Potential Savings by Shipping CAULIFLOWER in Double-Layer Packs

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The study on which this report is based was conducted under authority of the Agricultural Marketing Act of 1946 (RMA, Title II).

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SUMMARY

During the 1942-43 shipping season, wholesale prices of cauliflower at New York averaged $3.50 per crate. Ten years later the corresponding average was only $3.25, and during some of the intervening years the prices at the wholesale level were even more depressed. But during the same decade packing and transportation costs increased by the following percentages:

Cost of refrigeration	up	32.5 percent
Freight charges	up	29.4 "
Field packing labor	up	97.1 "
Other labor	up	71.5 "
Containers	up	62.4 "

Lower prices on the one hand and higher packing and shipping costs on the other account for the fact that at times cauliflower has been abandoned in the field.

The Western Growers Association, a nonprofit association of vegetable and melon growers in California and Arizona, under contract with the U. S. Department of Agriculture, studied alternative methods of packing cauliflower and made transportation tests. These investigations demonstrated that substantial savings in costs of containers, transportation, and refrigeration were possible by trimming the heads closer, and by packing two layers, instead of one, in a slightly larger shipping container. The study was confined to these shipping-point and transportation aspects of the container problem. The limited quantity of cauliflower shipped in the experimental containers did not permit a study of the acceptability of the containers by wholesale receivers and retailers.

Through the methods used in the study, freight charges on the experimental containers, projected to a carlot basis, would be reduced from 8.7 to 5.1 cents per head, refrigeration charges would be reduced from 2.6 to 1.5 cents, and container costs from 3.9 to 2.4 cents per head. Although the cost of packing labor increased from 0.6 cent to an estimated 1.1 cents per head, the overall reduction in these major cost components would amount to 5.7 cents, which is 36 percent of the 15.8 cents per head currently paid by the industry. This amounts to a potential saving of $310 on a minimum carload shipment, compared to costs when the present cauliflower container is used.

The established practice is to pack from 9 to 14 heads of cauliflower face up in a single layer, with most packs comprising from 10 to 12 heads. The protective jacket leaves that remain on the heads constitute a substantial part of the 42 pounds which is the average weight of such crates when packed for shipment.

Packing tests indicated that the nailed broccoli crate would lend itself to double-layer packing of closely trimmed heads. Shortening the stem and removing at least a pound more of jacket leaves than is ordinarily trimmed off at the time of packing make it possible to pack two layers of cauliflower heads in a broccoli crate.

In a series of ten transportation tests made from the Santa Maria district of California to New York City, the average percentage of bruising was found to be less for cauliflower packed double-layer in the broccoli crate than for cauliflower packed single-layer in the standard cauliflower crate.

The double-layer packing could be handled better in a packing line operation in a shed than in the field. As most producers already have sheds that are used for cauliflower and other commodities, the method could now be used by many shippers.

POTENTIAL SAVINGS BY SHIPPING CAULIFLOWER IN DOUBLE-LAYER PACKS

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INTRODUCTION

California is by far the most important source of cauliflower, but producers in that State have realized a steadily diminishing return from their output over the last 11 years. There have been times during the shipping seasons when it was uneconomical to harvest all of the crop and large quantities of cauliflower had to be abandoned in the field. Although this was due in part to a decline in wholesale prices at the terminal markets, the unfortunate situation could be attributed more directly to steadily mounting costs of containers, packing, shipping, and transportation.

That problem prompted the U. S. Department of Agriculture to carry out this investigation through a contract with the Western Growers Association, a voluntary nonprofit association of vegetable and melon shippers in California, Arizona, and New Mexico.

Since the jacket leaves represent a large proportion of the weight of the cauliflower head even after it has been trimmed and prepared for shipment, further elimination of the protective leaves was tried to find out how such additional trimming affected the damage rate, freight and refrigeration charges, and related container and packing costs. Obviously, the shipping weight of the jacket leaves has become relatively more significant as a cost factor in view of the adverse economic trends cited.

Established shipping practices were reappraised and double-layer packing of closely trimmed cauliflower heads in broccoli crates, of somewhat larger capacity than the present cauliflower crate, was tried out and the technical aspects of the problem evaluated by the field personnel of the Western Growers Association. The results of those studies and experiments are set forth in this report.

ECONOMIC CHANGES AFFECTING CALIFORNIA CAULIFLOWER PRODUCTION

The decade preceding 1953 brought sharp increases in the cost of packing and shipping cauliflower from California to the East and some decline in market prices at the wholesale level. The producer's share of the consumer's dollar spent for cauliflower dwindled periodically to such an extent that, at times, crops had to be abandoned in the field. The mounting costs have constituted a serious threat to the production of this specialized agricultural product in California, which still ranks first among the producing States.

The Santa Maria-Guadalupe area is the principal cauliflower-producing region of California. In table 1 the increase in major cost items involved in packing and shipping cauliflower from that area to the New York market over the last 10 years is contrasted with the average wholesale price of U. S. No. 1 Grade cauliflower at the same market. The adverse relationship between wholesale commodity prices and corresponding shipping and transportation costs is evident in table 1 which shows the sequences of increased dollar outlays that occurred while the wholesale price, as reflected by the New York market, was actually less

Table 1.--Cauliflower: Wholesale price at New York and selected components of packing and shipping costs per crate, California, 1942-1952

Season beginning 1/	Wholesale price per crate 2/	Cost - per crate				
		Refrigeration 3/	Freight 4/	Field labor for packing 5/	Other labor per hour 6/	Containers 7/
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
1942	3.50	0.135	0.773	0.035	0.812	0.271
1943	3.02	.135	.773	.040	.812	.289
1944	3.28	.135	.773	.040	.812	.289
1945	2.92	.135	.773	.050	.924	.299
1946	2.85	.135	.819	.050	1.019	.341
1947	2.89	.152	.911	.055	1.124	.413
1948	3.21	.169	.928	.058	1.123	.379
1949	3.08	.177	.949	.058	1.172	.420
1950	2.86	.179	.953	.058	1.226	.464
1951	3.25	.179	.979	.060	1.328	.449
1952	3.25	.179	1.000	.069	1.392	.453
Percentage change from 1942 to 1952	Percent - 7.0	Percent 32.5	Percent 29.4	Percent 97.1	Percent 71.5	Percent 62.4

1/ Shipping seasons include the last month of the calendar year shown and the first five months of the following year.

