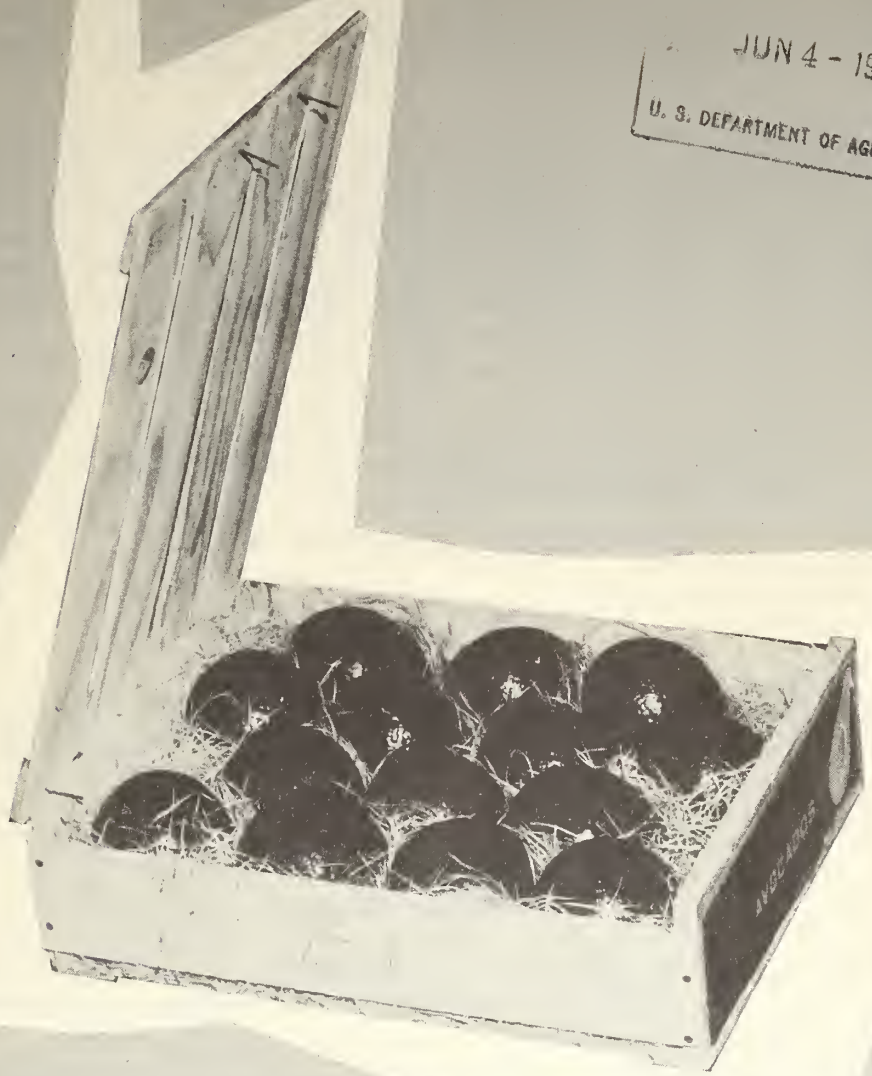


Evaluation of SHIPPING CONTAINERS for Florida AVOCADOS

Marketing Research Division
Agricultural Marketing Service

Marketing Research Report No. 228

UNITED STATES DEPARTMENT OF AGRICULTURE

C O N T E N T S

ACKNOWLEDGMENTS

Frank M. Kent, chairman of the 1956-57 Florida Avocado Administrative Committee, and T. P. Clinard and F. Piowaty, members of the Container Research Subcommittee, cooperated in this study. David M. Biggar, manager of the 1956-57 Florida Avocado Administrative Committee, arranged for the test shipments and represented the Florida avocado industry in the joint project. Credit is also given to Philip W. Hale, agricultural economist, Agricultural Marketing Service, who worked on the initial phases of this study.

Washington, D. C. May 1958

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. - Price 20 cents

U. S. DEPARTMENT OF AGRICULTURE

Errata

In Marketing Research Report No. 228, "Evaluation of Shipping Containers for Florida Avocados," 4 lines were omitted on page 4. The last paragraph of the text on that page should read:

"From the test results, it can be seen that the loads sustained by the test boxes of any one type were relatively uniform. It is interesting to note that the 3/4-bushel boxes, regardless of type, exhibited considerably more deflection (bulging of the sides) at maximum load than any of the flats. Thus considerable deflection of the 3/4-bushel boxes could occur because of superimposed loads without any indication of failure of the boxes in stacking."

Agriculture - Washington May 1958

SUMMARY

During the 1956-57 avocado season--November through March, inclusive--60 test shipments of avocados packed in 6 standard and 2 nonstandard types of containers were examined upon arrival at New York and Chicago markets. Eight shippers of the south Florida avocado industry made these shipments.

A marketing agreement and order, during the 1956-57 season, prohibited the shipping of Florida avocados in other than the "standard" flat (1-layer $\frac{1}{4}$-bushel box), except for those fruits weighing 20 ounces or more or measuring 3-7/8 inches or more in diameter. The multilayer 3/4-bushel container was used for the larger avocados. "Nonstandard" flats (1-layer 1/5-bushel boxes) also were shipped by special permission and evaluated.

The condition of the containers and avocados in these 60 test shipments was evaluated on their arrival in the Chicago and New York terminal markets. All the containers evaluated were generally adequate in protecting the avocados during transit. No serious bruising and little damage from bruising or skin discoloration were found. Some slight bruising and some slight skin discoloration were usually apparent, but were usually too minor to impair the salability of the avocados.

Considerable variation in the method of packing was found. The amount of wood excelsior used varied from none to large amounts. Tightness of pack varied from "tight" to "disarranged." The tight pack usually arrived in the better condition.

Upon arrival in the terminal markets, the fiberboard boxes appeared in good condition, were easy to handle, open, and close, and were attractively printed. However, the fiberboard boxes suffered from creasing and bulging, and the covers of many were concave from overhead weight. The wood boxes offered good ventilation, were very sturdy, and were good for stacking and handling. Handlers complained of splinters from the wood boxes and reported that the boxes sometimes needed renailing. There was no great difference in cost between the standard wood and fiberboard flats--the wood flats cost about 22 cents and the fiberboard flats about 18 to 21 cents, depending upon the material and construction.

Prior to the marketing agreement program, the use of a large number of containers of slightly varying dimensions and the frequent shifting from one size of container to another had resulted in confusion, and sometimes deception as to the trading unit, among the wholesalers and retailers. Wholesalers and retailers in the Chicago and New York markets were found to be generally satisfied with the standard containers used during the 1956-57 avocado season. They were particularly desirous that the avocado industry continue to use uniform standardized containers, and were less concerned with the specific dimensions of such containers.

The results of the study give no indication that a shift to the exclusive use of containers of any one type of material--that is, wood, fiberboard, or wirebound wood--would be beneficial to the Florida avocado industry.

It is suggested that avocado shippers, to minimize bruising and discoloration in transit, (1) use a generally tight pack, (2) leave some headroom between the fruit and the lid and experiment with the use of some type of compression pad, and (3) use moderate amounts of excelsior well distributed throughout the pack, especially along the sides and into the corners of the 1-layer boxes.

EVALUATION OF SHIPPING CONTAINERS FOR FLORIDA AVOCADOS

By James B. Fountain and Donald R. Stokes, agricultural economists,
Transportation and Facilities Branch

INTRODUCTION

The Florida avocado industry has grown from an annual production of about 1,400 tons in the early 1930's to nearly 14,000 tons. About 2 million shipping containers are now used to transport these avocados to market. The purpose of this study was to evaluate the different types and sizes of containers in use.

