Relationship of Price and Quality of Potatoes at Retail Level

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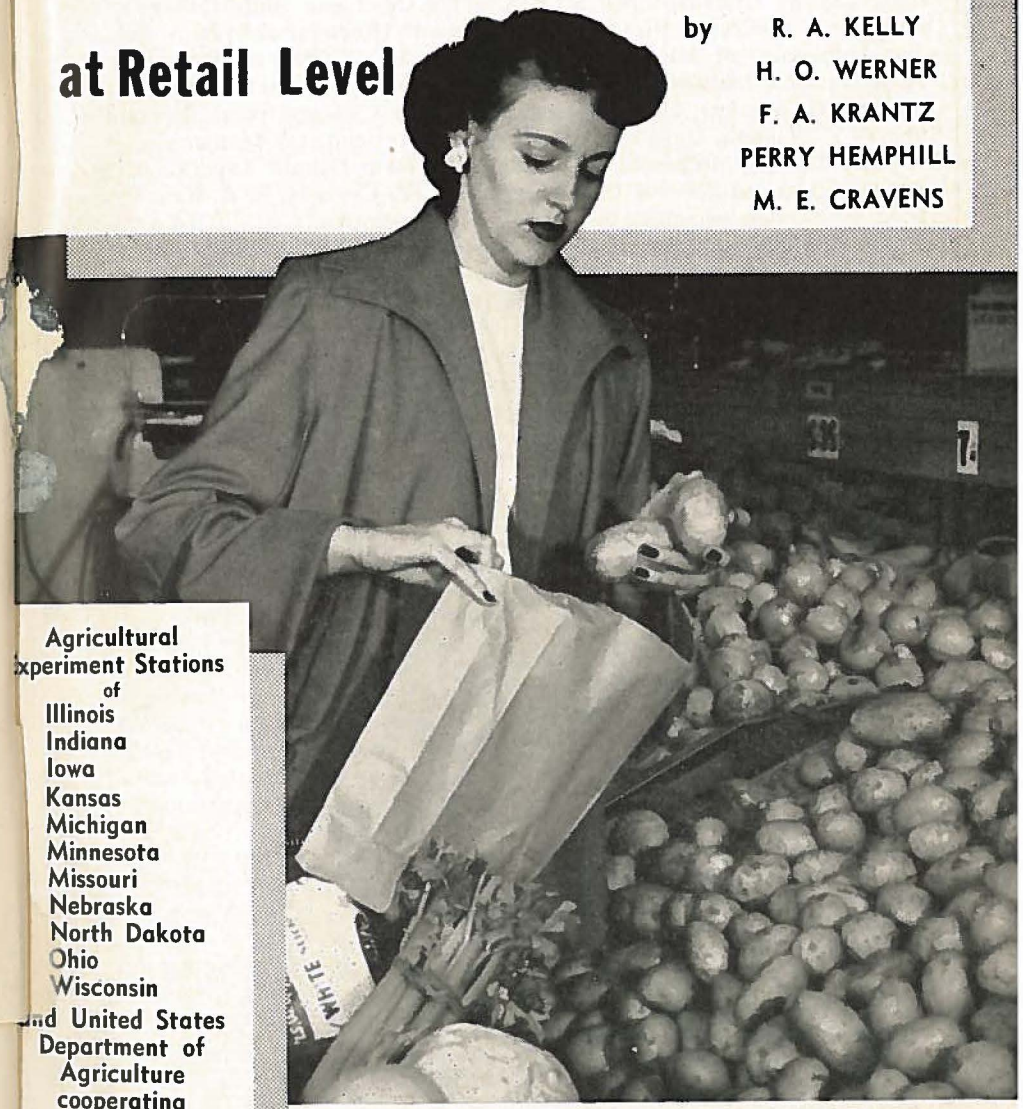

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Relationship of Price and Quality of Potatoes at Retail Level

by R. A. Kelly, H. O. Werner, F. A. Krantz, Perry Hemphill, and M. E. Cravens

THE MARKET quality and general appearance of potatoes offered for sale in retail stores in north-central states has improved greatly recently. U.S. No. 1 potatoes are now available in most towns and cities. Much must be done, however, before retail potatoes can compare with other vegetables and fruits in grade, quality, uniformity, and attractiveness. The variation in size permitted in U. S. No. 1 potatoes often is much greater than is desirable for a stabilized sales program.