2/ Average price of U. S. No. 1 quality cauliflower from California on the New York City market. Source: USDA Market News Service.

3/ Tariff charge for 20,000 pounds initial icing plus 5,000 pounds additional top ice en route.

4/ Rail rate of $2.38 per 100 pounds from Santa Maria, Calif., to New York, N. Y.

5/ Labor charge per crate for packing in field, Santa Maria-Guadalupe area. Piecework basis.

6/ Average hourly wage rates applicable to shed-packing operations.

7/ Furnished by Wooden Box Institute, San Francisco, Calif.

during the 1952-53 season than it had been 10 years before. Data are not available on the average price received during the 1953-54 season, but during the week ending March 2, 1954, the average wholesale price of cauliflower on the New York market was $2.75 per crate. In view of the greatly increased packing and shipping costs shown, the lower price of cauliflower in recent years is especially significant.

The relationships between prices and costs during the same 11-year period are set forth on a percentage basis in table 2. In this tabulation the postwar season 1945-46 was selected as a base year because freight and refrigeration charges remained relatively stable during World War II. Furthermore, the labor and container costs have risen much more rapidly since the 1945-46 season than they did during the war.

This rise in costs is undoubtedly reflected in the number of rail shipments from California during this same period. For the 10-year period 1940-49 carlot shipments

Table 2.--Cauliflower: Index numbers of wholesale price at New York and selected components of packing and shipping costs per crate, California 1942-52

(1945 season - 100)

Season beginning	Commodity price	Refrigeration cost	Freight cost	Labor cost	Other cost	Container cost
1942	120.03	100.00	102.72	80.0	87.88	90.64
1943	103.74	100.00	100.00	100.0	87.88	96.66
1944	112.48	100.00	100.00	100.0	87.88	96.66
1945	100.00	100.00	100.00	100.0	100.00	100.00
1946	97.84	112.56	105.98	110.0	110.28	114.05
1947	99.21	116.30	117.93	115.0	121.65	138.13
1948	113.44	128.80	120.11	115.0	121.54	126.76
1949	105.49	133.09	122.83	115.0	126.84	140.47
1950	98.22	133.09	123.37	120.0	132.68	155.18
1951	111.32	133.09	126.63	130.0	143.72	150.17
1952	111.59	133.09	129.35	138.0	150.65	151.51

of cauliflower originating in all districts of California averaged 5,449 annually. In 1950, only 3,642 cars were shipped and by 1952 carlot shipments had dropped to 2,457. In 1953, the total was only 1,940 cars. Some of the decline may be attributed to diversion from rail to motortruck, but it should be noted that during the same period unloads of carlot shipments of cauliflower from California arriving at New York City declined from an average of 796 for the 1940-49 period to 227 cars in 1952 and 190 in 1953. These data are based on straight carload shipments only; the amount of cauliflower included in mixed carload shipments with other vegetables is not known.

HARVESTING AND PACKING CAULIFLOWER

There are two general methods of collecting cauliflower for shipment, depending upon whether the packing is done in the field or in a shed which is usually located on a railroad siding. Field packing is the more common method in California.

The stem of the cauliflower plant above ground is from 1 to 1½ inches in diameter and about 6 inches in length. The leaves, which measure up to 30 inches, constitute most of the total weight of the mature plant. A well-grown plant has more than 40 leaves, exclusive of the 12 protecting leaves around the head, and weighs from 8 to 12 pounds.

In harvesting the crop, each plant is severed with a sharp knife well down toward the ground. Field carts, sleds, or other types of tractor-drawn conveyances are used for collecting and transporting the heads to accessible temporary locations established along the edges of the field, or to a packing shed (fig. 1). In either case, the picker in the field removes the extreme outer leaves of the plant to facilitate subsequent inspection and to enable the packer to maintain uniformity of heads. Methods used in field-packing vary somewhat among growers, but a typical operation is described below.

After the cauliflower is cut, it is hauled in a truck to the edge of the field and dumped near a pile of crates. The packer places a small portable stand next to the pile

Figure 1.--Collecting cauliflower in the field. Operator sets tractor in slow motion and tosses heads into bin mounted on sled.

of cauliflower. This stand holds the empty crate at an angle of about 45 degrees with the lower end a few inches from the ground to facilitate placing the heads in the container.

Depending upon the size of the heads, 11 or 12 are usually packed in one crate. After the heads have been placed butts down in the crate a considerable amount of the outer head leaves protrudes from the top of the container. This is sheared off with a sharp knife as shown in figure 2. The crates are then stacked to await the truck in which they are transported to a packing shed where the lids are applied and the crates loaded in a refrigerator car.

An alternate method is to transport the heads from the field in field baskets or in bulk to a packing shed where the packing is carried out in a line operation. The cauliflower heads are unloaded near the packing line where the heads are packed in shipping containers in much the same manner as in the field (fig. 3). As each crate is packed, it moves forward on a conveyor through a shearing machine that cuts off the excess foliage projecting above the top of the crate. The crates then move on to the lidding machine which fastens the prefabricated covers. Labels are applied by hand as the crates continue to move along the conveyor to the loading platform. Although the greater part of the cauliflower crop is packed in the field, most growers have packing sheds which they use for other commodities and which they can use for cauliflower.

