freight charge is based on two-thirds of the estimated weight for jumbo crates, that is, 58.67 pounds per box, taking a 20,000-pound minimum carload rate.

11/ Same as 10/ except a 33,000-pound carload minimum is used based on multiple-minimum rates.

In a standard 324-crate load of WGA jumbo crates (No. 1220) and a 560-box load of 2/3-capacity fiberboard containers (No. 6560), a crate equivalent of melons was delivered to New York, N. Y., at an estimated saving of 5 cents for the WGA crate and 26 cents for the fiberboard box compared to the standard 288-crate load of conventional jumbo containers (No. 1152). The crate-equivalent cost for a standard 432-crate load of 2/3-capacity wirebound containers (No. 5104) was estimated at 9 cents more than for the conventional crates.

Although the fiberboard container cost 14½ cents more to pack than a conventional jumbo crate, an estimated saving of 34½ cents per crate-equivalent was realized in refrigeration and freight costs. This saving was accomplished by shipping 373.3 crate-equivalents of melons in the fiberboard boxes under standard refrigeration at the same charge per car as that applicable for the 288-crate load of conventional containers, and through the multiple-minimum carload freight rates, under which the applicable rate was 20 cents less per hundred pounds than the rate for the 288-crate load of conventional jumbo crate. An additional estimated saving of 6 cents was realized with the fiberboard boxes in packing, handling in the plant, and carloading, compared to the conventional crates.

As in the case of the fiberboard containers, the two cost items having an estimated saving of 5 cents per crate for the new WGA crates was accounted for by refrigeration (3.2 cents) and carloading (1.8 cents).

The overall crate-equivalent cost of the 2/3-capacity wirebound crate was raised by the initial cost of the container. While there was an estimated saving of 5 cents per crate equivalent in carloading, and 2 cents in packing and plant handling, the initial container cost was 16 cents more per crate equivalent than the conventional jumbo crate.

Adaptability to Heavier Loading

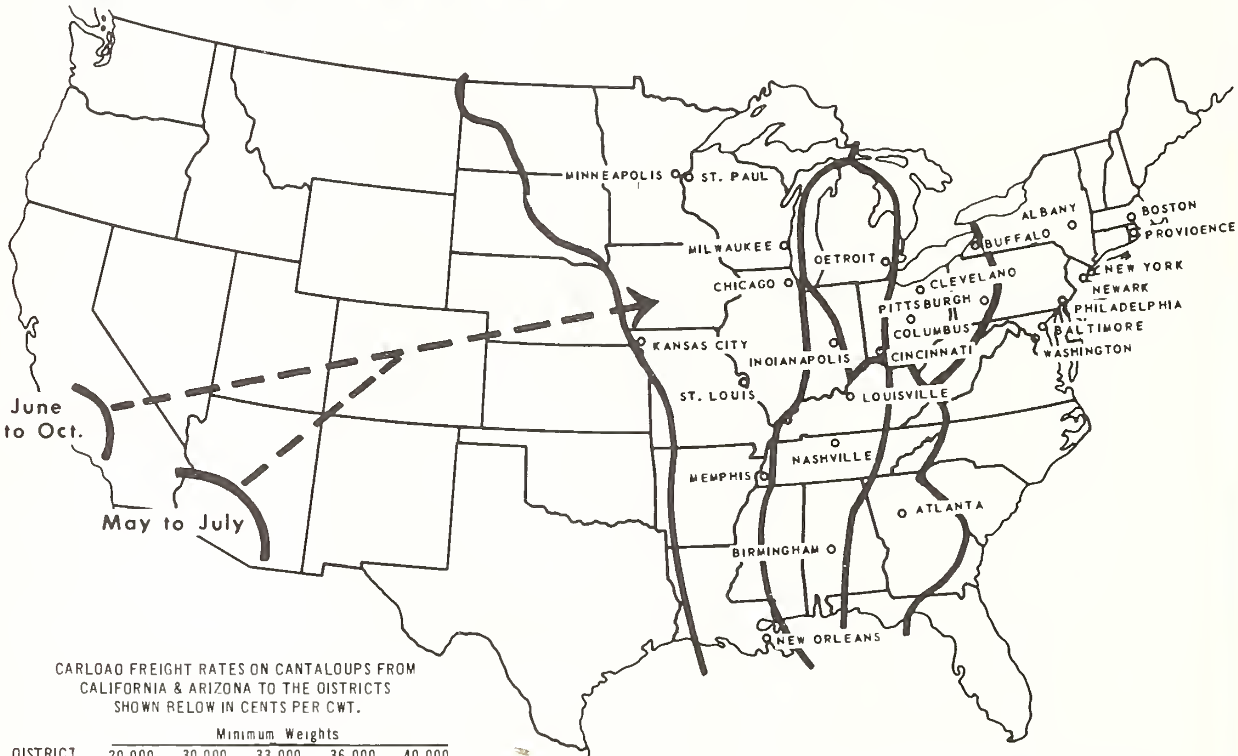
During the 1958 season, multiple-minimum or incentive freight rates for heavier loads were established by the rail carriers on transcontinental shipments from the California and Arizona producing areas. Under these rate tariff provisions the applicable freight rates between the same origin and destination points (in cents per hundred pounds) are progressively lower for higher carload minimums. The geographical basis of application of the multiple-minimum rates is shown in figure 21.