During the 1956-57 avocado season--November through March, inclusive--60 test shipments in 6 standard and 2 nonstandard types of containers were examined upon arrival at Chicago and New York markets. Eight shippers of the south Florida avocado industry participated in the test.

The marketing agreement and order regulating the handling of avocados grown in south Florida in 1956-57 prohibited the shipment of avocados in other than the standard flat (1-layer $\frac{1}{4}$-bushel box), except for those avocados weighing 20 ounces or more, or measuring 3-7/8 inches or more in diameter. These larger avocados could be packed in 3/4-bushel multilayer containers. Fiberboard boxes and wood boxes were generally used. Some 3/4-bushel wire-bound boxes also were used for the larger avocados. The containers could vary in design and construction, but had to be of uniform inside dimensions--the 3/4-bushel boxes, 16-3/4 by 11 by 10 inches, and the "$\frac{1}{4}$-bushel" boxes $16\frac{1}{2}$ inches long, $13\frac{1}{2}$ inches wide, and either $3\frac{1}{4}$, 3-3/4, or $4\frac{1}{2}$ inches deep.

Restrictions on containers were effected in recognition of the unstable trading conditions created by the use of a multiplicity of sizes and kinds of containers. The objective of the restriction was to reduce the number of different sizes of containers in use so as to facilitate orderly trading.

The objective of this study was to evaluate containers used by the Florida avocado industry and to help promote standardization on the fewest and best containers, so as to get the fruit to the consumer in the best possible condition consistent with reasonable cost.

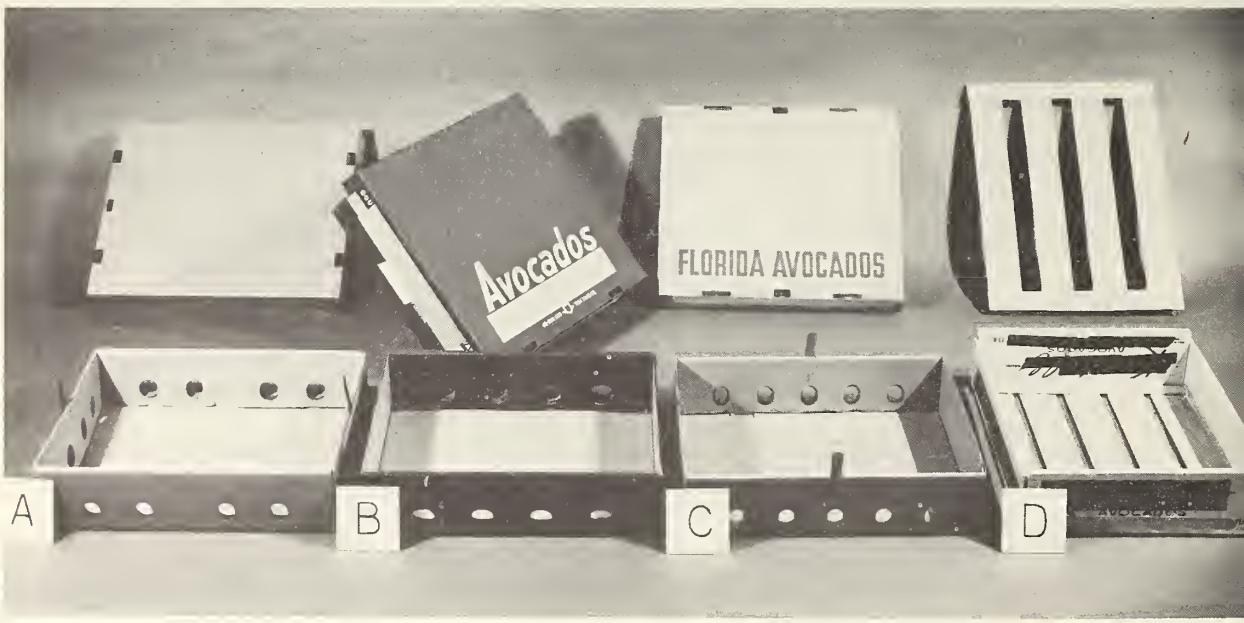
A total of 60 1/ shipments of avocados to the Chicago and New York markets were inspected during the 1956-57 season to evaluate the performance of alternative containers used commercially. The condition of the containers and fruit on arrival was examined by fresh fruit and vegetable inspectors and by container specialists of the Agricultural Marketing Service. Information was obtained on (1) bruising and skin discoloration, (2) average temperature of the fruit, (3) container damage, (4) general appearance of pack, (5) tightness of pack, (6) slackness of pack, (7) amount of excelsior used, and (8) trade reaction.

Description of Standard and Nonstandard Containers

The standard "flats," or 1-layer boxes, used for shipping Florida avocados in 1956-57 are shown in figure 1 and are described as follows:

Container "A" (fig. 1).--This is a 2-piece 1/4-bushel fiberboard flat with a half-telescope lid, closed by bending 2 metal tabs. It has double ends, 4 folded sides with 4 vent holes in each side, and 4 vent holes in 1 end. The inside dimensions are 16-1/2 by 13-1/2 by 3-3/4 inches. The bursting test is 200 pounds per square inch.

1/ The shipments were selected at random by the Avocado Administrative Committee to obtain a sample of different shippers and different containers.



N-20425

Figure 1.--The standard $\frac{1}{4}$-bushel flats: Container "A," fiberboard box, double ends, metal tabs; container "B," single ends, self-locking; container "C," single ends, metal tabs; container "D," wood flat.

Container "B" (fig. 1).--This is a 2-piece ¼-bushel fiberboard flat with a half-telescope lid on the sides and full telescope on the ends. It is closed by self-locking flaps. This container has single ends and triple folded sides, with 4 vent holes in each side. The inside dimensions are 16-1/2 by 13-1/2 by 3-3/4 inches. The bursting test is 200 pounds per square inch.

Container "C" (fig. 1).--This is a 2-piece ¼-bushel fiberboard flat with a half-telescope lid, closed by bending 2 metal tabs. It has single ends and triple folded sides, with 5 vent holes in each side. The inside dimensions are 16-1/2 by 13-1/2 by 3-3/4 inches. The bursting test is 200 pounds per square inch.

Container "D" (fig. 1).--This is a 6-piece nailed wood ¼-bushel flat. The lid is nailed on by a machine. The inside dimensions are 16-1/2 by 13-1/2 by 3-3/4 inches. The ends are ½-inch thick and the sides ¼-inch.

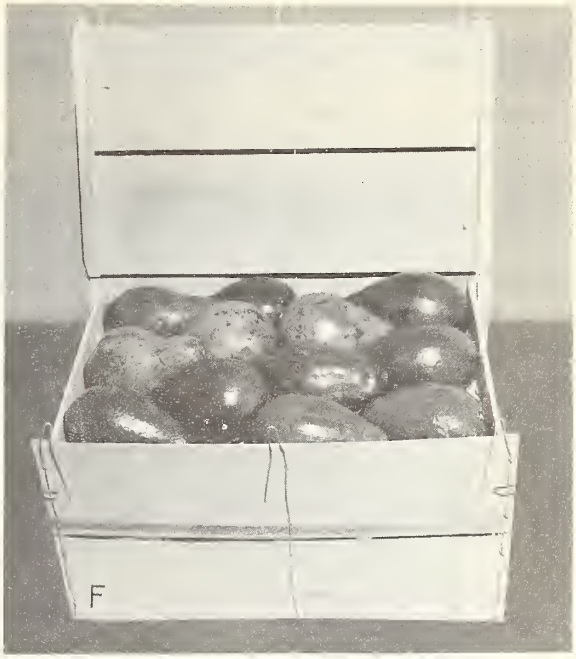
The standard 3/4-bushel fiberboard boxes used for shipping Florida avocados weighing 20 ounces or more during the 1956-57 season are shown in figures 2 and 3 and are described as follows:

Container "E" (fig. 2).--This is a 2-piece full-telescope 3/4-bushel fiberboard box. There are 4 vent holes in each side, 2 vent holes in each end, and 1 hand hole in each end. The inside dimensions are 16-3/4 by 11 by 10 inches. The bursting test is 200 pounds per square inch.