There has been such a demand for apples, citrus fruit, peaches, and other fruits sorted into different sizes that sizing has become well-established. In some areas potatoes have been marketed by size. However, it is not known if homemakers are interested in potatoes of different sizes.

Consumer surveys similar to the U. S. Department of Agriculture study indicate customer preference for different size potatoes.[1] However, this type of survey does not supply information on customer acceptance of sized potatoes under different marketing conditions or as to what actual size the consumer prefers. Retail stores in Chicago ordinarily have offered only potatoes of assorted sizes from which customers could select their preferred size. Since they did not have access to displays of tubers carefully sized, many customers may have varied concepts of the meaning of the terms, Small, Medium, and Large. Factors other than size, such as shape of the tubers or depth of eyes, may also be a part of the customer's concept of size or their willingness to accept certain potatoes. Hence, their acceptance of sized potatoes may or may not be identical with their stated preferences.

Because of lack of information about many aspects of handling sized potatoes, an experiment on size-price relationship was conducted as the first step in a cooperative study of the relation of quality to price and volume of sales of potatoes in retail stores.

Plan of the Experiment

Eleven carloads of U. S. No. 1 washed Triumph potatoes sorted into four size classifications—Small (1⅞ to 2¼ inches), Medium (2¼ to 3 inches), Large (3 to 4 inches),[2] and Assorted (1⅞ to 4 inches), combination of the other sizes)—were shipped in 100-pound burlap bags to Chicago in successive weeks (figure 1). Seven cars were shipped from North Platte Valley in western Nebraska and four from Red River Valley of Minnesota and North Dakota. Each car contained 375 sacks of sized and 125 sacks of Assorted potatoes. Number of sacks containing any one size varied from car to car, depending

[1] *Potato Preferences among Household Consumers*, Misc. Publ. 667, U. S. Department of Agriculture, 1948.

[2] These sizes conform to three of the promulgated U.S.D.A. consumer grades except for the minimum size of small potatoes, which is listed as 1¾ inches.

