SUITABILITY OF TRAY-PACK SHIPPING CONTAINERS AND BIN CONTAINERS FOR PALLETIZED OVERSEAS SHIPMENTS OF SMALL APPLES

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SUITABILITY OF TRAY-PACK SHIPPING CONTAINERS AND BIN CONTAINERS FOR PALLETIZED OVERSEAS SHIPMENTS OF SMALL APPLES

By James B. Fountain, Roy M. Hovey, Lawrence A. Risse, and Martin Doordan, *agricultural economists, Transportation and Facilities Research Division, Agricultural Research Service*

SUMMARY

Washington-Oregon apples packed in 42-pound tray-pack boxes may be shipped to Europe on pallets at less cost and arrive in better condition than when handled individually in break-bulk shipments. However, some of the unitized pallet loads did not arrive intact because of loose or broken straps or damaged boxes or pallets. Palletized bin boxes—four fiberboard boxes each holding 200 pounds of apples unitized together on a pallet—are less costly for packing and shipping Washington-Oregon apples to Europe than palletized tray-pack boxes, but they result in more bruising injury to the apples. In addition, the palletized bin boxes are suitable for only those European receivers that prepackage apples before distribution to retailers. Deep-cup pulpboard trays especially designed for the soft fleshed Golden Delicious apples cost 4 cents more per 42-pound box than shallow-cup trays. But these deep-cup trays protected the apples better from bruising damage in break-bulk test shipments made to Europe from Virginia and from the Pacific Northwest. Palletizing the deep-cup tray-packed apples did not materially reduce the level of bruising.

The costs of packaging and palletizing materials, direct labor, coldroom, and transport charges from apple packinghouses in Washington and Oregon to the receivers' warehouses in Europe were:

	Cost per box (dollars)
Type of container:	
Shallow-cup tray pack:	
Nonpalletized	3. 54
Palletized	3. 36
Deep-cup tray pack:	
Nonpalletized	3. 58
Palletized	3. 40
Bin boxes, palletized	2. 51

There were no significant differences in serious bruise injury (over 1 inch in diameter) among the shipping containers. Significant differences in damage bruise injury (½ to 1 inch in diameter), however, were found in apples shipped:

1. In bin boxes compared with those shipped in the shallow-cup tray-pack boxes, palletized or nonpalletized.
2. In nonpalletized shallow-cup tray-pack boxes compared with those shipped in palletized shallow-cup tray-pack boxes.
3. In nonpalletized shallow-cup tray-pack boxes compared with those shipped in palletized deep-cup tray-pack boxes.

No significant differences were seen in bruising of apples packed and shipped in the deep-cup tray-pack boxes, palletized or nonpalletized.

Not all boxes arrived in excellent condition. About 4 percent of the nonpalletized shallow-cup or deep-cup tray-pack boxes were seriously damaged compared with 1 to 2 percent of those palletized. The bin boxes were not seriously damaged.

INTRODUCTION

Only 0.1 percent of the apples shipped in palletized tray-pack boxes were pilfered compared with 1 percent of those in nonpalletized tray-pack boxes. No apples were pilfered from the palletized bin boxes.

Wholesale receivers in Europe preferred receiving the tray-pack boxes palletized, but often complained that many pallet units arrived in poor condition. European receivers who prepackaged apples preferred the palletized bin boxes because they were less costly.

During the 10-year period, 1929–38, U.S. exports of fresh apples accounted for 8.9 percent of the total U.S. commercial apple crop. During the 22-year period, 1949–70, U.S. apple exports averaged about 2.5 percent of the total crop.[1]

A spokesman for the apple industry says that some factors responsible for this decline in U.S. apple exports are:

(1) European countries embargoed U.S. apples following World War II because apples were considered a luxury.

(2) Several European countries, during this embargo, substantially expanded their apple acreage (also, similar expansion occurred in the Southern Hemisphere).

(3) Overseas countries have been slow to reduce post-war trade barriers.

(4) European trade groups have been protectionist.

(5) The prices of U.S. fruit are relatively higher than prices of fruit produced in Europe and in other fruit-exporting countries because of inflation.

(6) Apple industries in some competing countries "enjoy" subsidies.

(7) Improved cultural and handling practices and substantially increased and improved storage facilities in major European-producing countries have resulted in a larger volume of better fruit being available over a longer marketing period for both domestic and export markets. (See reference listed in footnote 1.)

Western European apple-importing countries account for about 75 percent of world imports. These countries get about two-thirds of their apple supplies from various European apple-exporting countries and most of the rest from Argentina, Australia, South Africa, New Zealand, and the United States.

The U.S. apple industry must continue to seek ways to package and transport apples efficiently to permit exports of high-quality fruit at prices that customers in Europe or in other countries are willing to pay.

The purpose of this study was to investigate ways to package and ship fresh apples to Europe at lower costs or to improve their arrival condition or both. This study investigates the costs of packaging and shipping in shallow-cup and deep-cup tray-packed boxes, palletized and nonpalletized, and bin boxes, palletized. In addition, the extent of bruising of the apples, damage to the boxes and bins, and pilferage of apples when they were packed and shipped in these containers were investigated.

PROCEDURE

Costs and Charges

The costs of packaging and shipping U.S. apples in alternative containers were based on northwestern grown apples shipped from west coast ports to Europe. Packing and transport costs for eastern growers would not be significantly different except for ocean or transcontinental freight. Each shipper regardless of location has minor variations in materials, labor, and overhead costs. The costs shown here are to compare the different packing and shipping systems.

The costs of packaging and palletizing materials for the boxes, trays, and pallets were obtained from manufacturers and suppliers. The cost of these materials was based on the average cost per thousand units to Washington and Oregon packer-shippers for either carlot or other large-quantity orders.

The costs of direct labor for packing, palletizing, loading, unloading, and handling at packinghouses, ports of embarkation and destination, and receivers' warehouses were obtained by time studies. Labor costs were calculated on a basis of $2 per hour at the packinghouse, $4.50 per hour at port of embarkation, and $2 per hour at port of destination and at the receivers' warehouses in Europe.

The costs of storage at shipping point were obtained from the owner of a Northwest packing-

[1] BURROWS, FRED W. FUTURE BLEAK FOR U.S. APPLE, PEAR EXPORTS. The Packer, Jan. 2, 1971.

house design firm and packinghouse owners or managers. Cost per square foot for packinghouse storage was based on a 60-day storage period.

Prevailing truck and ocean-contract rates were used to determine the transport charges from packinghouses to European markets. The ocean rates to various countries in Europe were averaged by weighting the rates according to the quantity of fresh apples shipped during 1967.