Container "F" (fig. 3).--This is a 3/4-bushel wood wirebound box with inside dimensions of 16-3/4 by 11 by 10 inches.

N-20426

Figure 2.--Two-piece full telescope 3/4-bushel fiberboard box.



BN-5410

Figure 3.--Wood 3/4-bushel wirebound box.

Container "G" (fig. 4).--This is a 2-piece 1/5-bushel half-telescope fiberboard box, with single ends and metal clips for closing. Inside dimensions are 14-1/4 by 11-1/2 by 3-3/4 inches. It has 2 vent holes in each side.

Container "H" (fig. 4).--This is a 2-piece 1/5-bushel fiberboard box with a half-telescope lid, closed by bending 2 metal tabs. This container has single ends, triple folded sides with 4 vent holes in each side. The inside dimensions are 15-7/8 by 11-1/2 by 3-3/4 inches.

COMPRESSION TEST OF STANDARD CONTAINERS

To obtain information on the stacking properties of the different containers, the Forest Products Laboratory, 2/ Forest Service, U. S. Department of Agriculture, made top-to-bottom compression tests of samples of (1) the 3/4-bushel wirebound box (container "F," fig. 3); (2) 3/4-bushel multilayer fiberboard container (container "E," fig. 2); (3) single-end fiberboard flats (containers "B" and "C," fig. 1); (4) double-end fiberboard flats (container "A," fig. 1); and (5) nailed wood flats (container "D," fig. 1). Such tests may be used to obtain an indication of the capacity of containers to resist crushing, such as that which may be caused by heavy static loads in storage warehouses. Only 3 boxes of each type were available for this test. The results are given in table 1.

From the test results, it can be seen that the loads sustained by the test boxes of any one type were relatively uniform. It is interesting to

---

2/ Maintained in cooperation with the University of Wisconsin.

N-20424

Figure 4.--Nonstandard 1/5-bushel fiberboard flats: container "G,", 14¼ inches long and container "H," 15-7/8 inches long.

Table 1.--Results of top-to-bottom compression tests on Florida avocado boxes, 1956-57

Type of box	Maximum load			Average maximum load	Average deflection at maximum load
	Sample 1	Sample 2	Sample 3		
	Pounds	Pounds	Pounds	Pounds	Inches
A. Double-end fiberboard flats	796	1,080	950	942	.210
C. Single-end fiberboard flats 1/	704	734	668	702	.288
D. Nailed wood flats	6,070	5,800	6,520	6,130	.192
E. 3/4-bu. multilayer fiberboard	1,632	1,482	1,234	1,449	.492
F. 3/4-bu. wirebound	3,580	3,810	3,530	3,640	0.945

1/ Single-end fiberboard flat with metal tabs; container "B," a single-end fiberboard flat with a self-locking cover, was not tested.

Experience has indicated that boxes in longtime storage do not safely sustain loads equal to the machine compression test values. Since the length of storage is unknown, it appears reasonable to consider values equal to 50 percent of the test results. When this reduction is applied, there seems to be little question of the ability of the 3/4-bushel wirebound and nailed wood flat to support stacking loads, provided the boxes are properly alined in stacking.

Moisture conditions also affect the stacking properties of containers. The effect of moisture on stacking strength of fiberboard is greater than on the other materials tested.

For example, at 8 percent moisture content, the single-end fiberboard flats carried an average load of about 700 pounds. Information obtained from work involving fundamental behavior characteristics of fiberboard indicates that these flats will support 66 percent of this load, or about 462 pounds, for 5 days; 62-1/2 percent, or 438 pounds, for 10 days; and 53 percent, or 371 pounds, for 100 days.

If these same flats were stored at 40 degrees F. and 90 percent relative humidity, the moisture content would be approximately 20 percent. Under these conditions, the top-to-bottom machine compression value would decrease to approximately 305 pounds and the box could be expected to support only 201 pounds for 5 days, 190 pounds for 10 days, and 162 pounds for 100 days.

It appears therefore that the fiberboard flats should withstand a reasonable amount of stacking unless the temperature and humidity of the storage area are such that the moisture content of the fiberboard approaches 20 percent.

ARRIVAL CONDITION OF AVOCADOS AND CONTAINERS IN TERMINAL MARKETS

Condition of Avocados in Standard Containers

The 6 standard containers evaluated in the 1956-57 avocado season gave generally adequate protection to the fruit. No "serious" bruising and little "damage" by bruising or skin discoloration were found. The "slight" bruising and skin discoloration found had little effect on the salability of the avocados. The condition of the avocados upon arrival in Chicago and New York is shown in table 2.

The average percentage of avocados with slight bruising and skin discoloration in the multilayer packs (wirebound and fiberboard containers) was 15.9 percent; in the fiberboard flat, 6.1 percent; and in the wood flat, 12.0 percent. Insufficient shipments of the self-locking fiberboard box were observed to constitute an adequate sample. The differences between the single-end fiberboard flat and the wood flat, and between the double-end flat and the wood flat, were found to be statistically significant at the 5 percent level.

The amount of excelsior used and tightness of pack (lack of freedom of movement among the avocados and between them and the sides of the container) appeared to have considerable effect upon the amount of slight bruising and skin discoloration found upon arrival of the test shipments. The average percentage of slight bruising and skin discoloration in boxes containing moderate amounts of excelsior and a tight pack was 8.2 percent, as compared to 9.3 percent for the loose pack with the same amount of excelsior. Large amounts of excelsior with a loose pack showed a higher percentage of bruising than large amounts of excelsior in a tight pack, 16.1 and 8.1 percent, respectively. Boxes having no excelsior and packed loosely showed more bruising than when they were packed tight. Therefore, it is quite evident that a tightly packed box is important to minimize bruising of avocados (see table 3).

Table 2.--Condition of Florida avocados upon arrival in Chicago and New York, by type of standard containers, 1956-57

Containers	Shipments 1/	Lots 2/	Percentage of fruit showing bruising and skin discoloration	
			Slight 3/	Damage 3/
	Number	Number	Percent	Percent
A. Double ends, fiberboard, half-telescope	6	17	4/6.5	0.6
B. Self-locking fiberboard, half-telescope	3	4	16.7	1.6
C. Fiberboard, half-telescope, single ends	13	38	4/4.8	0
D. Wood flat	13	34	4/12.0	0.1
E. 3/4-bushel fiberboard, full telescope	3	7	16.1	0.3
F. Wirebound box, 3/4-bushel	1	2	15.0	0

1/ Sixty shipments were observed, but only 39 are included in bruising and discoloration studies, for various reasons such as errors through including defects present at harvest time with defects occurring during shipment.

2/ A lot represents a group of containers packed with comparable avocados of the same size, from which a representative sample was inspected for each shipment.

3/ "Slight" bruising and skin discoloration were not sufficient to affect materially the appearance or salability of the avocados, although "damage" by bruising or skin discoloration was large enough to affect appearance and salability.