Under these multiple-minimum rates substantial savings in freight costs per container can be realized by loading the cars to higher carload weights. In addition, refrigeration cost per container is materially reduced when heavier loads are used as the tariff charges for standard refrigeration are assessed per car. The extent to which each container studied lends itself to heavier loading without increasing container damage and commodity bruising is an important measure of its efficiency in reducing overall transportation costs.

Savings in transportation and refrigeration costs on heavier loads of the various containers on shipments from central California to New York City are presented in table 11. The potential savings are shown here on a standard jumbo crate-equivalent basis. The freight rate and refrigeration charges used

MULTIPLE-MINIMUM FREIGHT RATES FOR CANTALOUPS

Shipped from California and Arizona to Eastern and Southeastern Markets



CARLOAO FREIGHT RATES ON CANTALOUPS FROM CALIFORNIA & ARIZONA TO THE OISTRICTS SHOWN BELOW IN CENTS PER CWT.

OISTRICT	Minimum Weights 20,000	30,000	33,000	36,000	40,000
1	260	250	240	230	219
2	258	248	238	228	217
3	254	244	234	224	213
4	249	239	229	219	208
5	239	229	219	209	198
6	219	209	199	189	178

FOR RATES FROM THE IMPERIAL VALLEY, BLYTHE ANO ARIZONA; SUBTRACT 10 ¢ PER CWT. FROM THE ABOVE RATES

IN ORОER TO OBTAIN THE LOWEST POSSIBLE CARLOAO CHARGE BASEO ON THE ALTERNATING RATES, THE FOLLOWING BREAKING POINTS ON THE ESTABLISHEO MINIMUMS ARE

LOAO WEIGHT UP TO 28,846 POUNOS - USE RATE FOR 20,000 MIN.
LOAO WEIGHT 28,847 POUNOS TO 31,680 LBS. INC., - USE RATE FOR 30,000 MIN.
LOAO WEIGHT 31,681 POUNOS TO 34,500 LBS. INC., - USE RATE FOR 33,000 MIN.
LOAO WEIGHT 34,501 POUNDS TO 38,087 LBS. INC., - USE RATE FOR 36,000 MIN.
LOAO WEIGHT 38,088 POUNOS ANO OVER - USE RATE FOR 40,000 MIN.

DATA ON RATES IN 1958 FROM TRAFFIC DEPARTMENT, WESTERN GROWERS ASSOCIATION, LOS ANGELES, CALIF.

U.S. DEPARTMENT OF AGRICULTURE   NEG. B206-60(11)   AGRICULTURAL MARKETING SERVICE

Figure 21.