Other costs, not substantially affected by size and type of containers, such as receiving, supervision, sales, fieldmen, equipment, and overhead, were not included in this study.

Physical Performance

The physical performance of alternative containers was evaluated for Golden Delicious apples grown in Virginia and shipped to Europe as well as for Golden Delicious, Red Delicious, and Newtown apples produced in and shipped from the Northwest to Europe.

Four test shipments of Golden Delicious, Red Delicious, and Newtown apples were made from Oregon to Sweden by ocean carrier during 1966–67 to test the shallow-cup tray-pack boxes, palletized and nonpalletized, and the palletized bin boxes. In 1968, two test shipments from Washington and three from Virginia of Golden Delicious apples were made to England and Norway by ocean carrier to test the shallow-cup and deep-cup tray-pack boxes, palletized and nonpalletized.

The apples selected for the tests from Oregon were packed from late September to early October and held in cold storage. The first shipment left on November 19, 1967, and arrived in Stockholm, Sweden, December 29, 1967. The last shipment left Oregon on December 29, 1967, and arrived in Sweden on February 10, 1968.

The apples selected for the tests in 1968 were produced in Washington and Virginia. They were packed into the test boxes shortly before each shipment was scheduled to leave.

An experimental design was used for each series of ocean carrier test shipments to analyze the bruising data statistically. Each test shipment from Oregon contained 24 shallow-cup tray-pack boxes, nonpalletized; 24 shallow-cup tray-pack boxes, palletized; and three pallets of bin boxes. Each test shipment from Washington contained 10 shallow-cup and 10 deep-cup tray-pack boxes, nonpalletized, and 10 shallow-cup and 10 deep-cup tray-pack boxes, palletized. Each test shipment from Virginia contained 16 shallow-cup and eight deep-cup tray-pack boxes, nonpalletized, and 16 shallow-cup and eight deep-cup tray-pack boxes, palletized. The test boxes were placed among other boxes to simulate normal commercial handling conditions.

Boxes were inspected at the receiver's warehouse for the four shipments to Sweden in 1967. For the five shipments in 1968, boxes were inspected as they were unloaded from the boat at the dock. Apples were inspected and scored for degree of bruising.[2]

DESCRIPTION OF SHIPPING CONTAINERS

The shipping containers tested for apples were: (1) Shallow-cup tray-packed boxes, nonpalletized; (2) shallow-cup tray-packed boxes, palletized; (3) deep-cup tray-packed boxes, nonpalletized; (4) deep-cup tray-packed boxes, palletized; and (5) fiberboard bin boxes, palletized.

Tray-Pack Boxes and Trays

The tray-pack boxes tested are shown in figure 1. Inside length, width, and depth dimensions of the boxes used were 19¾ by 12 by 11¾ inches. Each apple was wrapped in tissue paper and a pad was placed on the top layer of apples. For Golden Delicious apples, polyethylene-film box liners were included.

The shallow-cup pack had five trays and a top pad (fig. 1, *C*). The deep-cup pack had five trays and a molded pulpboard "cap" (fig. 1, *D*).

In Oregon and Washington, the net weight of tray-pack boxes varied from 40 to 44 pounds because of density differences in different apple varieties. For this study, an average net weight of 42 pounds was used to calculate costs per box or per pound.

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[2] Degrees of bruising are: Slight bruising injury, bruise between ¼ and ½ inch in diameter and less than ⅛ inch in depth; damage bruising injury, bruise between ½ and 1 inch in diameter and less than ⅛ inch in depth; and serious bruising injury, bruise over 1 inch in diameter or more than ⅛ inch in depth.

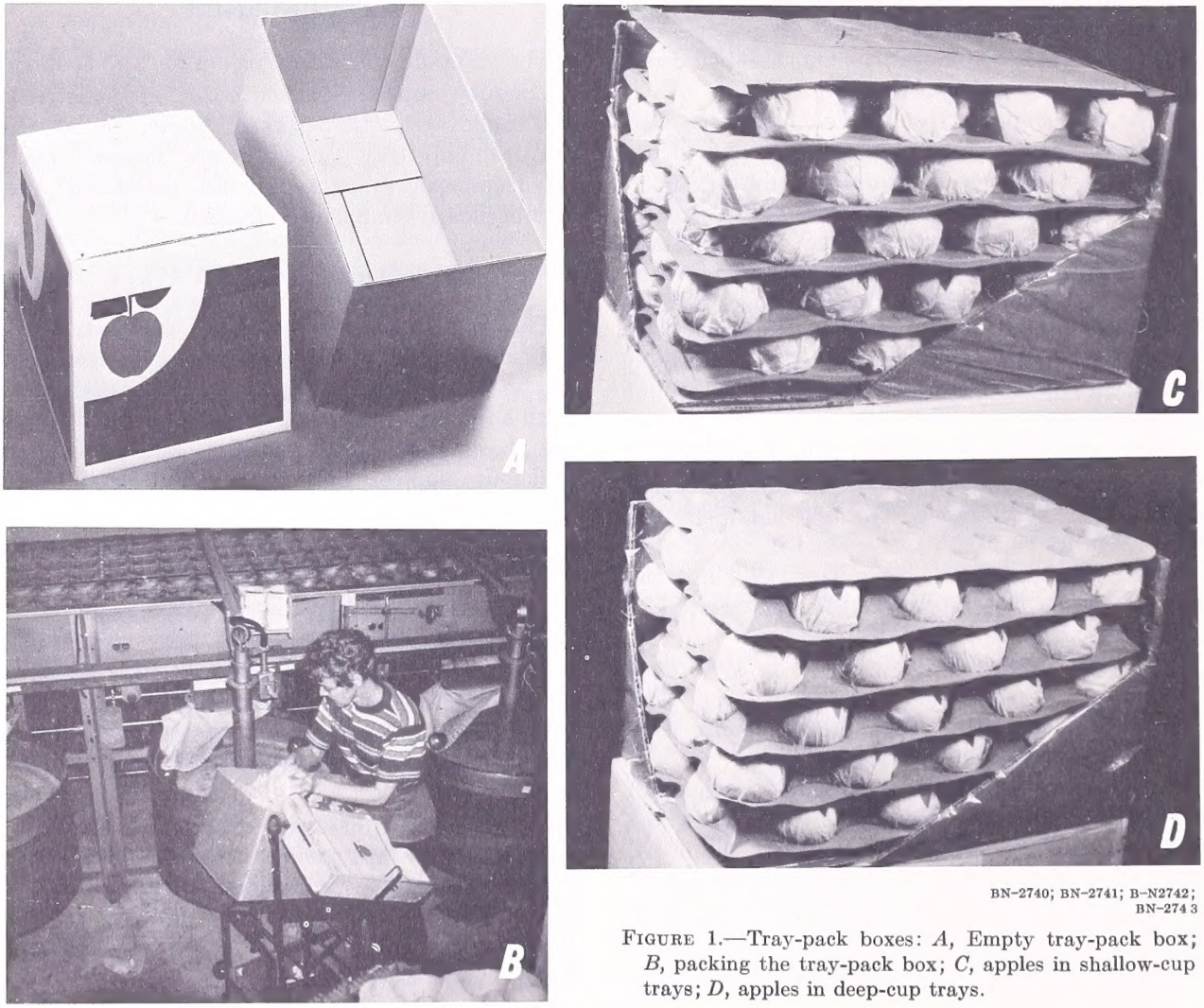
The boxes were stacked on 48- by 40-inch pallets, seven per layer, five high, for a total of 35 boxes. The pallets were then stored until time for export. Before inland movement to port of embarkation, the boxes were restacked on 48- by 42-inch export pallets, seven per layer, seven high, for a total of 49 boxes. These pallets were delivered to the port and moved onto the ship; each box was then removed from the pallet and stored inside the ship's chamber.