4/ Certain differences among these percentages are statistically significant at the 5 percent level. The significant differences noted were between 4.8 percent and 12.0 percent and between 6.5 percent and 12.0 percent.

Table 3.--Condition of Florida avocados packed in standard containers, upon arrival in Chicago and New York, by amount of excelsior and tightness of pack, 1956-57 1/

Amount of excelsior	Lots		Percentage of fruit showing bruising and skin discoloration			
			Slight		Damage	
	Tight	Loose	Tight	Loose	Tight	Loose
	Number	Number	Percent	Percent	Percent	Percent
None (no pads)	10	3	5.4	10.3	0	0
None (with paper pads)	6	---	14.5	---	0	0
Small	2	13	0	8.1	0	0
Moderate	29	19	8.2	9.3	0.4	0.1
Large	10	9	8.1	16.1	0.2	1.1

1/ Includes following containers: (1) Fiberboard, half-telescope, single ends, ¼-bushel; (2) wood, ¼-bushel; (3) fiberboard, half-telescope, self-locking, ¼-bushel; (4) fiberboard, half-telescope, double ends, ¼-bushel; (5) fiberboard, full telescope, 3/4-bushel; and (6) wirebound, 3/4-bushel.

"Headroom" is measured from the top of the avocados to the lid. Some headroom appears to be desirable, as it seems to result in less bruising and skin discoloration of the avocados (table 4).

The average percentage of avocados with slight bruising and skin discoloration, when headroom was in the range of none to ¼-inch, was 14.8 percent, and in the range of ¼ to 1 inch, it was 6.0 percent. The difference between these 2 percentages was statistically significant at the 5 percent level.

Packing the container with little or no headroom leads to more bruising and skin discoloration immediately beneath the cover in the fiberboard boxes than in the wood boxes. However, in wood boxes the pressure of the nailed lids frequently makes the wood excelsior cut into the skin of the avocados.

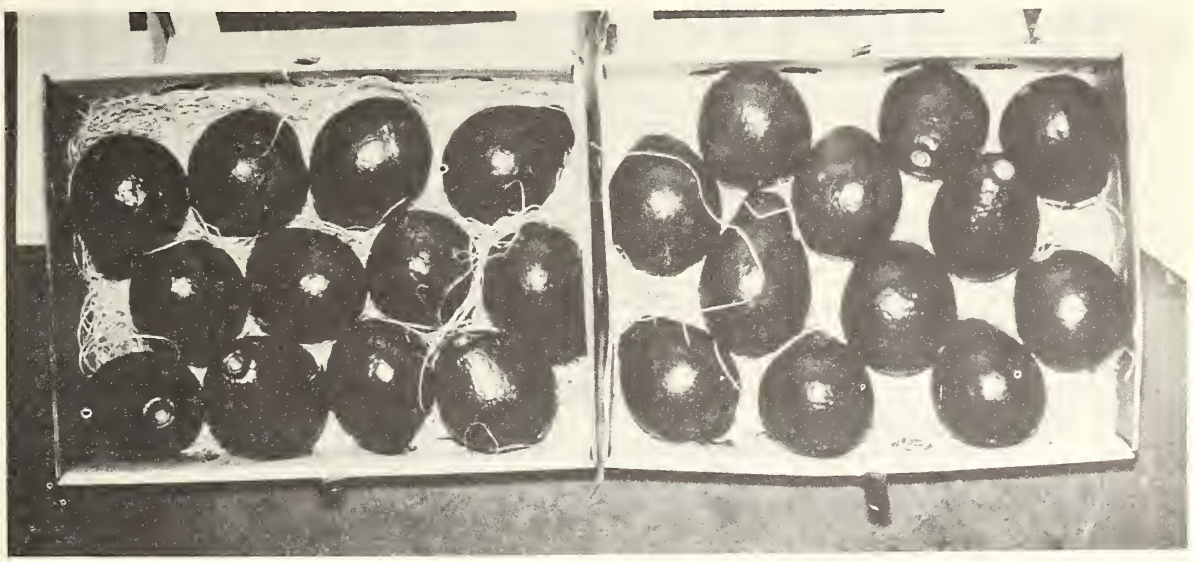
Table 4.--Condition of Florida avocados packed in standard containers, upon arrival in Chicago and New York, by slackness of pack, 1956-57 1/

Headroom	Shipments	Lots	Percentage of fruit showing bruising and skin discoloration	
			Slight	Damage
	Number	Number	Percent	Percent
0 to $\frac{1}{4}$ inch	13	36	2/14.8	.5
$\frac{1}{4}$ to 1 inch	23	62	2/6.0	.1

1/ Includes following containers: (1) Fiberboard, half-telescope, single ends, $\frac{1}{4}$-bushel; (2) wood, $\frac{1}{4}$-bushel; (3) fiberboard, half-telescope, self-locking, $\frac{1}{4}$-bushel; (4) fiberboard, half-telescope, double ends, $\frac{1}{4}$-bushel; (5) fiberboard, full telescope, 3/4-bushel; and (6) wirebound, 3/4-bushel.

2/ Differences between these groups are statistically significant at the 5 percent level.

There was considerable variation in the methods of packing used by the Florida shippers (see fig. 5). The relationship of the amount of bruising and skin discoloration of the avocados and the variation in pack, by shippers, is shown in table 5.



BN-5408

Figure 5.--Avocados, 12-count size, packed in different alinements, with moderate amount of excelsior, in receiver's warehouse, New York, 1957.

Table 5.--Condition of Florida avocados and variations in pack of standard containers upon arrival in Chicago and New York, by shippers, 1956-57 1/

Shipper	Test shipments sent	Slight bruising and skin discoloration	Tightness of pack		Amount of excelsior used					Headroom	
			Generally tight	Generally loose	None (paper pads used)	None (no pads)	Small	Moderate	Large	0 to $\frac{1}{4}$ inch	$\frac{1}{4}$ to 1 inch
	No.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
A	7	2/3.1	48.0	52.0	---	---	22.2	77.8	---	33.3	66.7
B	5	8.8	70.0	30.0	---	---	---	55.6	44.4	62.5	37.5
C	3	16.7	16.7	83.3	---	---	---	100.0	---	50.0	50.0
D	3	6.5	75.0	25.0	---	---	50.0	50.0	---	25.0	75.0
E	3	12.6	100.0	---	57.1	---	---	42.9	---	---	100.0
F	7	13.7	25.0	75.0	---	12.5	50.0	37.5	---	37.5	62.5
G	3	2/6.5	62.4	37.6	---	100.0	---	---	---	---	100.0
H	6	2/12.4	57.1	42.9	---	---	---	42.1	57.9	31.5	68.5

1/ Includes the following containers: (1) Fiberboard, half-telescope, single ends, $\frac{1}{4}$-bu.; (2) wood flat, $\frac{1}{4}$-bu.; (3) fiberboard, half-telescope, self-locking, $\frac{1}{4}$-bu.; (4) fiberboard, half-telescope, double ends, $\frac{1}{4}$-bu.; (5) fiberboard, full telescope, 3/4-bu.; and (6) wirebound, 3/4-bu.

2/ Certain differences among these percentages are statistically significant at the 5 percent level. The significant differences noted were between 6.5 percent and 12.4 percent, and between 3.1 percent and 12.4 percent.

It is evident from the data in table 5 that it is difficult, because there were so few test shipments, to establish a definite relationship between (1) the shipper and his method of packing and (2) the percentage of bruising and skin discoloration present upon arrival of the fruit at destination. However, shippers A, D, and G, whose shipments showed the lowest percentages of bruising and skin discoloration, for the most part used a generally tight pack with headroom from $\frac{1}{4}$ to 1 inch. Shippers C and F, most of whose packs were generally loose, showed the highest average amounts of skin discoloration and bruising.