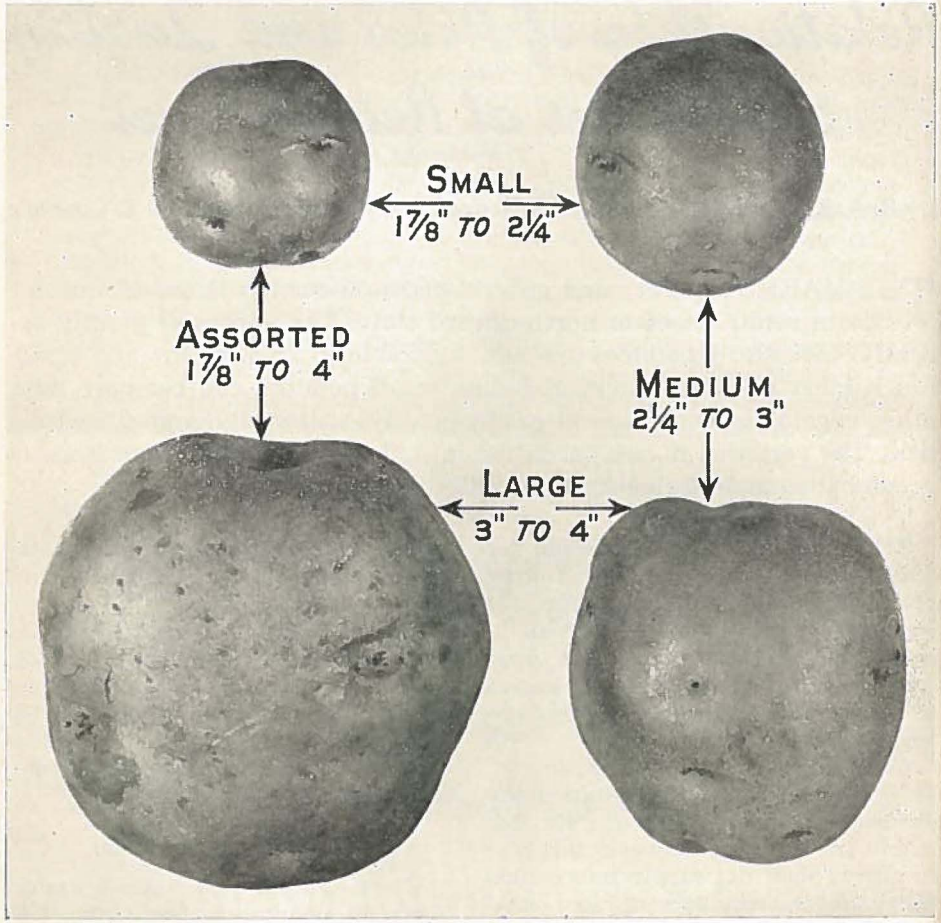


FIG. 1. Size ranges of Small, Medium, Large, and Assorted experimental potatoes

on proportion of each size in stocks from which experimental lots were taken.

Tubers of these four sizes were placed on sale simultaneously in three stores of each of three chains between January 3 and March 20, 1948. A more complete explanation of the structural design of the experiment is given elsewhere by F. A. Krantz.[3] Each of the four sizes was displayed in each store in adjacent racks of identical capacity and form. No advertising or sales promotion was used other than the customary signs about the size, variety, and price (figure 2). During the experiment no other potatoes except Russet Burbanks were sold in the store. Russet Burbanks are used largely for baking so they did not compete directly with the Triumph, which is ordinarily used for other purposes.

The retail prices of the different sizes were determined each week after consultation with the produce merchandiser. During the first week, all sizes of potatoes were sold at the same price. After the first week the prices were varied so as either to sell an equal volume of each size or to sell each size in the same ratio as the potatoes were produced.

[3] Krantz, F. A., *An Analysis of Some Factors That Might Influence the Volume of Sales of Small, Medium, and Large Potatoes in a Controlled Experiment on Customer Preferences.* Proceedings of the American Society for Horticultural Science. In press.

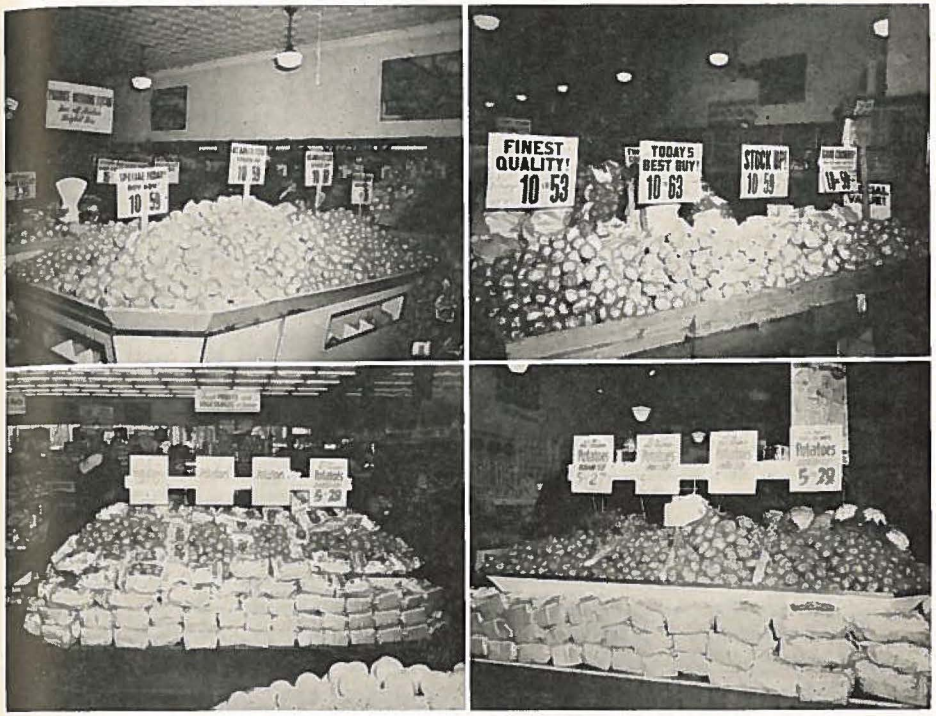


FIG. 2. Representative potato displays in experimental stores.