In practice, field packing is likely to be intermittent because the movement of the heads to the packing stands does not keep pace with the packing and lidding operation. Field packing is usually paid for on a piecework basis, whereas hourly labor rates prevail

Figure 2.--Field packer shearing projecting jacket leaves from crate of cauliflower heads.

where the shed-packing method is used. Effective supervision of the shed-packing operation encourages better continuity of flow and more rigid adherence to marketing standards.

Heads of the most desirable market size, with wrapper leaves, weigh from 3 to 4 pounds, and the curds vary in diameter from 4½ to 6½ inches. They must be at least 4 inches in order to meet the requirements of the U. S. No. 1 grade. Federal standards specify that the heads must be *well trimmed* which means that the jacket leaves may be limited to the number and length considered necessary to protect the head. No jacket leaves are required when the heads are packed with cushions, partitions, or other means which protect the curds against bruising.

The markets consistently demand snow-white heads, and they must be compact, with no sign of segmentation or spreading. Any discoloration, blemishing, over-maturity, or other deficiency, is detrimental to the salability of the product.

California cauliflower is presently packed face-up in the so-called western pony crate, which provides for a single layer of from 9 to 14 heads, depending on size (fig. 4). The range narrows down to between 10 and 12 heads of medium size in the vast majority of shipments. This nailed cauliflower crate is designated as Container No. 405 in the Western Freight Container Tariff. The loading rule applicable to this container when it is packed with cauliflower specifies that crates must be loaded lengthwise of the car on tops with exceptions authorized when the remaining space at the end of the car

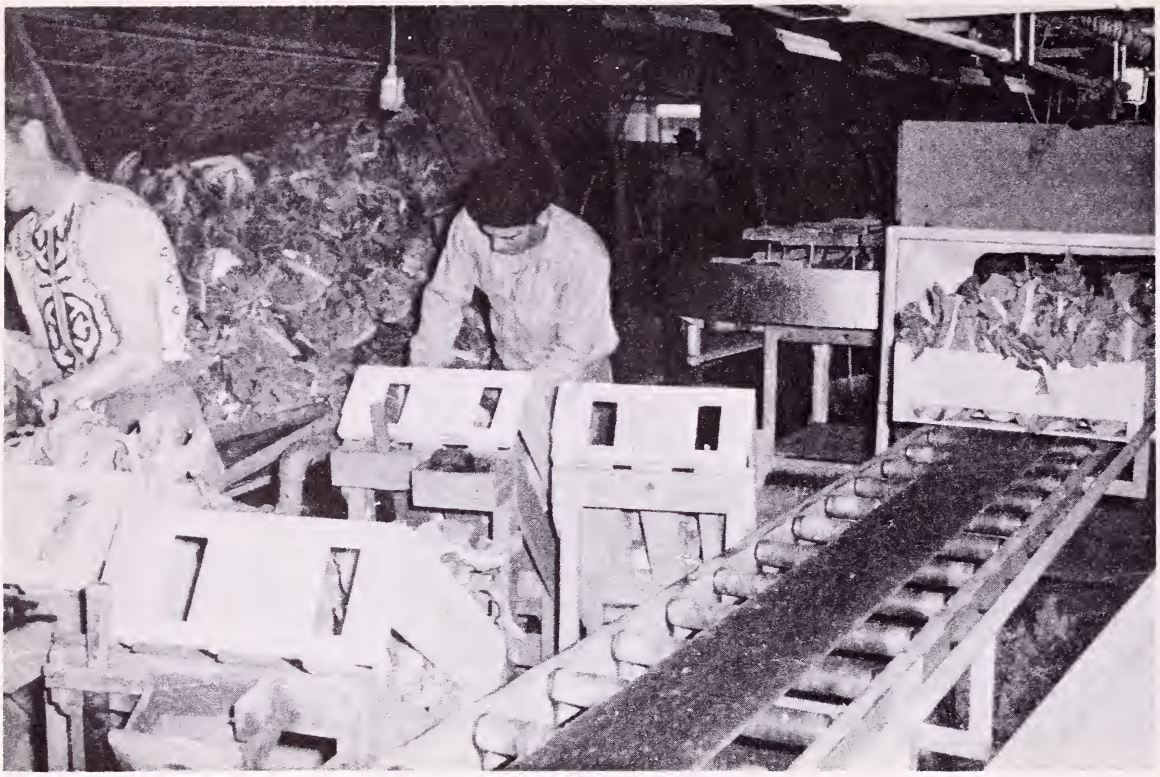

Figure 3.--Cauliflower packing in a shed. Heads are removed from the field basket at the left and packed upright in single layers. The packed crates move on the conveyor into the trimming machine where revolving blades are set to allow up to 1½-inch bulge.

can better be filled in by placing the containers crosswise of the car. The stripping requirement is waived when channel ice is used.

EXPERIMENTAL DOUBLE-LAYER PACKING OF CAULIFLOWER HEADS

The problem of curtailing the high costs of shipping cauliflower from California to the eastern terminal markets was approached from two angles. Closer trimming of protective jacket leaves was tried out as a means of reducing the shipping weight, and parallel consideration was given to the replacement of the standard pony crate with a shipping container that would permit double-layer packing of cauliflower heads without increasing the likelihood of damage.

The shipping weight of the present cauliflower crate averages 42 pounds, which is also the estimated weight used by the western railroads for billing purposes. Under present practices, the jacket leaves remaining on the head of cauliflower, which are usually discarded by consumers, constitute as much as 75 percent of the total weight of the head as shipped. Their purpose is to protect the curd from injury, but they appear to contribute disproportionately to the cost of transporting the product to market.