The average temperatures of the fruits at the center and perimeter of the containers, upon arrival in New York and Chicago, are shown in table 6.

Table 6.--Average temperatures of Florida avocados upon arrival in New York and Chicago, by type of standard container, 1956-57

Container	Shipments	Lots	Temperature	
			Center fruit	Perimeter fruit
	Number	Number	Degrees F.	Degrees F.
A. Fiberboard, half-telescope, double end	6	5	52.7	51.0
B. Fiberboard, half-telescope, self-locking	3	7	53.6	51.4
C. Fiberboard, half-telescope, single ends	11	32	53.6	50.9
D. Wood	13	21	48.4	46.7
E. Fiberboard, full telescope, 3/4-bushel	1	2	50.5	49.5
F. Wirebound, 3/4-bushel	1	2	51.0	50.0

Both the center and perimeter fruit shipped in the wood flats arrived about 4 degrees F. cooler than that in the fiberboard containers. However, it is not known whether this difference is due to the container or to some other factor, such as the practice of certain shippers of having their avocados transported at lower temperatures than do other shippers.

It will be noted that the center fruit in all containers arrived at a higher temperature than the fruit on the perimeter, and that this difference varied with each type of container. The method of packing as well as the container can account for this difference. The two multilayer boxes have the least difference in temperature, the smaller difference indicating good air circulation.

Most of the containers studied arrived with a generally tight pack, although there were not enough test shipments to demonstrate clearly the relationship between tightness of pack and bruising or discoloration of the fruit (table 7). All of the lots in the multilayer wirebound box arrived in a generally tight pack. The wood flats and the double-end fiberboard boxes were usually packed tighter than the other types of containers.

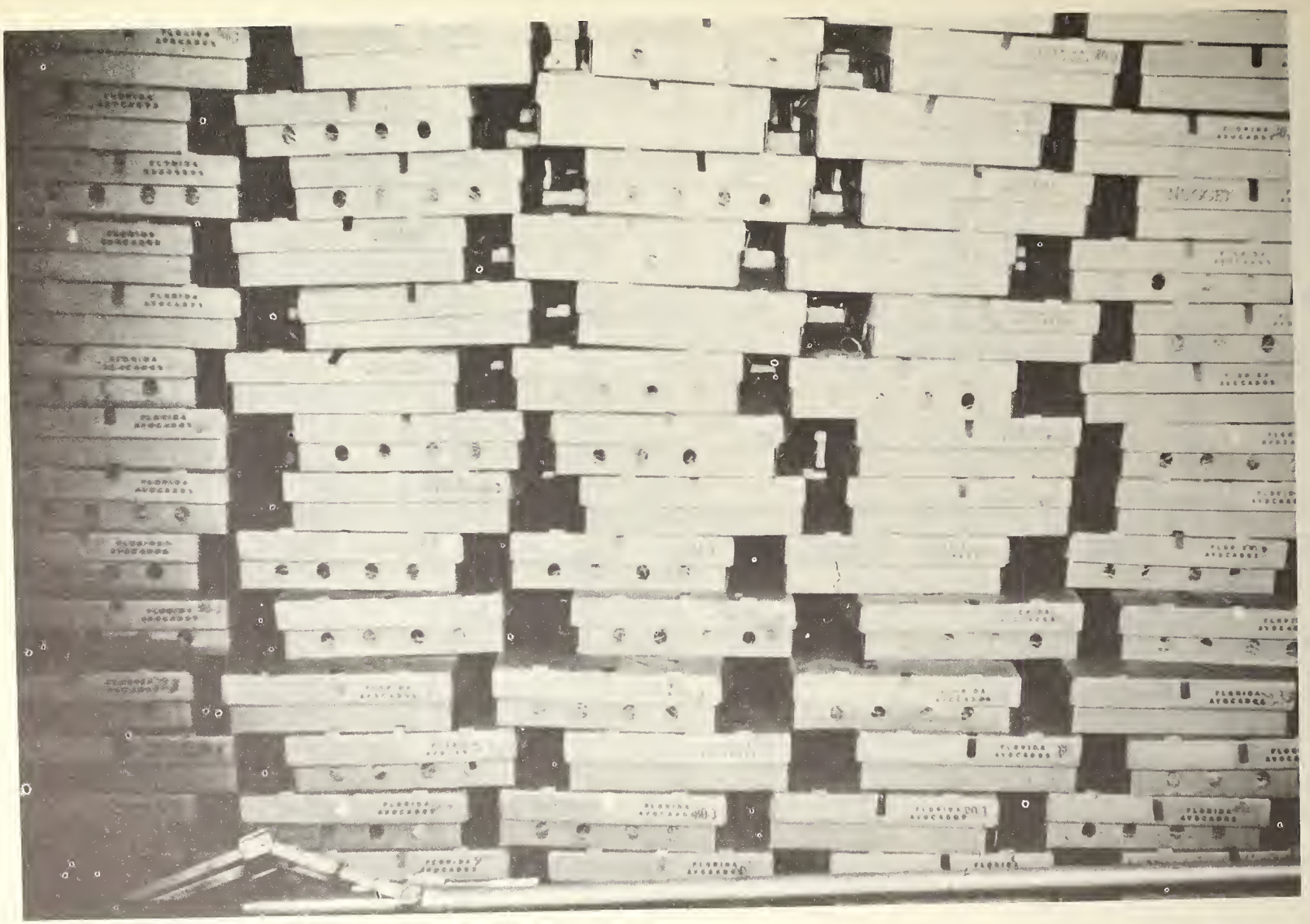
The single-end fiberboard flats arrived with small to moderate amounts of excelsior (table 8). The wood flats arrived with mostly moderate to large amounts, as did the self-locking fiberboard flats. The double-end fiberboard flat usually was used with no excelsior. The fiberboard multilayer box was used with paper pads and excelsior, while the wirebound box had paper pads only.

Condition of Standard Containers

As a rule, container damage was not severe in the 60 commercial shipments of avocados observed. The types of damage, related to different types of containers, could be classified as follows:

Type of damage reported	Containers
Concave from overhead weight	Single-end and double-end fiberboard boxes
Creasing	All fiberboard containers
Sides and ends bulged	Self-locking fiberboard boxes
Broken slats	Wood flats

No damage to the multilayer wirebound container was found. Single-end fiberboard flats were sometimes creased and slightly bulged. The double-end fiberboard flats were sometimes slightly creased and slightly concave from overhead weight. Some wood flats arrived damaged, with the contents spilled, because of a loose or improperly stacked load. The general appearance of all the containers and packs was "good" (see fig. 6).



BN-5406

Figure 6.--Avocados in fiberboard boxes in a truck ready to unload in New York. Note good condition of containers, and loading pattern to provide air channels for ventilation and cooling of fruit.