Palletized Tray-Pack Boxes

The palletized tray-pack boxes were tray-pack boxes shipped to the overseas receiver on a pallet. These boxes were stacked on 48- by 42-inch pallets according to size and grade, seven per layer, six high, for a total of 42 boxes (fig. 2). Two straps were used to secure the boxes to the pallet. The wooden pallets weighed about 40 pounds and measured 5¼ inches high. The total shipping unit weighed about 1,972 pounds (42 boxes times 46 pounds gross weight per box plus 40-pound pallet).

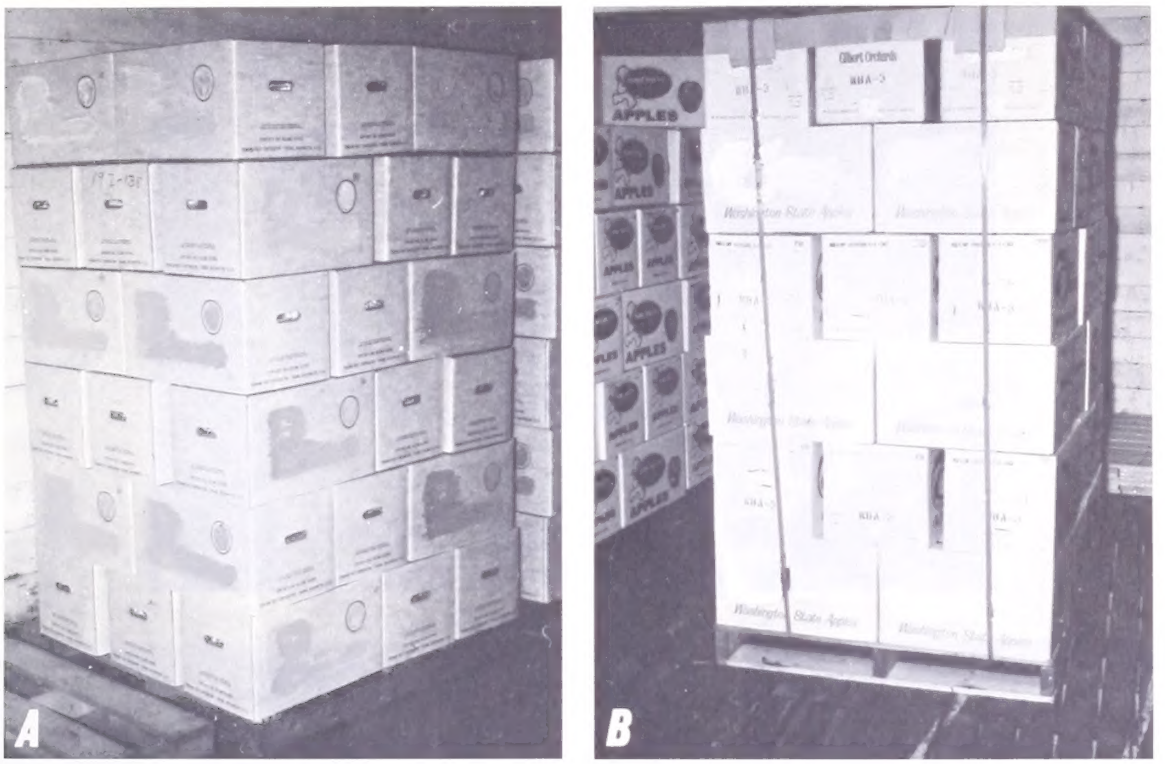
Palletized Bin Boxes

The palletized bin-shipping containers tested are shown in figure 3. Inside length, width, and depth dimensions of these containers were 23 by 20 by 22 inches, with 6-inch top flaps. One wooden cornerpost was used in each bin. One bin had a capacity of about 200 pounds and the apples were



BN-2740; BN-2741; B-N2742; BN-2743

FIGURE 1.—Tray-pack boxes: *A*, Empty tray-pack box; *B*, packing the tray-pack box; *C*, apples in shallow-cup trays; *D*, apples in deep-cup trays.



BN-2744; BN-2745

FIGURE 2.—Palletized tray-pack boxes: *A*, A pallet load of tray-packs; *B*, a strapped pallet load of tray-packs at the packinghouse.

mechanically jumble-packed into the bin by a filling machine (fig. 3).

Four of these bins were placed on a two-way wooden pallet measuring 48 by 42 inches with a part-telescope lid measuring 47 by 41 by 6 inches fitting over all four bins. Three straps were used to secure these four bins to the pallet. The packed shipping container had outside dimensions of 48 by 42 by 30 inches, a net weight of about 800 pounds (19-box equivalent), and a gross weight (including the pallet) of about 875 pounds.