Potato prices on the Chicago wholesale market rose from December through the first week in April (figure 3) thus increasing retail prices. During this time the price of Russet Burbanks was considerably above Triumphs.

To obtain information on the cause and amount of loss and the quantity discounted, the retail display of each size was checked by the store personnel at intervals during each day. All damaged tubers were removed and placed in separate containers. To keep only fresh tubers displayed, all potatoes from the previous week were removed from experimental stores. The displays in Chains A and B were refilled every Monday with fresh potatoes arriving in Chicago the preceding Friday or Saturday, and in Chain C, on Wednesday with potatoes arriving Monday or Tuesday. Sales, discounts, and shrinkage were checked almost daily.

This report is divided into three sections. The first reports on consumer acceptance of pre-sized potatoes; the second on consumer preference; and the third on grade, condition, damage, and injury to different sized potatoes.

Consumer preference — During the last three weeks of the price-quality relationship experiment in Chain C stores 257 customers who had purchased sized Red River Triumph potatoes were interviewed. Information was obtained on the size of potato purchased, size

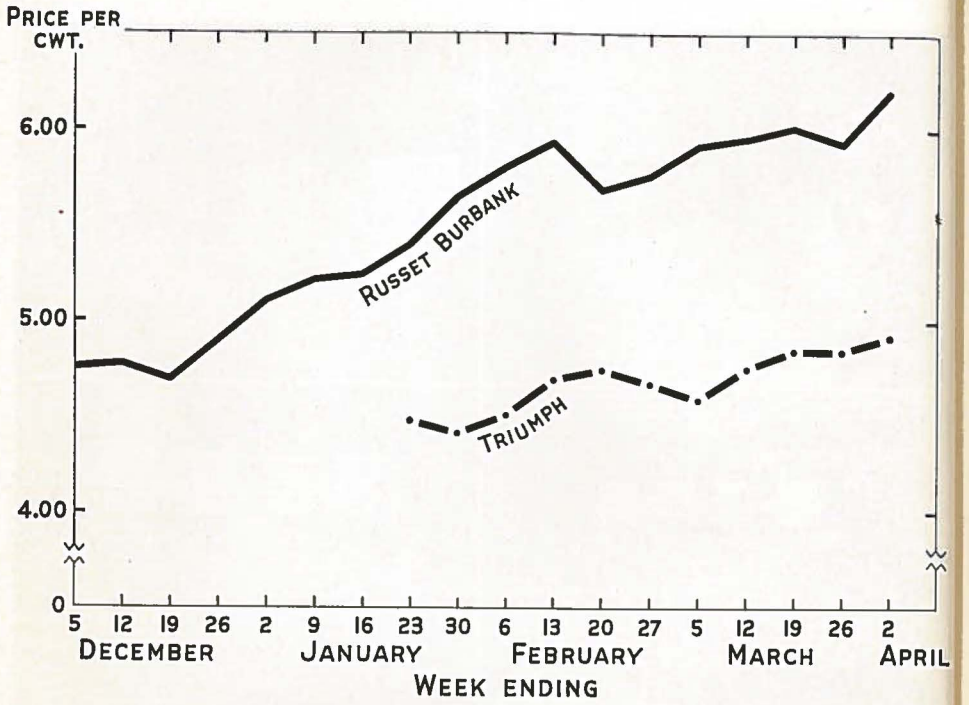


FIG. 3. Weekly wholesale prices of U. S. No. 1 Grade Russet Burbank and Nebraska Triumph potatoes in Chicago, December 1, 1947, to April 2, 1948. (Only one quotation was given for Triumphs February 13 and 20 and March 12 and 19.)

usually purchased, reason for purchase of specified size, intended use, and number in family over one year of age.

The same questionnaire was used during late March and April in interviewing 411 customers in 16 chain and independent stores selected at random in various income areas of Chicago. The potatoes sold were those usually found in normal trade channels at that season. More new-crop potatoes, which were smaller and brighter than old-crop tubers, were on the market.

The results obtained from this customer interview study are reported in the second section of this bulletin (page 17) entitled "Consumer Preference for Size."