Table 7.--Tightness of pack of standard Florida avocado containers upon arrival, New York and Chicago, by containers, 1956-57

Container	Shipments	Lots	Percentage packaged							
			Generally tight pack				Generally loose pack			
			Tight	Tight to fairly tight	Fairly tight	Total	Fairly tight to loose	Loose	Loose to disarranged	Total
	No.	No.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
A. Fiberboard, half-telescope, double ends	7	20	5.0	5.0	55.0	65.0	20.0	15.0	---	35.0
B. Self-locking fiberboard, half-telescope	3	6	---	---	16.7	16.7	50.0	33.3	---	83.3
C. Fiberboard, half-telescope, single ends	13	38	---	---	44.7	44.7	18.4	23.7	13.2	55.3
D. Wood	18	67	7.5	19.4	34.3	61.2	20.9	14.9	3.0	38.8
E. Fiberboard, full-telescope, 3/4-bushel	3	7	---	---	57.1	57.1	---	42.9	---	42.9
F. Wirebound, 3/4-bushel	1	2	---	---	100.0	100.0	---	---	---	---

Table 8.--Amount of excelsior used in specified containers of Florida avocados shipped to New York and Chicago, by containers, 1956-57

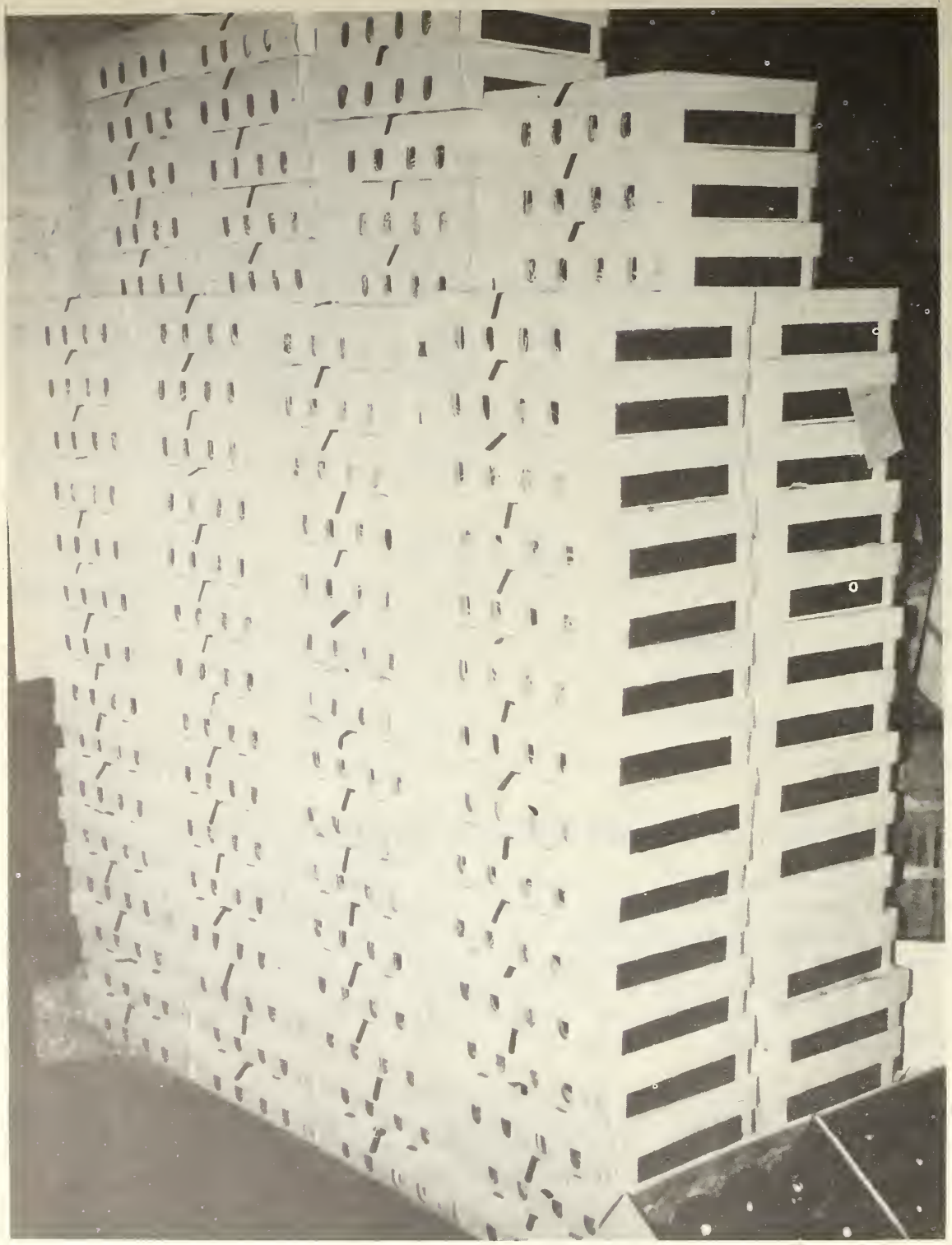
Container	Shipments	Lots	Percentage of containers having specified amounts of excelsior				
			None (no pads)	None (paper pads used)	Small	Moderate	Large
	No.	No.	Pct.	Pct.	Pct.	Pct.	Pct.
A. Fiberboard, half-telescope, double ends	7	18	89.0	---	5.5	5.5	---
B. Fiberboard, half-telescope, self-locking	2	5	---	---	---	60.0	40.0
C. Fiberboard, half-telescope, single ends	13	38	---	---	28.9	71.1	---
D. Wood	13	60	---	---	5.0	48.3	46.7
E. Fiberboard, full-telescope, 3/4-bushel	3	7	---	57.1	---	42.9	---
F. Wirebound, 3/4-bushel	1	2	---	100.0	---	---	---

Condition of Nonstandard Containers and Avocados Packed in Them

Only 6 test shipments were made of the 2 smaller flats during the 1956-57 avocado season. The shipments of the 2 nonstandard flats, combined, averaged 21.7 percent slight bruising and skin discoloration--considerably higher than was found for the standard-size fiberboard flats, which averaged 6.1 percent. The avocados packed in the nonstandard containers were shipped late in the season and consequently may not have been as resistant to damage as avocados shipped earlier.

The average temperature upon arrival for the small nonstandard flat was much lower, 45.6 degrees F., compared to 53.8 degrees F. for the other fiberboard flat. Theoretically, the smaller 1/5-bushel flats, because they are narrower, should have better ventilation than the larger $\frac{1}{4}$-bushel flats.

The 2 nonstandard flats showed much the same container damage as the larger flats. They arrived in generally good condition and with good appearance (see fig. 7). The 2 nonstandard containers arrived generally tightly packed, and contained small to moderate amounts of excelsior.



BN-5407

Figure 7.--Florida avocados packed in 1/5-bushel nonstandard fiberboard boxes stacked 20 high in the receiver's warehouse, New York, 1957.

The apparent inconsistency of the nonstandard flats, arriving with a generally tight pack and with small to moderate amounts of excelsior, and yet showing higher amounts of slight bruising and skin discoloration than the standard flats, may be due to their being shipped late in the avocado season. Insufficient shipments were made to indicate conclusive differences in the performance of the nonstandard containers as compared to the ¼-bushel flats.

TRADE REACTION TO STANDARD AND NONSTANDARD CONTAINERS

Overall, the standard containers were received favorably, although some receivers mentioned features of the containers which they regarded as undesirable. Many dealers made no comment at all as to their "likes" or "dislikes" for various avocado containers. The following comments apply only to the 1-layer containers or "flats," because the 3/4-bushel wirebound boxes and full-telescope fiberboard boxes were not widely used for interstate shipments.

Common reasons for liking the fiberboard containers were:

1. They have good display features, good printability.
2. They are easy to handle, open, and close.
3. No renailing is required.
4. They have good stacking qualities.
5. They have better overall appearance than wood flats.

Common reasons for disliking fiberboard containers were:

1. Dampness affects containers.
2. They buckle from overhead weight, covers become concave.
3. They provide less ventilation than wood flats.
4. Metal tabs catch on other containers.

Common reasons for liking wood containers were:

1. They provide superior ventilation.
2. They have superior stacking qualities.
3. They give excellent protection for fruit.