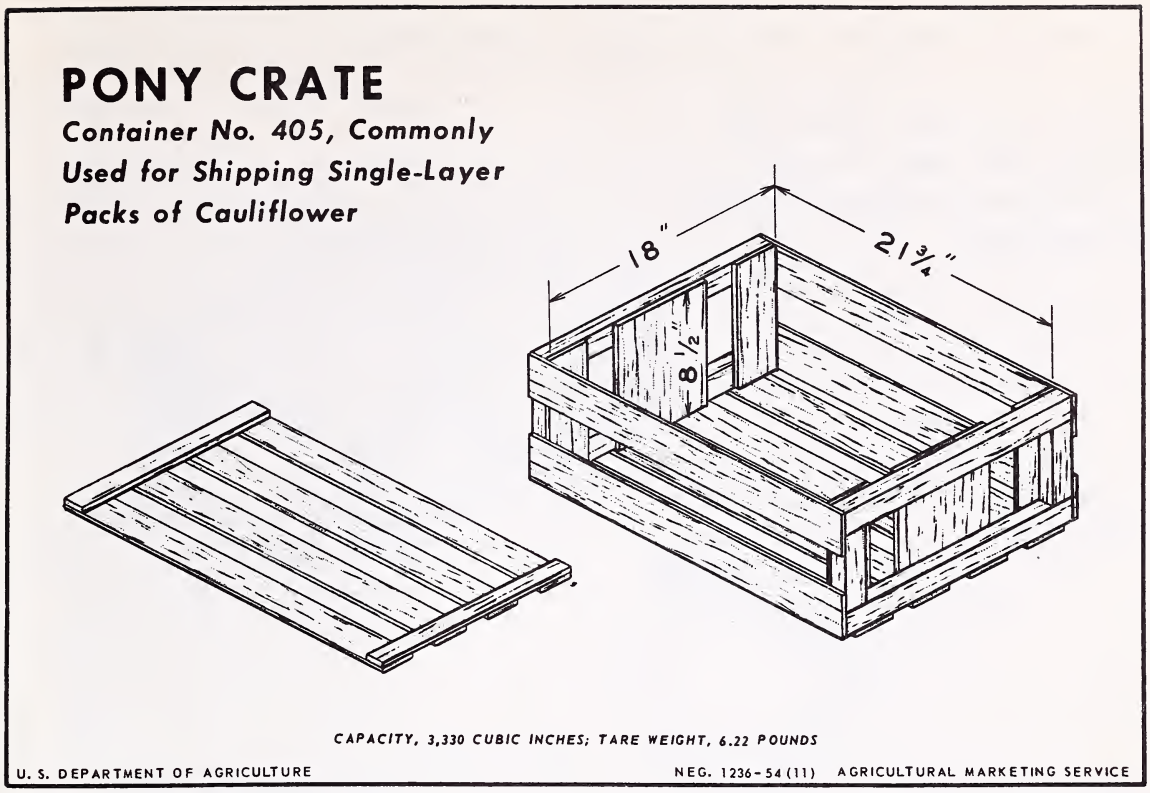

Figure 4.--Construction and dimensions of Container No. 405, the pony crate now commonly used for shipping cauliflower.

Preliminary packing experiments were performed by the research staff of Western Growers Association to learn which type of container would be most suitable for the subsequent shipment of closely trimmed heads on an experimental basis. The WGA (Western Growers Association) lettuce crate, designated as Container No. 935 in the Western Freight Container Tariff 1-D, was initially considered. This crate has inside dimensions of 14-1/4 by 18-1/4 by 20-1/2 inches. It is 5-3/4 inches deeper, 1/4 inch wider, and 1-1/4 inches shorter than the standard cauliflower crate, No. 405. A single packing test disclosed that only a small amount of additional trimming was necessary in order to pack the heads in double layers. However, the potential for any saving in transportation charges with that container was insignificant, because the light trimming saved little weight, the relatively large box occupied much space, and the container cost was higher than that of the broccoli crate.

After additional packing tests, the nailed broccoli crate, Container No. 340, was chosen for experimental shipments of the double-layer packs (fig. 5). Three shipping tests were conducted during December 1952 in each of which four broccoli crates with double-layer packs were shipped to New York City. Two check crates of cauliflower in standard pony crates were included in each test shipment for purposes of comparison. In these initial shipping tests, the upper-layer heads in the broccoli crates were packed upright instead of being inverted as was done in later tests. No pads were used between the layers in the test containers. The destination inspection records are shown in table 3, and they indicate that in only one test was there less damage in the