Damage to Potatoes—The potatoes were typical of U. S. No. 1 quality from these regions. They were not specially selected for quality or more strictly sorted as to grade. Potatoes were thoroughly inspected for grade by inspectors of the Production and Marketing Administration at the shipping point. Further inspections were made in the Chicago warehouses and in the retail stores.

Sacks containing the potatoes inspected at shipping time were marked so that they would not be inspected again in Chicago. Because different sacks were inspected at each point, it was possible to determine when the damage and injury might have occurred. The results from these inspections are reported in the third section of this bulletin.

Consumer Acceptance of Pre-sized Potatoes

BEFORE LAUNCHING a program of marketing potatoes by sizes, it is desirable to know both the present and potential proportion of different sizes in the potato crop.[4] The extent to which the percentages of tubers of different sizes in the various carloads checked with sizes in commercial fields may be judged from reports of two western Nebraska warehouses on 126 lots of potatoes sized in the 1947-48 season (figure 4). These reports showed that in 12 per cent of the lots, 50 per cent or more of the tubers were over 2⅝ inches; in 58 per cent of the lots, 31 to 50 per cent of the tubers were over 2⅝ inches; and in 29 per cent of the lots, less than 30 per cent of the tubers were over 2⅝ inches. However, these percentages vary according to growing conditions from year to year.

The average percentages of Small, Medium, and Large potatoes in the lots sized for the experimental study from the two areas are shown in table 1.

[4] Throughout this report the arithmetic mean was used in calculating the percentages.

Table 1. Size of U. S. No. 1 Potatoes in the Lots from Which the Experimental Tubers Were Obtained

Size	North Platte Valley, Neb. (7 cars)	Red River Valley, Minn. and N.D. (4 cars)
	per cent	
Small (1⅞" to 2¼")	17	18
Medium (2¼" to 3")	60	78
Large (3" to 4")	23	4

The proportion of Small potatoes was about the same in the two areas, but the percentage of Medium was higher in the Red River Valley than in Nebraska. The percentage of Large was much lower.

The Red River Valley potatoes were representative of sizes as found in the crop. Samples taken from growers' fields in three locations in Minnesota averaged 18.2 per cent for Small, 73.1 for Medium, and 8.7 for Large. Comparable figures for the four carloads of

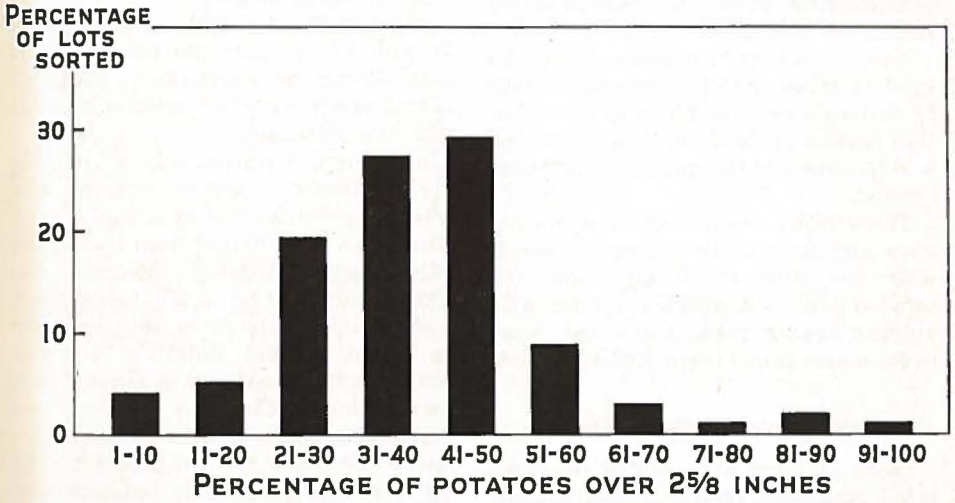


FIG. 4. Percentage of western Nebraska U. S. No. 1 Triumph potatoes above 2⅝ inches as determined by sorting 126 lots (each lot one or more carloads) in two warehouses in western Nebraska during 1947-48 season.