COSTS AND CHARGES

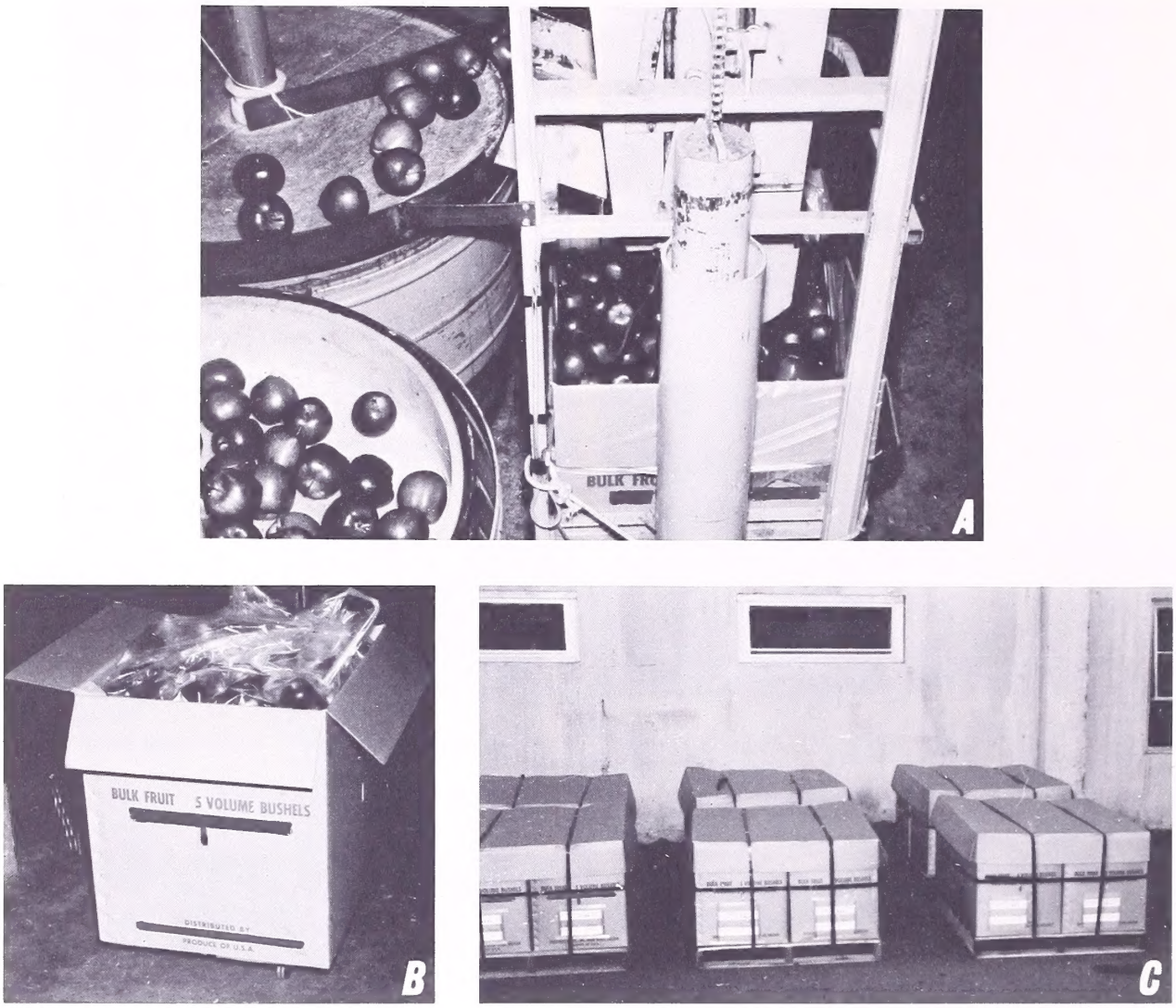
Materials and Direct Labor Costs to Pack and Palletize

Table 1 lists the costs of packaging materials, palletizing materials, and direct labor to pack and palletize for the various containers. Total costs were as follows:

Type of container:	*Cost per container (cents)*
Shallow-cup tray-pack box:	
Nonpalletized	86. 6
Palletized	97. 2
Deep-cup tray-pack box:	
Nonpalletized	90. 8
Palletized	101. 4
Bin, palletized (42 pounds)	47. 4

Handling Costs From Packinghouse to Receiver Warehouse

Costs of labor for handling the packed palletized and nonpalletized boxes into and out of storage, loading and unloading trucks and ships, moving into and out of terminal points, and removing apples from boxes at receiving warehouse for consumer packaging are shown in table 2. Removing the apples from the boxes at the receiving warehouse is shown in figure 4. The cost



BN-2746; BN-2747; BN-2748

FIGURE 3.—Bin boxes: *A*, Filling bin boxes; *B*, bin box filled with apples; *C*, completed strapped pallet loads of bin boxes ready for shipment.

of handling 42 pounds of apples in nonpalletized tray-pack boxes was 57.7 cents per box. This cost per box was 31.9 cents for palletized tray-pack boxes and 20.1 cents for palletized bin boxes (table 2). The five- and six-layer pallet loads of tray-pack boxes were 62½ and 80 inches high, respectively, and were forklifted one at a time. The pallet load of bin boxes was 30 inches high and was forklifted three at a time.

Coldroom Costs

Shallow- or deep-cup tray-pack boxes not consigned to be exported on a pallet were commonly stored in the coldroom on pallets (5 high, 7 per layer, 35 boxes) stacked three pallets high. Those tray-pack boxes consigned for export on pallets, however, probably would be stored in the coldroom (6 high, 7 per layer, 42 boxes) only two pallets

TABLE 1.—*Cost of packaging materials, palletizing materials, and labor for packing and palletizing Red Delicious, Golden Delicious, and Newtown apples produced in and shipped from the Northwest in specified containers, 1968*