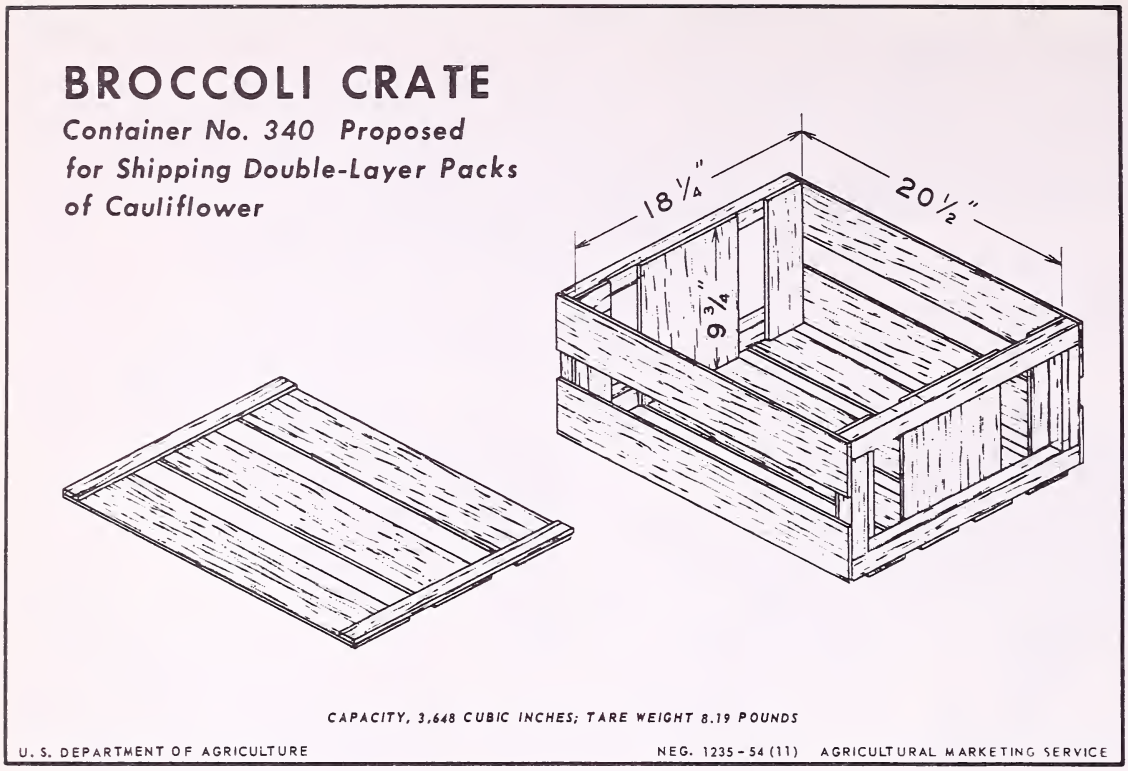

Figure 5.--Construction and dimensions of the broccoli crate, Container No. 340.

double-layer packs. The other two shipments registered higher bruising and damage by reason of the experimental double-tiering. In packing, the butts of the top-layer heads were offset between heads in the bottom layer so that they would not rest directly on the lower-layer curds. However, midribs of those heads caused some damage to the sides of the lower-layer heads and pressure of the cover slats bruised the exposed curds in the top layer.

Table 3.--Bruising of cauliflower packed in double and single layers, December 1952 1/

Test number	Single-layer pack							Double-layer pack 2/						
	Heads in pack	Results of bruising: Slight		Damaged		Serious		Heads in pack	Results of bruising: Slight		Damaged		Serious	
		Number	Percentage of total	Number	Percent	Number	Percent		Number	Percent	Number	Percent	Number	Percent
1	24	3	12.5	0	0	0	0	94	16	17.0	6	6.4	0	0
2	24	4	16.7	2	8.3	0	0	96	11	11.5	2	2.1	0	0
3	22	3	13.6	1	4.5	0	0	88	27	30.7	9	10.2	2	2.3
Total	70	10	14.3	3	4.3	0	0	278	54	19.7	17	6.2	2	0.7

1/ All heads in each type pack had butts down.

2/ Bruising by layers in double-layer packs was noted in tests 1 and 3; of the 182 heads in the 2 tests, the top layers contained 15 slightly bruised, 6 damaged and no seriously damaged heads. The bottom layers contained 28 slightly damaged, 9 damaged, and 2 seriously damaged.

The heavier damage to the double-layer packs in these first shipping tests pointed to a probable deficiency in the packing arrangement which was corrected in the following series of tests, conducted in 1953.

Cauliflower heads of various shapes were selected at random for experimental trimming and packing and a standardized technique was developed. Under the procedure indicated in figure 6, all projecting foliage was first cut horizontally just above the curd. A second horizontal cut through the stalk of the plant reduced the head depth sufficiently to permit double-layer packing and simultaneously severed the outer layer of jacket leaves growing from the lower part of the stalks. Diagonal cuts trimmed off any stiff jacket leaves left protruding at an angle from the head that might damage adjacent curds. The heads represented in figure 6 show the variations in the pattern of growth of the jacket leaves surrounding the cauliflower curd.