Table 2. Sales of Potatoes of Each Size With Price of All Sizes the Same

Chain	Week ending	Price per pound	Percentage of total sales				Sales
			Small	Medium	Large	Assorted	
		cents					pounds
A	Jan. 10	5.5	13	39	30	18	9,150
B	Jan. 10	5.9	8	36	30	26	15,365
B	Jan. 17	5.9	9	35	28	28	14,615
B	Jan. 24	4.9	9	37	30	24	14,640
C	Feb. 17	5.8	17	39	18	26	9,005
	Average	5.6	11	38	27	24	11,757

sized potatoes shipped from the Red River Valley were 17.8, 78.1, and 4.1 per cent, respectively.

Freezing, which was not considered part of shrinkage, amounted to 0.7 per cent in potatoes handled by Chain A, 2 per cent by Chain B, and 0.3 per cent by Chain C. Freezing damage caused by exposure occurred while the potatoes were being trucked from warehouse to retail store, and, therefore, was not associated with size.

EXPERIMENTAL RESULTS

The relative volume of sales of the four sizes was not significantly affected by any difference in characteristics of potatoes from western Nebraska and the Red River Valley.

There was little difference due to the kind of retail outlet in the percentage of various sizes sold. Much of the variation in sales probably may be attributed to differences in the quality in different carloads.

The relative volume of sales did not vary significantly in successive weeks when the prices for all sizes were the same (table 2). A decided difference in volume among sizes was noted, however, when prices were differentiated.[5]

Sales Under Uniform Prices

When potatoes were sold at the same price, customers preferred Medium. Almost as many bought Assorted as Large, but very few chose Small. Continuing the uniform price for all sizes during three weeks in Chain B did not appreciably alter the relative volume of sales.

The sales of Assorted potatoes were below those of Large during three weeks, about the same during one week, and definitely greater during another week. This greater sale during one week may have been due partly to a greater overlapping of size and less apparent difference between Medium and Large classes during that week. During that week 6.5 per cent of the Medium were over 3 inches, and 4.2 per cent of the Large were under 2¾ inches, while 18.25 per cent of the Assorted lot were over 2¼ inches.

Sales of Small potatoes lagged (table 2) with 17 per cent the peak for this size. This peak occurred in Chain C during one week when contrast in sizes was at a minimum.

In Chain C, with the price of all sizes at 5.8 cents a pound during the first week, the distribution of sales between sizes was very different from that of the other chains. Although Medium size was equally popular in all chains, there was much less interest in the Large size in Chain C that Small sold about equally with Large and in greater proportion than in Chains A and B.

The percentage of sales of Small potatoes fell below that of production in the western Nebraska lot but exceeded it in the Red River Valley lot (table 3). The mean percentage sold during the five weeks was 15 per cent of the sized potatoes which is slightly lower than the production of this size. In both regions the percentage of sales was below production for Medium and above for Large.

[5] Krantz, *op. cit.*

Table 3. Sales of Small, Medium, and Large Potatoes Compared with Production in Nebraska and Red River Valley When All Sizes Priced Alike

	Small	Medium	Large
		per cent	
Nebraska			
Sales	13	49	38
Production	17	60	23
Red River Valley			
Sales	23	52	25
Production	18	78	4

Sales under Differential Prices

The greatest effect of difference in price on volume of sales of the various sizes was noted in Chain A (figure 5). The variance in volume of sales due to interaction of prices with sizes is above the one per cent level of significance. This information should, therefore, be useful in determining the relative interest of consumers in sized potatoes and the extent to which this interest is modified by price. During the first week, when all sizes were sold at 5.5 cents a pound, the following percentages were sold: Small, 12.9; Medium, 39.5; Large, 29.9; and Assorted, 17.7 (table 4). Total sales were higher that week than during any other week of the test.

During the second week, prices in Chain A were raised 0.4 cent a pound for Medium and Large potatoes and lowered 0.6 cent a pound for Small. With this change the proportionate volume of sales of Large remained the same, but there was a slight increase in the sale of Small and a distinct increase in Assorted at the expense of Medium.