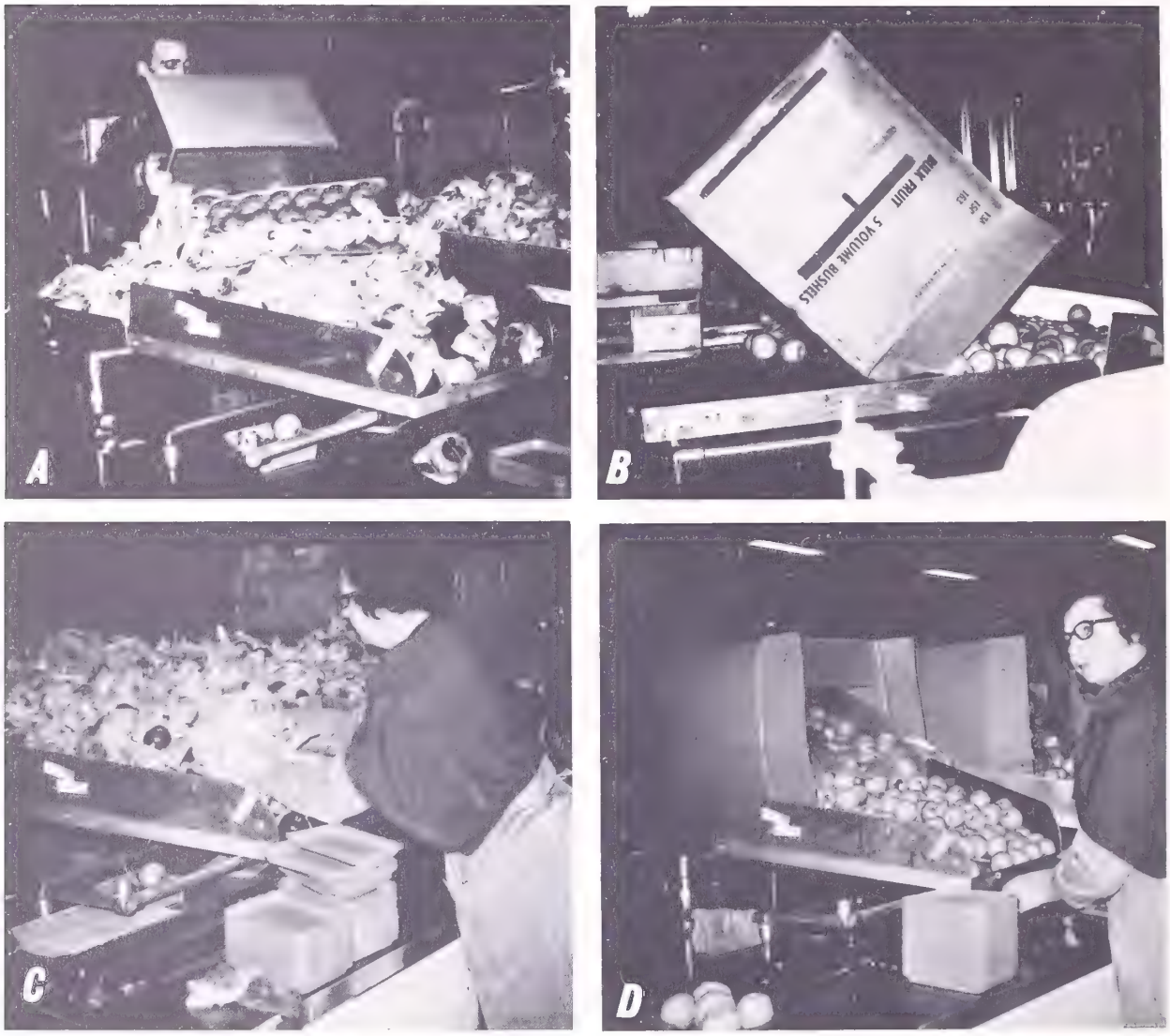
Item	Cost per box or box equivalent [1]				
	Shallow-cup tray-packed box		Deep-cup tray-packed box		Bin box, palletized
	Nonpalletized	Palletized	Nonpalletized	Palletized	
Materials:	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
Packaging [2]	74. 6	74. 6	78. 8	78. 8	17. 9
Palletizing [3]	0	8. 7	0	8. 7	18. 6
Total	74. 6	83. 3	78. 8	87. 5	36. 5
Direct labor: [4]					
To pack	12. 0	12. 0	12. 0	12. 0	7. 4
Palletize	0	1. 9	0	1. 9	3. 5
Total	12. 0	13. 9	12. 0	13. 9	10. 9
Total costs, materials and labor	86. 6	97. 2	90. 8	101. 4	47. 4

[1] Based on apples packed 42 pounds per box. Pallet loads consisted of 42 tray-pack boxes or an equivalent of 19 boxes per pallet load of bin boxes.
[2] Includes cost of boxes, trays, paper wraps, and pads. For cost of 1¼ mil-polyethylene-film box liner add 4.5 cents.
[3] Includes cost of pallet and strapping materials.
[4] Labor costs based on hourly wage of $2.

TABLE 2.—*Cost of specified handling operations of shallow- and deep-cut tray-pack boxes, palletized and nonpalletized, and bin boxes, palletized, packinghouse to overseas receiver's warehouse, 1967 and 1968* [1]

Handling operation	Cost per box or box equivalent [2]		
	Shallow-cup or deep-cup tray-packed box		Bin box, palletized (stacked 3 high)
	Nonpalletized	Palletized	
	Cents	*Cents*	*Cents*
At packinghouse: [3]			
Move into and stack in storage	1. 5	0. 2	0. 1
Move from storage and load into truck	. 4	. 4	. 3
At port of embarkation: [4]			
Unload and move into storage shed	. 6	. 6	. 5
Move to ship side and load into chamber	6. 5	3. 2	2. 4
At port of destination: [3]			
Unload and move into storage shed and stack	10. 9	. 7	. 5
Move from storage shed and load into truck	9. 1	1. 1	. 8
At receiver warehouse: [3]			
Unload truck and move into storage	4. 1	1. 1	. 8
Open boxes and remove apples for repackaging into small trays	24. 6	24. 6	14. 7
Total, handling operations	57. 7	31. 9	20. 1

[1] Includes 15 percent allowance for fatigue and personal time.
[2] Pallet loads consisted of 42 tray-pack boxes or an equivalent of 19 tray-pack box units per pallet of bin boxes. 3 pallet loads of bin boxes contain the equivalent of 57 tray-pack boxes.
[3] Labor costs based on hourly wage of $2.
[4] Labor costs based on hourly wage of $4.50.



BN-2749; BN-2750; BN-2751; BN-2752

FIGURE 4.—Removing apples from tray-pack and bin boxes at warehouse: *A*, Dumping apples from tray-pack boxes; *B*, dumping apples from bin boxes; *C*, removing paper wraps and trays to repack; *D*, repacking from bin boxes.

high because of the greater weight stress on the lower layer of boxes. The cost of coldroom space for storing 42 pounds of apples in shallow- or deep-cup tray-pack boxes on 48- by 42-inch export pallets stacked two high was 13.7 cents and 11.1 cents when stacked three high on 48- by 40-inch packinghouse pallets. Comparable cost for apples stored in palletized bin boxes stacked seven high was 8.7 cents (table 3).

Transport Charges

The ocean-freight rates in 1968 for shipping apples from Pacific coast ports to ports in the United Kingdom were $1.70 per box, nonpalletized, $1.65 per box, palletized, and $28 ($1.47 per 42-pound box equivalent) per pallet of bin boxes. Rates to Scandinavian ports were correspondingly higher. Average transport charges from the packinghouse to European ports are shown in table 4.