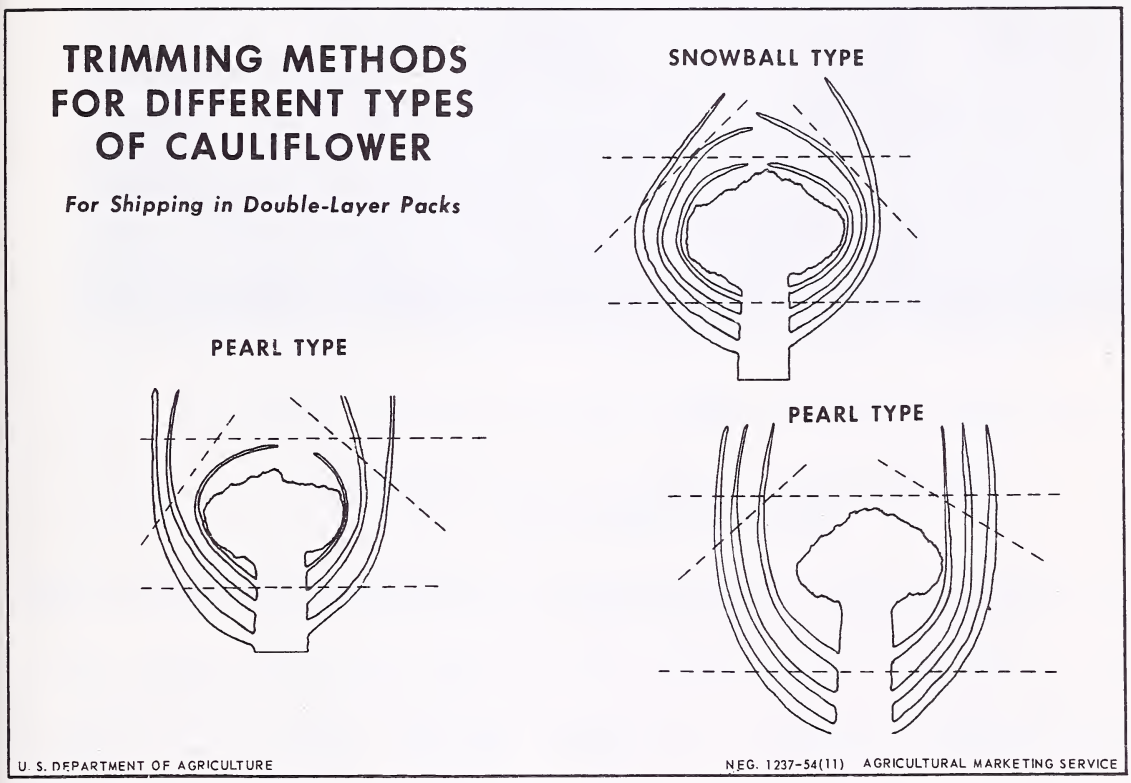

Figure 6.--Method of trimming cauliflower heads for double-layer packing, as applied to typical heads of different varieties.

The heads in the cross-sectional photograph (fig. 7) show the closer trimming more clearly. The depth of the closely trimmed head was 5 inches compared with the 8½-inch depth of the other head in the picture.

The further clipping of the stalks and jacket leaves and the inversion of the upper layers minimized the packing pressure, and soft-paper pads placed between the two layers provided a cushioning effect as additional protection against bruising.

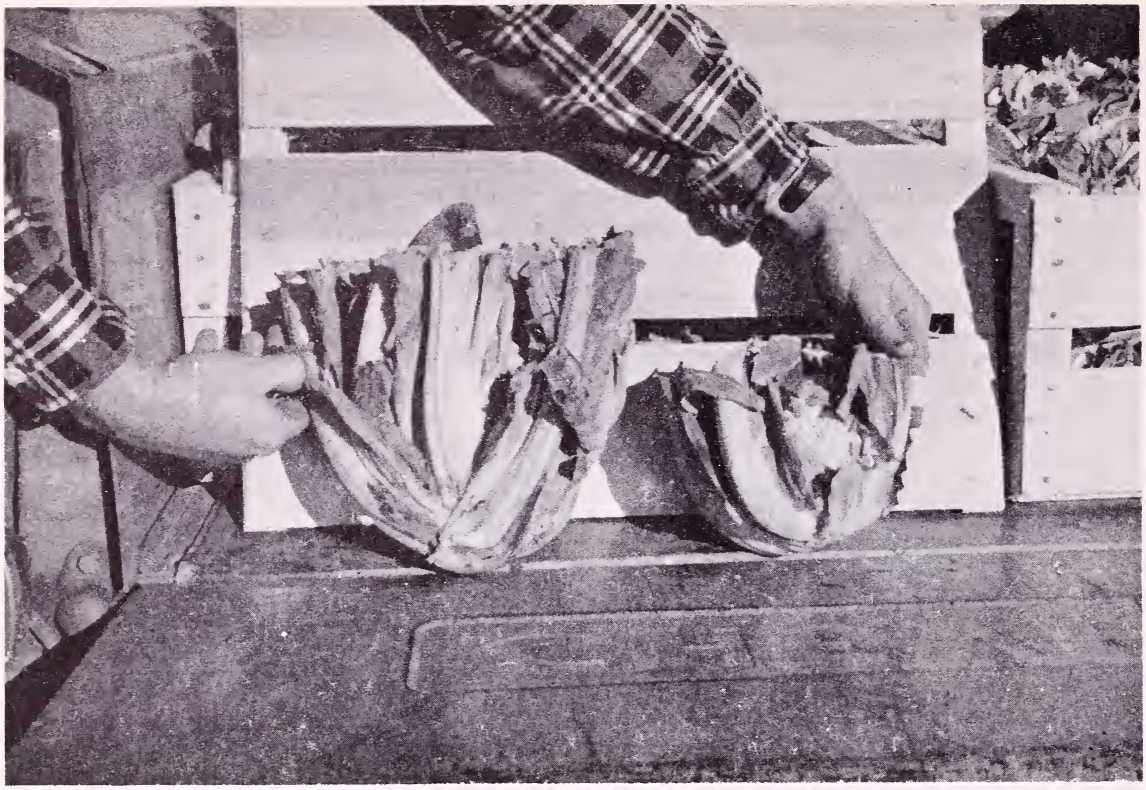

Figure 7.--The head on the left was taken from a single-layer cauliflower crate. The other head has been trimmed for packing in a double-layer test container.

TRANSPORTATION TESTS OF THE IMPROVED DOUBLE-LAYER PACK

Ten transportation tests of the improved double-layer pack were made from Santa Maria and other California shipping points to New York, N. Y.

Each test shipment of cauliflower included 3 No. 340 broccoli crates and 6 single-layer No. 405 crates for purposes of comparison. All heads were checked at origin as to size, maturity, and general condition and a similar inspection was made at destination.

The destination inspection records of 10 test shipments, in which the upper-layer heads in the broccoli crates were inverted, are summarized in table 4, which shows that the incidence of slight bruising was 16.7 percent lower, and serious bruising affecting U. S. No. 1 Grade 60 percent lower in the double-layer packs than in the single-layer packs. Too much significance should not be attached to these percentages because of the limited number of tests from which they were obtained, but it does appear safe to conclude that there should be no more injury to heads in the double-layer than in the single-layer pack.

Of the 11 heads showing decay, 10 were found in 1 test shipment. Although the decay was considerably greater in the single-layer crates in that test, little significance can

be attached to the finding because the significant decay took place in only 1 shipment, and because conditions other than the container or packing method might have been responsible.