Common reasons for disliking wood containers were:

1. They require a crate opener.
2. Splinters sometimes injure handlers.
3. They need renailing.
4. Protruding excelsior looks bad.

Six test shipments of the nonstandard 1/5-bushel containers were shipped to 4 wholesalers during the 1956-57 avocado season. Three wholesalers expressed unfavorable reactions to these containers, while 1 received them favorably. Most of the receivers agreed that it is difficult to compare

sizes of avocados offered for sale in flats of different sizes unless they are displayed side by side, and therefore the 1/5-bushel box is considered deceptive (see fig. 8). Reactions to the 6 test shipments may be summarized as follows:

Container G.--3 shipments, 2 wholesalers. Description: Half-telescope lid, 14-1/4 by 11-1/2 by 3-3/4 inches, single ends, 2 vent holes in each side.

One wholesaler expressed a favorable reaction to this container. He preferred the smaller box because "they bring the same price." He said: "That trade which prefers the salad-size avocado will accept a 12-size in a smaller lug just as readily as a slightly larger 12-size in the larger box; the trade pays the same price. It was a mistake for the avocado industry to have converted to the larger box, for the price went down to the same level on the larger lugs as it previously was on the smaller lugs. Therefore, the avocado industry suffered that much loss." Significantly, he later said he doubted he would get the same price for the smaller box now, for a chainstore buyer questioned him as to the size of the containers he was selling.

The other wholesaler, however, "disliked" this container. "The larger box is preferred by the trade," he explained, and he thought that it had a better appearance than the smaller 1/5-bushel box. "Poor sizing" of the avocados in the smaller flat also was given by this wholesaler as a reason for disliking this container.

BN-5405

Figure 8.--The 20-count size avocados packed in the $\frac{1}{4}$-bushel flat in the center of this photograph are actually larger (although smaller count size) than the 16- or 18-count size avocados packed in the 1/5-bushel flats on the left and right side of the picture.

Container H.--3 shipments, 2 wholesalers. Description: Half-telescope lid, 15-7/8 by 11-1/2 by 3-3/4 inches, single ends, 4 vent holes in each side.

Some favorable comments about this container included: "The box offered good ventilation, being narrower and with 4 vent holes in each side." The good condition and appearance of this 1/5-bushel flat also was noted by these wholesalers. However, the 2 wholesalers expressed the following "dislikes" for this container: (1) One wholesaler explained: "The small box sells OK, but, to tell the truth, the trade prefers the larger standard box." He also said the avocados "look off-size" in the smaller container. (2) The avocado salesman for the other wholesaler said: "What are you going to use next--a cigarette box?" He also called the smaller box a "gyp-box." "If my customers were able to compare the smaller with the regular box, I would have had to lower the price. Actually, my customers did not realize they were getting the smaller box; but a 14-size avocado in this box is about a 16-size in a regular box, so a customer is losing 2 avocados. They get less for their money."

COST OF CONTAINERS, PACKING MATERIALS, AND DIRECT LABOR

The comparative costs of the various containers and packing materials used for packaging avocados during the 1956-57 season are shown in table 9. The double-end half-telescope fiberboard box, which appeared to be the most sturdy of the fiberboard boxes and in the best condition in the terminal markets and wholesale and retail stores, was the most expensive of the $\frac{1}{4}$-bushel fiberboard flats, costing about 21.2 cents (excelsior not used with this box), compared to 19.6 cents (including cost of excelsior used) for the similar fiberboard box with single ends. The half-telescope single-end self-locking fiberboard box was the cheapest of the 3 most commonly used fiberboard flats. This box, including packing materials, cost only 17.6 cents. Although only a limited number of shipments of this container were observed in the terminal markets, more bruising and skin discoloration were found in the avocados packed in this container, as shown earlier in this report.

Wood flats cost about the same as fiberboard flats, although usually more excelsior is packed with the avocados in the wood boxes.

The 3/4-bushel full-telescope boxes are cheaper than the 3/4-bushel wire-bound boxes. However, only a small percentage of Florida avocados shipped out of the State are packed in this larger unit.

The smaller nonstandard 1/5-bushel fiberboard flats are cheaper, of course, than the $\frac{1}{4}$-bushel size, but cost more per equivalent quantity of avocados packed. Not only is the cost of packaging materials increased, but labor costs to pack avocados in the small 1/5-bushel containers and handle them throughout the entire marketing system are increased per equivalent quantity of avocados marketed.

Table 9.--Cost of various types and sizes of containers and packing materials used for Florida avocados, 1957

Container	Size by volume	Containers		Packing materials				Total
		Per 1000	Each	Item and unit	Price	Amount used	Cost per container	
		Dol.	Dol.		Dol.	Lb. or No.	Dol.	Dol.
A. Half-telescope fiberboard box, double-end, metal clip	1/4-bu.	211.98	.212	None	---	---	---	.212
B. Half-telescope fiberboard box, single-end, self-locking cover	1/4-bu.	163.32	.193	Excelsior	101.04/ton	1/4 lb.	.013	.176
C. Half-telescope fiberboard box, single-end, metal clip	1/4-bu.	182.85	.183	do.	101.04/ton	1/4 lb.	.013	.196
D. Wood box	1/4-bu.	198.00	.198	do. 1/	101.04/ton	1/2 lb.	.025	.223
E. Full-telescope fiberboard box	3/4-bu.	262.50	.263	None 2/	---	---	---	.263
F. Wirebound box	3/4-bu.	310.00	.310	Paper pad 3/	19/1000	2	.038	.348
G. Nonstandard half-telescope fiberboard box, single end metal clip, 14-1/4-inch length	1/5-bu.	148.50	.148	Excelsior	101.04/ton	1/4 lb.	.013	.161
H. Nonstandard half-telescope fiberboard box, single end metal clip, 15-7/8-inch length	1/5-bu.	175.00	.175	do.	101.04/ton	1/4 lb.	.013	.188

1/ Some packers use more or less than ½-lb. of excelsior and some use compression pads which cost $45 per 1,000.

2/ Paper pads (cardboard dividers) are used by some packers between layers of avocados packed in 3/4-bu. fiberboard boxes.

3/ Paper pads (cardboard dividers) are used between layers of avocados and also on the bottom and top of the pack by some avocado packers.

The cost of labor to pack avocados in the various containers during the 1956-57 season was not determined. However, preliminary investigations undertaken a year earlier, to ascertain the effect of alternative containers on packing labor costs, indicated that differences in labor requirements were dependent on a number of factors and varied widely between plants. This was due to differences in containers, equipment, and practices in sorting, grading, and packing. Packing labor requirements, regardless of type of container used, were much less in those plants which pre-sized avocados with automatic equipment before packing them. Eye-sizing of the avocados from bins or tubs while packing was less efficient. Labor requirements also varied with the amount of excelsior or other packing materials used and the care with which the avocados were placed in the container, which varied by shipper as well as by individual packer.

Labor requirements for packing avocados also vary with the varieties or sizes and shapes of the avocados. The larger avocados can be packed faster. Those varieties which are more nearly round can be packed faster than those with elongated necks.

Direct labor costs for assembling containers and for packing and closing them averaged from 2 to 4 cents for flats and 4 to 5 cents for the larger 3/4-bushel containers.

PRACTICES, TRENDS, RECOMMENDATIONS

A total of 46 varieties of Florida avocados was shipped in 1956-57, as shown in table 10 in the appendix. Of these, about 92 percent were shipped in $\frac{1}{4}$-bushel containers, as shown in table 11 in the appendix.