Transport charges per 42 pounds of apples for shallow- or deep-cut tray-pack boxes were $1.98, nonpalletized, and $1.93, palletized, and for bin boxes, palletized, $1.75.

Total Costs and Charges

The total costs for the packaging and palletizing materials, labor to pack and palletize, labor to handle, coldroom, and transport charges are shown in table 5.

The total costs and charges (those affected by type and size of container) from Northwest packinghouse to receiver warehouse, including removal of the apples for consumer packaging, per 42-pound box equivalent of apples were as follows:

	Cost per box
Type of container:	
Shallow-cup tray-pack box—	
Nonpalletized	$3.54
Palletized	3.36
Deep-cup tray-pack box—	
Nonpalletized	3.58
Palletized	3.40
Bin box, palletized	2.51

BRUISING

Shallow-Cup Tray-Pack and Bin Boxes

Bruising was higher for the apples packed in bin boxes than for those packed in shallow-cup tray-pack boxes, nonpalletized or palletized (table 6). The differences in the amount of bruising between the nonpalletized and palletized tray-pack boxes were not statistically significant.

In the bin boxes, 33.2 percent of the apples were slightly bruised compared with 19.4 and 19.9 percent for the nonpalletized and palletized tray-pack boxes, respectively. Also, in the bin boxes, 8.8 percent of the apples were damage bruised compared with 3.7 and 2.2 percent for the nonpalletized and palletized tray-pack boxes, respectively.

In the bin boxes more bruised apples were found in the lower layers than in the middle or upper layers.

Shallow-Cup and Deep-Cup Tray-Pack Boxes

Golden Delicious apples packed in shallow-cup tray-pack boxes, nonpalletized had more damage bruising than when they were packed into boxes that were shipped palletized (table 7). This differ-

TABLE 3.—*Storage space requirements for packinghouse coldroom and costs for apples packed in tray-pack and bin boxes, 1968* [1]

Item	Floorspace per pallet unit	Boxes per pallet stack	Costs per box or box equivalent [2]
	Square feet	*Number*	*Cents*
Shallow- or deep-cup tray-pack boxes:			
3 pallets high [3]	18.2	105	11.0
2 pallets high [4]	18.2	84	13.7
Bin boxes, palletized:			
7 pallets high [5]	18.2	133	8.7

[1] Estimates of cost, not prices, charged for commercial cold storage space.

[2] Based on a yearly cost per square foot of $2.26 for a 100- by 100-foot building costing $85,000, plus refrigeration equipment costing $45,000. Yearly costs for this coldroom space are: $6,400 for 25-year building and 15-year refrigeration depreciation; $2,600 for taxes and insurance at 2 percent of $130,000; $3,900 for interest computed at 3 percent of average investment; $4,800 for operational costs of water, electricity, and refrigeration; $1,300 for maintenance of equipment at 1 percent of $130,000; and $3,600 for operating labor. An average 60-day storage period over an average 214-day use period is assumed. Cost per square foot divided by 214 days times 60 days equals $0.634 per square foot for 60 days. This cost times floorspace divided by the number of boxes equals cost per box. These data were obtained from Food Industries Research & Engineering, Yakima, Wash. Example of calculation: $2.26 per square foot divided by 214 days, multiplied by 60 days, multiplied by 18.2 square feet, and divided by 105 boxes equals 11 cents per box for storage space.

[3] Based on 35 boxes on a 48- by 40-inch packinghouse pallet with 2 inches overhang on the 40-inch side, and 30 percent for aisle space.

[4] Based on 42 boxes on a 48- by 42-inch export pallet with no overhang, and 30 percent for aisle space.

[5] Based on 19 boxes per unit of 4 bins on a 48- by 42-inch pallet with no overhang, and 30 percent for aisle space.

TABLE 4.—*Transport charges for shipping apples from Northwest packinghouses to European markets, 1968*

Item	Shallow-cup or deep-cup tray-packed boxes		Bin boxes, palletized
	Nonpalletized	Palletized	
Inland transport:			
Pallets per load ... number	[1] 18	18	[2] 42
Boxes or box equivalent per pallet ... number	49	42	19
Boxes or box equivalent per load ... number	882	756	798
Net weight of apples per load [3] ... pounds	37, 044	31, 752	33, 516
Gross weight including packaging materials and pallets [4] ... pounds	41, 292	35, 496	36, 750
Transport charges per standard-box equivalent [5] ... cents	23. 9	24. 0	23. 5
Ocean-freight charges: [6]			
Per standard-box equivalent ... dollars	1. 74	1. 69	1. 51
Total cost inland transport and ocean-freight charge ... dollars	1. 98	1. 93	1. 75

[1] Used in inland transport to port of embarkation only.
[2] 168 bins.
[3] Average net weight of 42 pounds per box.
[4] Calculated at 46 pounds per tray-pack box and 40 pounds for each pallet, and 875 pounds per pallet of bin boxes.
[5] Calculated at 30 cents per gross hundredweight from Northwest packinghouses to Seattle and Portland ports and 21 cents from the overseas destination port to the receiver warehouse (for example, 41,292 pounds multiplied by 51 cents per cwt. and divided by 882 boxes).
[6] Weighted average charges for countries in Europe were based on the quantity of fresh apples shipped to those countries during 1967, as reported in U.S. Dept. Agr., *Agricultural Statistics*, 1969, p. 213. About 25 percent of the apples exported to Europe in 1967 were to Sweden and Norway, and 75 percent went to other European countries. Charges per box were obtained from Seaport Shipping Co., Freight Forwarders and Brokers, Seattle, Wash., and Portland, Oreg.

TABLE 5.—*Costs of packaging and palletizing materials, labor to pack, palletize and handle, coldroom, and transport for apples in shallow- and deep-cup tray-pack boxes, palletized and nonpalletized, and bin boxes, palletized, Northwest, 1968*

Item	Cost per box or box equivalent				
	Shallow-cup tray-packed box		Deep-cup tray-packed box		Bin box, palletized
	Nonpalletized	Palletized	Nonpalletized	Palletized	
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Materials and labor to pack and palletize	0. 87	0. 97	0. 91	1. 01	0. 47
Handling from packinghouse to receiver warehouse	. 58	. 32	. 58	. 32	. 20
Coldroom	. 11	. 14	. 11	. 14	. 09
Transport	1. 98	1. 93	1. 98	1. 93	1. 75
Total, all items	3. 54	3. 36	3. 58	3. 40	2. 51

ence was not statistically significant for the test shipments made from Virginia. Differences in bruising of apples packed and shipped in nonpalletized and palletized deep-cup tray-pack boxes were not statistically significant. Apples in the deep-cup tray-pack boxes arrived with significantly less bruising than those in nonpalletized shallow-cup tray-pack boxes.