Table 4. Volume of Sales of Each Size of Potato Was of Total Sales and Percentage Prices of Small, Large, and Assorted Were of Medium Size

Car No.	Week ending	Small		Medium		Large		Assorted	
		Price index*	Per cent of total sales	Price index	Per cent of total sales	Price index	Per cent of total sales	Price index	Per cent of total sales
Chain A									
1	Jan. 10	100	12.9	100	39.5	100	29.9	100	17.7
2	Jan. 17	83	14.8	100	33.7	100	29.3	93	22.2
3	Jan. 24	76	17.2	100	40.3	107	21.1	93	21.4
4	Jan. 31	76	19.5	100	33.8	107	20.4	93	26.3
5	Feb. 7	78	27.2	100	31.0	100	17.3	89	24.5
6	Feb. 14	84	16.0	100	31.6	94	28.5	94	23.9
7	Feb. 21	84	22.3	100	24.9	94	25.1	94	27.7
Chain B									
1	Jan. 10	100	8.1	100	36.8	100	29.6	100	25.5
2	Jan. 17	100	8.7	100	35.6	100	27.7	100	28.0
3	Jan. 24	100	8.2	100	37.2	100	30.0	100	23.6
4	Jan. 31	89	13.5	100	26.6	95	32.3	92	27.6
5	Feb. 7	84	14.4	100	25.3	94	27.4	88	32.9
6	Feb. 14	84	15.9	100	26.6	94	24.1	88	33.4
Chain C									
8	Feb. 17	100	17.3	100	38.8	100	18.2	100	25.7
8	Feb. 24	122	18.4	100	39.2	122	14.2	107	28.2
10	Mar. 2	122	17.7	100	33.3	122	11.4	107	37.6
10	Mar. 9	115	15.8	100	47.2	115	9.7	122	27.3
11	Mar. 16	115	9.0	100	54.7	115	7.8	122	28.5
11	Mar. 20	106	14.6	100	32.9	106	10.5	113	42.0

* Price index is based on the price of medium size potatoes at 100.