Table 4.--Condition of cauliflower from inspection reported by U. S. Department of Agriculture, 1953

Test number	Single-layer pack				Double-layer pack			
	Heads in sample	Condition			Heads in sample	Condition		
		Slight bruising 1/	Bruising damage 2/	Decay		Slight bruising 1/	Bruising damage 2/	Decay
	Number	Number	Number	Number	Number	Number	Number	Number
1	72	8	0	0	72	10	0	0
2	72	13	2	1	72	11	1	0
3	72	5	0	0	72	12	2	0
4	72	4	1	0	72	9	2	0
5	67	6	0	0	70	7	1	0
6	64	11	3	0	72	7	1	0
7	71	16	5	0	48	8	0	0
8	66	15	1	0	66	8	0	0
9	66	16	2	0	68	11	0	0
10	66	14	6	8	70	7	1	2
Total	688	108	20	9	682	90	8	2
Percentage of sample		Percent 15.70	Percent 2.91	Percent 1.31		Percent 13.20	Percent 1.16	Percent 0.29

1/ Slight bruising includes only injury that results in crushed, rubbed, or bruised portions of curds not serious enough to be scored against the damage tolerance in U. S. No. 1 cauliflower grade.

2/ Bruising damage includes only injury serious enough to prevent curds affected from grading U. S. No. 1 when inspected.

In 6 of the 10 tests shown in table 4, fewer curds in double-layer test crates were damaged by bruising than in the check crates. In 1 test neither type of pack contained damaged curds. In 7 of the 10 tests, slight bruising injury was greater in single-layer than in double-layer packs. The bruising damage occurring in the double-layer packs was

found mainly on the face of the curds, whereas in the standard single-layer packs most of the bruising was on the sides.

Because there was less compression in the double-layer packs, the upper-layer heads were easily removed for inspection at destination and there was no need to replace each head in precisely the same position. When heads are removed from the standard single-layer crates by inspectors or prospective buyers, each head must be restored to its previous location in the crate; otherwise, general disarrangement of the pack results as is shown in figure 8.

Figure 8.--A pony crate and a broccoli crate after examination. Note the disarrangement of the standard crate on the left compared with the orderly condition of the double-layer pack.

Characteristics of the Double-Layer Pack

The characteristics of the standard single-layer pack and the experimental double-layer pack of closely trimmed heads, as determined from examination of the containers observed in the transportation tests, are set forth in table 5.

It should be noted that, although the double-layer pack contains, on the average, more than twice as many heads, the cubic displacement and weight per cubic foot of the packed container are only slightly greater than the packed standard pony crate. The average net weight per head of cauliflower in the pack is reduced 1.32 pounds per head, and the number of heads per 100 pounds of shipping weight is increased 70.6 percent.

Table 5.--Average weight and number of heads of cauliflower per crate, by type of crate

Item	Average per crate: Weight	Average per crate: Heads	Average weight per head	Displacement	Weight per cubic foot
	Pounds	Number	Pounds	Cubic feet	Pounds
Crate					
Single-layer No. 405	41.93	11.44	3.16	2.38	17.6
Double-layer No. 340	50.22	23.38	1.84	2.57	19.5
Change in No. 340 from No. 405	8.29	11.94	-1.32	0.19	1.9

EFFECT OF THE DOUBLE-LAYER PACK ON COSTS

The use of the double-layer pack would have a marked effect on the costs of marketing cauliflower from California, as illustrated in figure 9. The principal components of shipping and transportation costs represented here are freight, refrigeration, packing, and container costs.

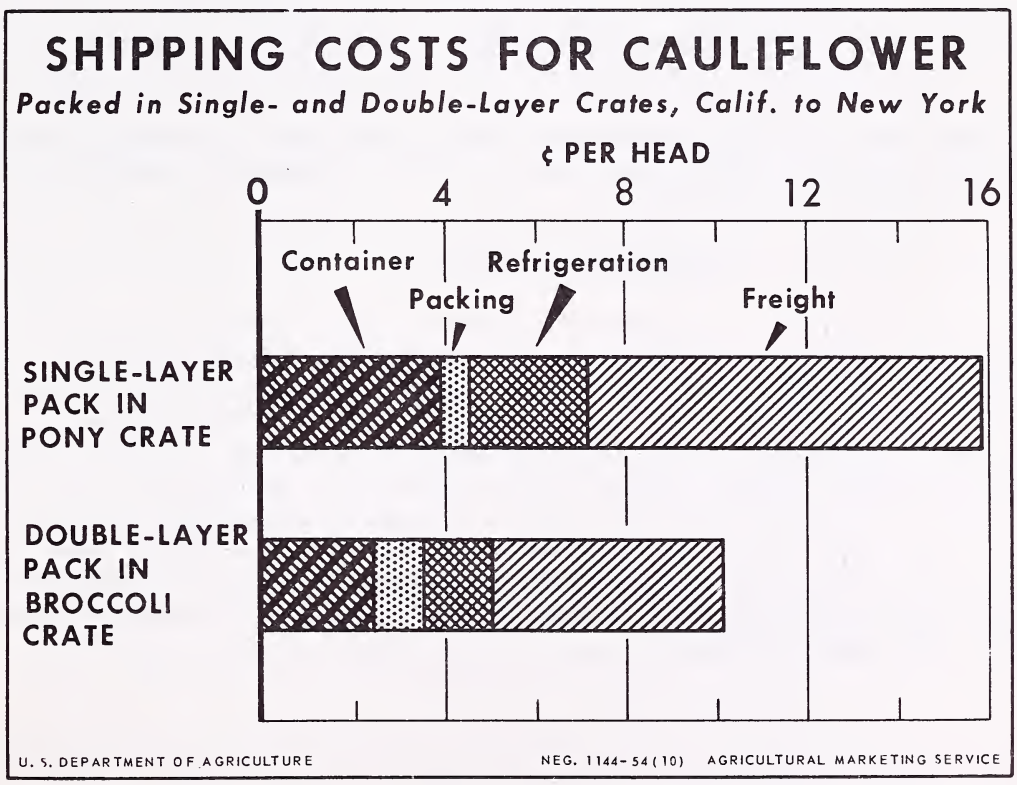

Figure 9.--Comparative selected costs of packing and shipping California cauliflower to New York in single- and double-layer crates.