CONTAINER DAMAGE AND PILFERAGE

Container Damage

All bin boxes arrived in Europe in excellent condition; none were seriously damaged. When the shallow- and deep-cup tray-pack boxes were

shipped nonpalletized, 4 percent arrived with serious container damage compared with 1.5 percent when they were shipped palletized. Some types of container damage are shown in figures 5 and 6.

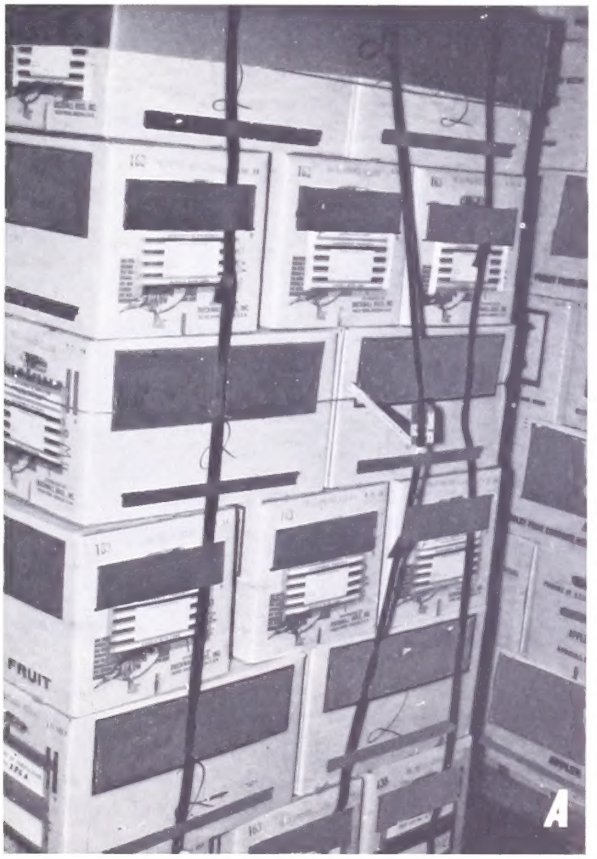
Pilferage

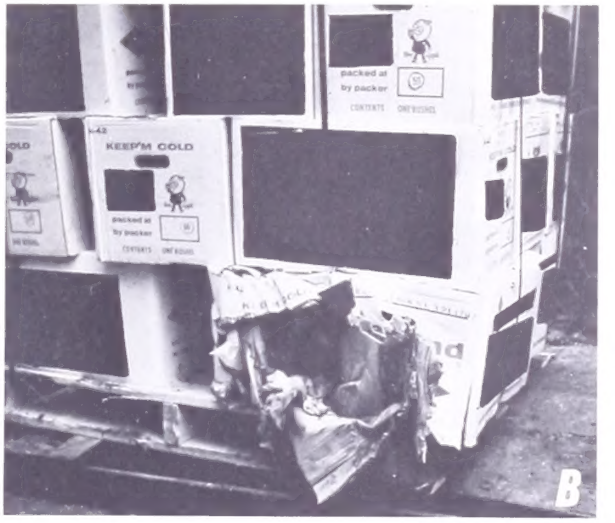
Pilferage—a serious problem in some export shipments—was 1 percent in the nonpalletized tray-pack boxes, 0.1 percent in the palletized tray-pack boxes, and zero in palletized bin boxes.

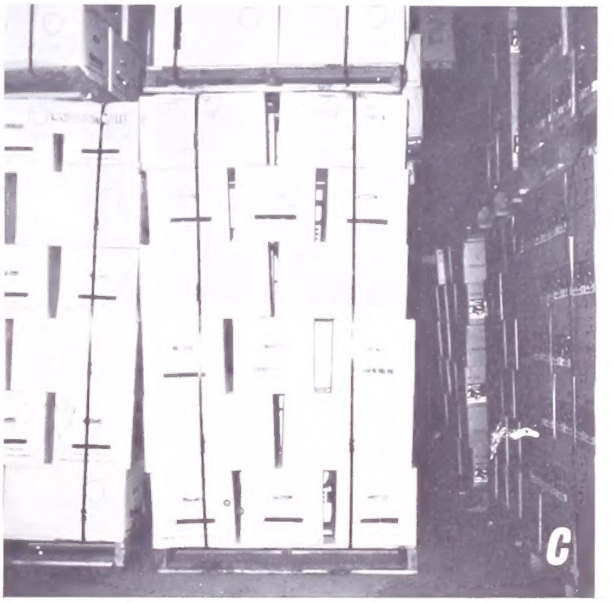
More apples were probably pilfered from the nonpalletized tray-pack boxes because (1) the cover could be removed, (2) the box could be stove in without fear of large numbers of apples falling out, and (3) at times, accidental damage to the container left the apples exposed.

For palletized tray-pack boxes, however, the cover could not be removed. But an individual box could still be stove in and, at times, accidental damage left apples exposed.

The bin boxes were not seriously damaged. Perhaps the fear of large numbers of loose apples falling out deterred deliberate attempts to damage these boxes.