Table 11.--Savings in transportation and refrigeration costs for rail shipments of cantaloups in heavier loads shipped under multiple-minimum rates from central California to New York, N. Y., by type of container and size of load, 1958 1/

Type of container and load count by loading patterns	Number of jumbo crate equivalents	Gross weight 2/	Minimum weight rate basis	Rate per cwt.	Savings in jumbo crate equivalents: Freight 3/	Refrigeration 4/	Total	Per crate
	Number	Pounds	Pounds	Dollars	Dollars	Dollars	Dollars	Dollars
No. 1152, conventional jumbo crate:								
Lengthwise on sides, 6 wide, 16 stacks:								
4 high, 384 crates	384	33,792	33,000	2.40	67.55	55.45	123.00	0.320
No. 1220, WGA jumbo crate:								
Crosswise on bottoms, 4 wide, 27 stacks:								
3 high, 324 crates	324	28,512	20,000	2.60	-	20.80	20.80	0.064
4 high, 432 crates	432	38,016	36,000	2.30	114.00	83.16	197.16	0.456
No. 5104, 2/3-capacity wirebound crate:								
Lengthwise on sides, 9 wide, 16 stacks:								
3 high, 432 crates	288	25,345	20,000	2.60	-	-	-	..
4 high, 576 crates	384	33,794	33,000	2.40	67.51	55.45	123.00	0.320
5 high, 729 crates 5/	480	42,242	40,000	2.19	173.09	110.88	283.97	0.592
No. 6560, 2/3-capacity fiberboard box:								
Crosswise on bottoms, 4 wide, 28 stacks:								
4 high, 448 crates	298.7	26,284	20,000	2.60	-	8.81	8.81	0.029
5 high, 560 crates	373.3	32,855	33,000	2.40	63.68	51.89	115.57	0.309
6 high, 672 crates 5/	448	39,426	40,000	2.19	161.55	95.02	256.57	0.573

1/ Basis of comparison is a standard load of the conventional jumbo crates (lengthwise on sides, 3 high, 6 wide, 16 stacks--288 crates).

2/ Computed on the basis of the published estimated weight of 88 pounds for a jumbo crate and two-thirds of the estimated weight (58.67 pounds) for a 2/3-size container.

3/ Includes freight rate only. Taxes are excluded.

4/ Includes charges for Standard Refrigeration (Rule 200) and for cooling at loading point (Rules 242 and 246). Charges for taxes and salt are excluded.

5/ Theoretical load. No such loads of wirebound and only 2 loads of the fiberboard boxes were originated during the 1957-58 shipping seasons.

in calculating the potential savings are from the applicable freight and protective service tariffs. The various sizes of loads are calculated on the basis of outside container dimensions.

The total potential savings from heavier loading range from about 3 cents per crate or $8.81 per car for 448 jumbo-crate-equivalent loads of No. 6560 fiberboard containers to 59 cents per crate-equivalent, or $283.97 per car, for the theoretical 720-crate-equivalent load of 2/3-capacity wirebound crates (No. 5104). Savings of as much as $123 per car may be realized by using a 4-layer load of conventional jumbo crates (No. 1152) and $197.16 for a 4-layer load of WGA jumbo crates (No. 1220). Potential savings in both freight and refrigeration charges vary not only with the size of the load, but also with the distances the shipments are transported. Thus potential savings on shipments from California and Arizona to markets in the Midwest in rate districts 2, 3, 4, 5, and 6 (fig. 21) are less than the savings on shipments from the same origin to New York shown in table 11.

During the 1958 season, the first season in which incentive rates were in effect, only limited experimental use was made of heavier loading. In that season only 3 percent of the cantaloup shipments in conventional crates and WGA crates from California and Arizona unloaded in 39 terminal markets covered by the Railroad Perishable Inspection Agency were loaded 4 or more layers high. In 1959, however, 68 percent of shipments to the same markets were loaded heavier.

Breakage rates for 3- and 4-layer loads of conventional crates and WGA crates from California and Arizona unloaded in 39 terminal markets covered by the Railroad Perishable Inspection Agency are shown in table 12. These data reveal little difference between the percentages of container damage for the 3- and 4-layer loads of both types of crates. Heavier loading of both types of jumbo crates did not appreciably increase the damage rate during the 1959 season.