Most of the flats currently in use are 3-3/4 inches deep. The multilayer container was restricted during the 1956-57 season to the shipment of large avocados, and the industry, by and large, feels that this has been of benefit to it.

It is apparent from the data gathered in this study that all types of containers used during the 1956-57 season were, in general, quite adequate. However, it is believed that it may be possible to reduce bruising and skin discoloration if shippers (1) use a generally tight pack, (2) leave some headroom between the fruit and lid or use some type of compression pad, or do both, and (3) use moderate amounts of excelsior, well distributed along the sides and into the corners of the 1-layer boxes.

More research is needed to (1) evaluate alternative loading patterns; (2) develop improved containers such as (a) wood and fiberboard combination containers which incorporate the advantages of each type of material, (b) polyethylene liners for containers or polyethylene-coated fiberboard containers to reduce discoloration due to friction of the avocados rubbing against the box, (c) containers of especially suitable dimensions for

particular varieties or sizes of avocados that are difficult to pack in standard-size containers; and (3) improve methods of packing avocados of various sizes and shapes in different containers, particularly when various packing materials, such as paper pads and excelsior, are used.

Limited evaluation of the smaller nonstandard flats shows that no particular industrywide benefits may be realized from their general use. These smaller containers show no promise of improving the condition of the fruit on arrival in the terminal markets, although, theoretically, their being narrower may mean better ventilation. Obviously, shipment of the same volume of fruit in 1/5-bushel containers as in $\frac{1}{4}$-bushel containers would require more of these smaller flats. This would increase costs of packaging and handling. A corresponding increase in consumer demand as a result of using the smaller flat does not appear to be probable. Some "demand" experts believe that the demand for avocados is inelastic, which means that consumers do not respond proportionately to a change in price. Publicity and education, however, might influence consumer preferences for avocados and persuade more people to buy this fruit, and thus change the elasticity of demand. There appears now to be no economic reason for the Florida avocado industry to convert to the smaller nonstandard containers.

The results of this study give no indication that a shift to the exclusive use of containers of any one type of material--that is, wood, fiberboard, or wirebound wood--would be beneficial to the Florida avocado industry.

APPENDIX

Table 10.--Comparative shipments of Florida avocados, by varieties, 1955-56 and 1956-57 seasons 1/

Variety	1955-56 2/	1956-57 3/
	Bushels	Bushels
Avon	1,569	455
Black Prince	331	555
Blair	173	351
Booth 1	28,921	18,298
Booth 3	17,093	11,814
Booth 5	1,808	688
Booth 7	65,452	36,153
Booth 7B (Ajax)	3,161	3,480
Booth 8	85,494	55,344
Booth 10	609	802
Booth 11	649	277
Byars 1	208	246
Choquette	2,368	1,852
Collinson	11,635	18,332
Dunedin	---	40
Fairchild	205	30
Fuchs	11,581	3,798
Hall	1,551	3,193
Hardee	181	122
Herman	972	863
Hickson	18,425	16,485
Itzamna	400	1,961
Linda	2,117	2,699
Lula	124,237	145,329
Marcus (Pumpkin)	51	94
Monroe	3,801	3,344
Nabal	500	491
Nadir	84	1
Nelson	141	208
Nirody	85	47
Peterson	402	293
Pinelli	906	200
Pollock	23,474	14,247
Rue	290	212
Schmidt	865	553
Seedlings	16,434	13,124
Sherman	190	96
Simonds	585	712
Simpson	1,093	514
Taylor	15,344	25,277
Tonnage	4,514	4,509
Trapp	13,028	10,547
Vaca	426	492
Waldin	50,259	38,148
Wagner	3,487	2,439
Winslowson	1,004	704
Total	516,103	439,419

1/ Annual report of Florida Avocado Administrative Committee, 1956-57, Homestead, Fla.

2/ Equivalent bushels shipped, as taken from certificates (flats at 15 pounds, multilayers at 40 pounds, bushels at 55 pounds).

3/ Approximate gross quantities received at packinghouses (including gradeouts) as taken from handlers' weekly reports (beginning Sept. 24, 1956). Net quantities shipped prior to Sept. 24, 1956 (4 flats equal 1 bushel).

Table 11.--Weekly shipments of Florida avocados, by size of containers, 1955-56 and 1956-57 seasons 1/

1955-56 season				1956-57 season			
Week ending:	Flats	Multilayer	Total quantity	Week ending:	1/4-bushel flats	3/4-bushel multilayers	Total quantity
	Number	Number	Bushels		Number	Number	Bushels
June 18 to				June 2 to			
July 2	2/3/ 167	2/3/141	3/162	June 30	3/20	---	3/5
9	2/6,152	2/1,164	2,351	July 7	778	---	195
16	2/8,792	2/1,932	3,470	14	2,714	---	679
23	2/17,004	2/4,155	7,000	21	8,215	69	2,105
30	2/14,148	2/4,211	6,513	28	14,045	880	4,172
Aug 6	2/ 9,820	2/5,776	6,946	Aug 4	12,695	2,216	4,835
13	2/11,329	2/5,902	7,213	11	10,493	1,881	4,035
20	2/17,927	2/5,258	7,991	18	8,996	979	2,982
27	2/25,700	2/8,679	12,410	25	15,458	736	4,416
Sep 3	2/25,858	2/11,441	14,459	Sep 1	25,760	730	6,988
10	2/13,774	2/10,877	11,557	8	20,583	690	5,663
17	2/19,300	2/17,021	17,446	15	34,608	595	9,097
24	2/19,477	2/11,267	12,876	22	35,912	729	9,524
Oct 1	2/29,954	2/6,315	12,048	29	36,148	881	9,697
8	25,678	10,142	14,027	Oct 6	37,716	726	9,974
15	20,522	7,217	10,544	13	40,068	1,112	10,851
22	58,324	26,878	34,740	20	54,694	610	14,131
29	32,252	21,518	24,202	27	55,964	1,836	15,368
Nov 5	27,009	19,951	21,715	Nov 3	47,170	975	12,524
12	48,663	22,304	28,894	10	63,473	1,340	17,208
19	45,161	33,856	36,682	17	76,512	887	19,793
26	27,186	15,603	18,499	24	45,167	961	12,013
Dec 3	38,894	17,012	22,483	Dec 1	81,023	1,679	21,515
10	32,750	21,835	24,564	8	91,945	1,993	24,481
17	2/36,015	21,919	25,290	15	77,565	1,630	20,614
24	2/13,627	8,345	9,655	22	33,852	1,086	9,278
31	16,275	14,814	15,180	29	29,923	707	8,011
Jan 7	2/27,824	14,933	18,153	Jan 5	65,281	1,454	17,411
14	2/32,836	17,156	21,075	12	62,516	1,793	16,974
21	31,667	12,238	17,096	19	48,484	911	12,804
28	21,444	8,306	11,591	26	30,700	1,294	8,646
Feb 4	22,273	5,277	9,526	Feb 2	41,027	1,120	11,097
11	15,228	6,947	9,017	9	46,446	707	12,142
18	12,867	3,179	5,601	16	32,586	818	8,760
25	7,021	1,326	2,751	23	21,537	1,061	6,180
Mar 3	2/2,957	1,225	1,658	Mar 2	13,023	438	3,584
10	2/379	779	678	9	8,462	133	2,216
17	304	33	101	16	3,116	25	798
24	73	5	22	23	433	---	108
31	251	44	96	31	212	---	53
	816,882	406,981	506,282		1,335,320	35,682	360,927

1/ Annual report of Florida Avocado Administrative Committee, 1956-57, Homestead, Fla.

2/ Includes nonstandard containers. 3/ Total for period indicated.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1958 O -463403