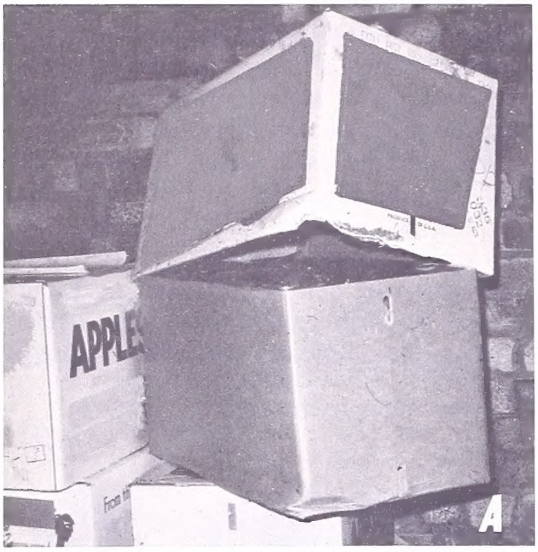


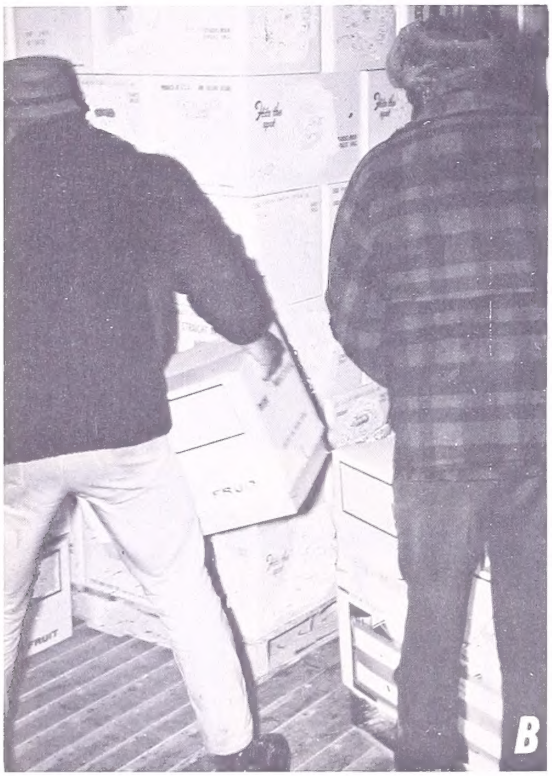


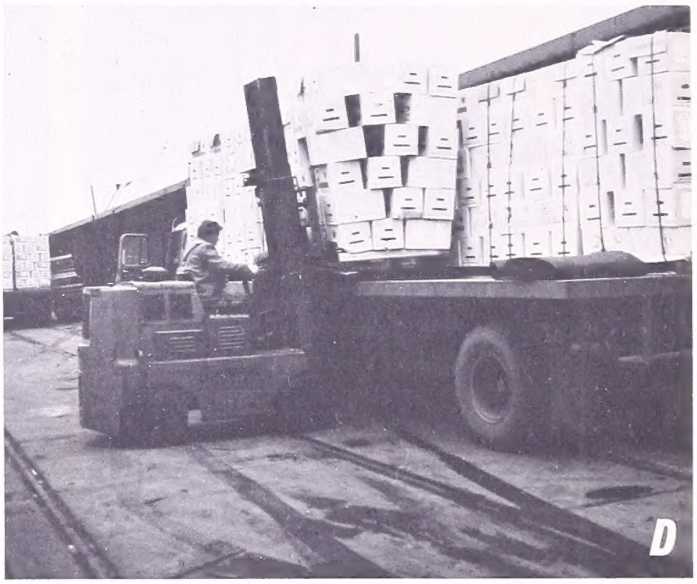


BN-2753; BN-2754; BN-2755

FIGURE 5.—Condition of palletized tray-pack boxes on arrival in Europe: *A*, Arrival at dock, note slackness of straps; *B*, closeup of serious damage to one box in bottom layer; *C*, double stack of palletized tray-pack boxes, note damage to boxes in top layer of lower pallet load.







BN-2756; BN-2757; BN-2758; BN-2759

FIGURE 6.—Condition and handling of containers on arrival in Europe: *A*, Tray-pack box showing container damage; *B*, handling tray-pack box at dock; *C*, bin boxes on arrival; *D*, palletized tray-pack boxes being loaded on trucks at a London dock.

TABLE 6.—*Percentage of small-sized Red Delicious, Golden Delicious, and Newtown apples bruised in shallow-cup tray-pack containers, palletized and nonpalletized, and in palletized bin boxes during transit, by degree of bruising in 4 boat shipments, from Oregon to Stockholm, Sweden, 1966 and 1967* [1]

Degree of bruising [2]	Shallow-cup tray-packed boxes		Bin box, palletized
	Non-palletized	Palletized	
	Percent	*Percent*	*Percent*
Slight	19. 4a	19. 9a	33. 2 b
Damage	3. 7a	2. 2a	8. 8 b
Serious	0	0	0
Total	23. 1	22. 1	42. 0

[1] Average of apple box sizes 163, 150, and 138. Means within a row followed by different letters are significantly different at a 5-percent level. Skin discoloration, skin breaks, and cuts were negligible.

[2] Degrees of bruising are: Slight bruising injury between ¼ and ½ inch in diameter and less than ⅛ inch in depth; damage bruising injury between ½ and 1 inch in diameter and less than ⅛ inch in depth; and serious bruising injury over 1 inch in diameter or more than ⅛ inch in depth.

TRADE REACTION

Importers and wholesale receivers expressed no preference for the shallow- or deep-cup trays.

These receivers were mixed in their reaction to palletized vs. nonpalletized boxes of apples. They reacted unfavorably to missing or loose straps, broken pallets, and disarranged box layers. But they were favorable to the ease and quicker loading, unloading, and handling of pallet loads that arrived in good condition.

Importers and wholesale receivers who prepackage apples reacted favorably to bin boxes. The most favorable comment heard for these boxes was the absence of paper wraps or trays to handle and throw away. Some complaints made about bin boxes were that (1) they were too small (some apple-exporting countries have used bins holding 2,000 pounds of apples), (2) they had to be tipped over and the apples dumped out (side or bottom openings would be preferred), and (3) they did not have enough ventilation holes to assure adequate ventilation.

TABLE 7.—*Percentage of small Golden Delicious apples bruised in nonpalletized and palletized shallow-cup and deep-cup tray-pack boxes during transit, by degree of bruising, in 2 boat shipments of Washington apples and 3 boat shipments of Virginia apples to European markets, 1967 and 1968* [1]

Degree of bruising [2]	Shallow-cup tray-packed boxes		Deep-cup tray-packed boxes	
	Nonpalletized	Palletized	Nonpalletized	Palletized
	Percent	*Percent*	*Percent*	*Percent*
2 shipments from Washington:				
Slight	67. 1	77. 6	77. 9	82. 9
Damage [3]	25.7a	15.5 b	15.2 b	11.3 b
Serious	0	0	0	0
Total	92. 8	93. 1	93. 1	94. 2
3 shipments from Virginia:				
Slight	75. 1	76. 1	76. 9	74. 0
Damage [3]	13. 0a	9. 7ab	6. 7 b	4. 8 b
Serious	1. 5	. 2	. 6	. 2
Total	89. 6	86. 0	84. 2	79. 0

[1] Average of apple-box sizes 163, 150, and 138 from Washington, and box size 150 from Virginia.

[2] Degrees of bruising are: Slight bruising injury between ¼ and ½ inch in diameter and less than ⅛ inch in depth; damage bruising injury between ½ and 1 inch in diameter and less than ⅛ inch in depth; and serious bruising injury over 1 inch in diameter or more than ⅛ inch in depth.

[3] Means followed by the same letter are not significantly different at the 5-percent level. Skin discoloration, skin breaks, and cuts were negligible.

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