The comparisons set forth in figure 9 are based on 2 carload shipments each totaling 20,000 pounds, the carload minimum weight for cauliflower. One carload consisted of 476 standard pony crates of 42 pounds each; and the other carload 398 broccoli crates with double-layer packs. The shipping weight of each broccoli container is 50.22 pounds.

Savings on Freight

The carload rate from Santa Maria to New York City during the 1952-53 season was $2.38 per hundred pounds, which, applied against 20,000 pounds, produces a freight charge of $476 per car.

The car of standard crates averaged only 11.44 heads per crate, which, multiplied by 476 crates, totals 5,448 heads in the car. The second car carried only 398 crates, but with the double-layer packing each container averaged 23.38 heads, which means that there were 9,302 heads of cauliflower in the car. Thus, the freight charge per head of cauliflower is reduced from 8.7 cents per head to 5.1 cents, a reduction of 41 percent.

Savings on Refrigeration

The refrigeration charges per head also would be reduced 41 percent, from 2.6 cents to 1.5 cents, by the use of the double-layer pack. The assumption is made that both cars would require 20,000 pounds of top ice at origin, which, if furnished by the refrigerator carline, would cost $105.80. An additional 5,000 pounds furnished en route would cost $34.39, so that the total charge for protective service would come to $140.19 before the 2 cars reached their common destination. The ice used in the initial icing is ordinarily provided by the shipper so that the actual cost might be somewhat less than $140.19, but the cost of refrigeration would be diminished in the same ratio as a result of the double-layer packs. Actual costs would also depend on weather, time in transit, and other circumstances. If the size of the load were increased above 20,000 pounds, the cost of protective service per head would drop slightly, but that fact does not impair the significance of the comparison set forth in figure 9.

Increased Packing Costs

The prevailing labor cost of packing the standard single-layer pony crates in the field is 6.9 cents each, on a piecework basis. The double-layer packing would have to be done in a shed and would normally be paid for at an hourly rate. It is therefore impossible to project the actual cost of packing the double-layer crate, but studies of packing operations made at Santa Maria and the cost experience of two growers, in close trimming of cauliflower heads for overseas shipment to the Armed Forces, indicated that the cost would not exceed 25 cents per crate. It is obvious that the cost would be much higher than that of single-layer packing, because the closer trimming of the jacket leaves would necessarily consume more time. Using the 25-cent estimate, the cost would be higher by 0.5 cents per head, an increase of 85 percent, but packing is a small component of the overall costs under consideration.

Reduced Container Cost

The delivered cost of a pony crate and lid at Santa Maria in 1953 was 45 cents and the corresponding cost of the standard broccoli crate was 56.5 cents, which included two protective separator pads. The use of the broccoli crate would cut the container cost by 1.5 cents per head, a reduction of 38.5 percent, because there are 12 more heads in the broccoli crate.

As indicated in figure 9, the potential net savings in shipping costs resulting from the use of the double-layer pack would be approximately 5.7 cents per head. This would be equivalent to a saving of $310 for the average number of heads now shipped in a minimum carload of the present single-layer containers.

It is probable that the double-layer pack of cauliflower would be used more extensively in mixed carloads with other vegetables than in straight carloads because of the greater number of heads involved in a straight car of the double-layer pack than in the single-layer. Straight carloads of the double-layer cauliflower pack would likely be limited to large receivers including chain stores. However, much of the cauliflower is now shipped in mixed carloads with other vegetables, and the dimensions of the No. 340 broccoli container are such that it may be shipped in mixed carloads with many other vegetables grown in California. A minimum weight of 24,000 pounds applies to mixed carloads.

CONCLUSIONS

Double-layer packing of closely trimmed heads of cauliflower in the crate now used for shipping broccoli offers potential savings over the conventional single-layer pack in the standard pony cauliflower crate.

These savings result from reducing the weight of the jacket leaves in proportion to the edible curd, eliminating about 1-1/3 pounds of waste product per head. This method also reduces the tare weight of the container in relation to the net weight of the edible part of the commodity. The resulting reduction in shipping weight would mean savings of approximately 40 percent in the costs of transportation and refrigeration of shipments of cauliflower.

The cost of containers also would be less for the double-layer pack, but the packing operation would cost more than the present single-layer pack in the pony cauliflower crate.

The net saving, taking all these items into account, on the basis of 1953 data, would be 5.7 cents per head, equivalent to $310 on approximately 5,500 heads in a 20,000-pound minimum carload shipment of pony crates.

In 10 transportation tests, less bruising was found in the double-layer pack, using the present broccoli crate, than in the conventional single-layer cauliflower crate. In these tests the two layers of cauliflower in the experimental containers were packed face-to-face, with paper pads placed between the two layers for protection of the curds.

Because of the difference between the average amounts of bruising found in the double-layer and single-layer packs, even though the number of test shipments was not large, it

may be assumed that the injury to cauliflower packed in double layers in the broccoli crate would not be more, and probably would be less, than is now experienced in the single-layer cauliflower crate.

The double-layer pack is better adapted to a packing-shed operation than to field packing, and probably would be used more extensively in mixed than in straight carload shipments because of the larger number of heads to the crate.

Because the study was confined to the technical aspects of cauliflower shipping and because of the limited number of test shipments made, it was not possible to evaluate the reaction of wholesalers and retailers to a double-layer pack. Therefore, the extent to which this pack might find acceptance within the trade is not known. Operators of small retail stores might well prefer the present single-layer pack because of the limited volume of their sales of this commodity. The double-layer pack might find greater acceptance by the larger establishments including chain stores and the wholesalers and the warehouses serving them.

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