In 1958, a few experimental 4-layer loads of the 2/3-capacity wirebound crates and the 4- and 5-layer loads of No. 6560 fiberboard containers were studied. These limited observations showed that no appreciable increase in container damage resulted from the heavier loading. In the 1959 shipping season 87 cars of No. 6560 fiberboard containers, loaded 5 layers high, were unloaded in 39 eastern markets with less than 1 percent total container damage. In addition, six 4-layer loads and one 4-layer with partial 5-layer load of wirebound crates were unloaded in the same markets with about the same percentage of damage as the smaller 3-layer loads. These data on container damage for the 1959 shipping season also suggest that heavier loading of No. 6560 fiberboard containers and No. 5104 wirebound crates will not appreciably increase the rate of container damage in transit.

Total Potential Savings

Use of the new, improved cantaloup containers covered in this study will make possible varying amounts of savings in the cost of containers in packing, handling, transportation, and refrigeration costs, and in losses due to melon bruising. The extent of the economies, however, depends upon the extent to

Table 12.--Container damage in rail shipments of California and Arizona cantaloups unloaded in 39 terminal markets, by type of container and size of load, 1959 season

Container, identification number, and size of load	Number of cars inspected	Container damage: Crates requiring recoopering	Container damage: Crates delivered in bad order
		Percent	Percent
No. 1152, Conventional jumbo crate:			
Three layers	45	12.0	2.4
Four layers	1,077	11.8	3.2
No. 1220, WGA jumbo crate:			
Three layers	2,535	6.6	1.1
Four layers	5,015	7.3	1.6

Data from reports of the Railroad Perishable Inspection Agency.

which (1) the various new containers are substituted for the conventional jumbo crates, (2) mechanical sizing of melons and various other labor-saving techniques are employed in packing the melons for shipment, and (3) heavier loading is used for rail shipments of the melons. It is therefore difficult to estimate accurately the potential savings that may result from the use of the new containers.

Savings from all sources can amount to as much as $3 million per year. This amount would be equal to about 6 percent of the average farm value of the crop (about $52 million) for the 1957 and 1958 seasons. Reductions in bruising should prolong the shelf life of the melons in all subsequent marketing channels, and after purchase by the consumer.

CONCLUSIONS

Cantaloup shippers can effectively reduce melon bruising, container damage, and costs of packing, loading, transportation, and refrigeration on long-distance rail shipments of their product by using any one of three new designs of shipping containers included in this study.

Bruising that affects the grade of melons can be reduced by as much as 70 percent by use of the 2/3-capacity wirebound crates and 85 percent by use of the 2/3-capacity fiberboard boxes, compared to the conventional jumbo crates. A similar reduction of about 50 percent in melon bruising can be derived from use of the new WGA jumbo crate.

Container damage in transit can be reduced by as much as 95 percent when fiberboard boxes are used, 75 percent when wirebound crates are used, and 46 percent when WGA crates are used, compared to the damage rate for conventional jumbo crates. Claim payments and recooperage costs paid by the rail carriers could be reduced by more than $1 million annually.

With adequate precooling before shipment and sufficient in-transit refrigeration, melons shipped in all three new containers may be expected to reach destination markets with about the same pulp temperatures as melons in the conventional crates. Melon firmness upon arrival at market may also be expected to be about the same in shipments of the different containers.

Differences between production labor requirements for packaging and loading equivalent quantities of melons in the new containers and in the conventional crates were small.

Substantial savings in freight and refrigeration costs can be realized by using the new containers. They permit heavier loading of rail cars to take advantage of the rail carriers' incentive program of lower freight rates for heavy loads. Potential savings from this source alone range from about $8 to about $280 per car.

The proportion of cars shipped from California and Arizona as heavy loads under the incentive rates increased from about 3 percent in 1958 to about 68 percent in 1959. Data on container damage in standard and heavier loads for 1958 and 1959 show that the rates of container damage are about the same in heavy loads as in the light loads.

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