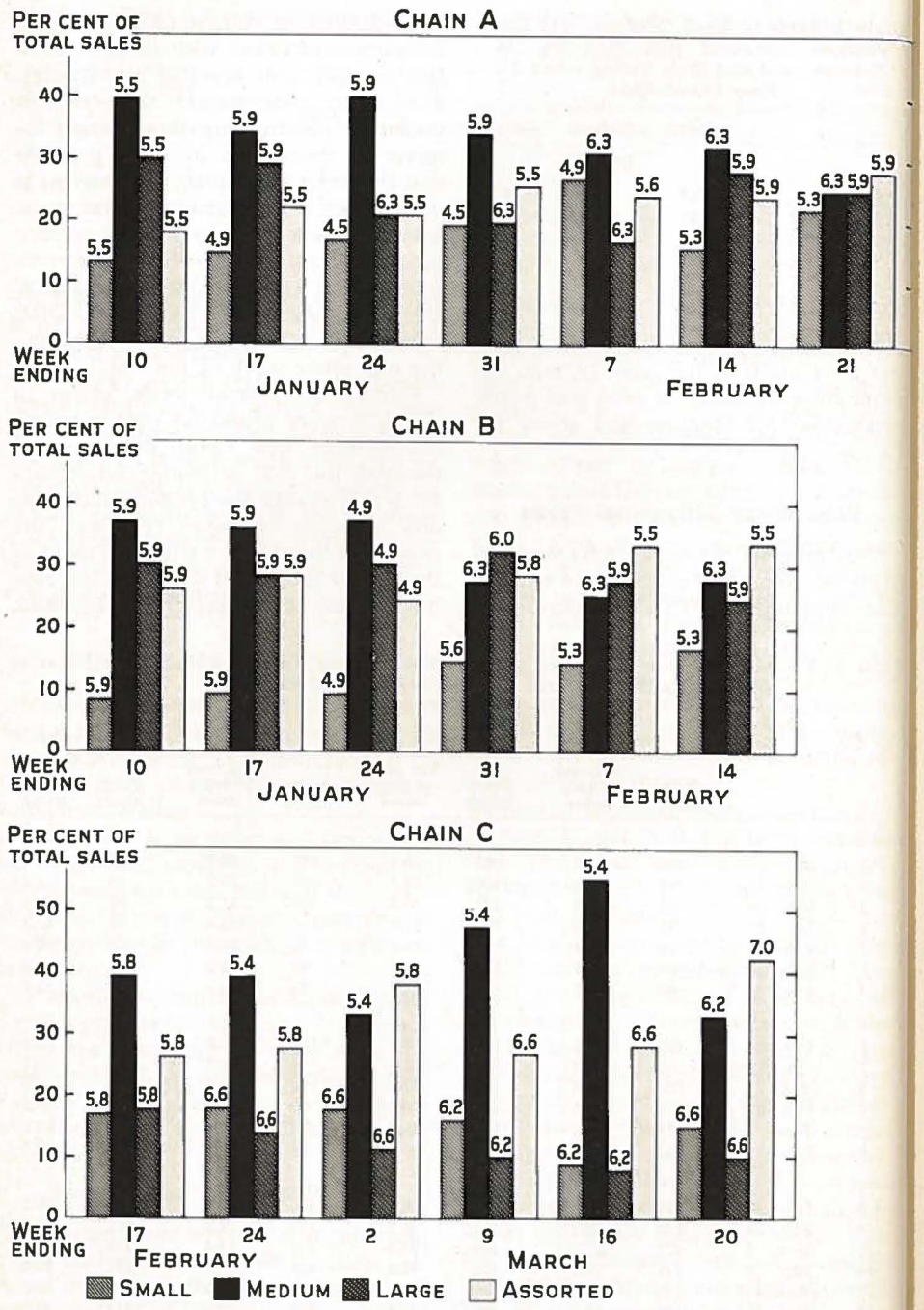


FIG. 5. Price per pound and percentage of weekly volume of sales to total sales of potatoes in each size, all chains. (Weeks ended on Tuesday.)

With Chains A and B an attempt was made to determine the prices necessary to move the four sizes in approximately equal amounts. With Chain C the policy was to price the potatoes

During the third week there was another increase of 0.4 cent a pound in the price of Large and a decrease of 0.4 cent in Small. Prices of Medium and Assorted continued the same as during the previous week. The result was lower sales of Large potatoes but a boost in Medium above the level of the first week. The additional reduction in price of Small brought a further increase in their sale.

Continuing these prices through the fourth week brought a further shift. Sales of Medium went down sharply and Large slightly less sharply, but Assorted sold better than at any other time during the test. The increased sale of Assorted at 5.5 cents a pound leads one to suspect that shrewd buyers may have been picking Large and Medium sizes out of the Assorted bin instead of buying them already sized at higher prices. Thus, although they may have bought practically as many Large and Medium as previously, the sale was reported as Assorted. It is interesting to note that at 4.5 cents a pound the proportion of Small potatoes purchased was still increasing.

A decided change in relative volume of sales in Chain A occurred during the fifth week when prices of Small and Medium potatoes were raised 0.4 cent a pound to 4.9 cents and 6.3 cents, respectively, and Assorted, 0.1 cent to 5.6 cents. Large remained at 6.3 cents. At these prices the relative sales of Medium and Large continued to drop. The sales of Assorted also dropped, but slightly less. The aggregate drop of 7.7 per cent in the three sizes was reflected in an increase in sales of Small. The probable reason was that many consumers had reached the limit they were willing to pay for the larger tubers and were buying at the lowest price without consideration of size. Regardless of reason, however, the proportionate sales of Small were higher and those of the Medium and Large lower than earlier.

Prices were altered again the sixth week to determine consumer acceptance of sized potatoes under a new price alignment. The price of Small was raised 0.4 cent a pound to 5.3 cents. Medium was continued at 6.3 cents. Large was lowered 0.4 cent to 5.9 cents, and Assorted was brought to 5.9 cents by a rise of 0.3 cent.

These price changes brought about a distinct response. The relative volume of sales of Medium potatoes remained the same, but there was a slight decrease in sales of Assorted, a drop of 11.2 per cent in Small, and a rise of 11.2 per cent in Large. Apparently customers buying Assorted potatoes were less aware or critical of increases than those buying Small potatoes.

Continuation of these same prices during the seventh week brought a definite shift in sales. Both Small, which had dropped sharply the previous week with the price increase, and Assorted recovered noticeably. Assorted reached its peak for the seven weeks of the test. Proportionate sales of Small were the second highest for any week. Again one suspects that the users of Medium and Large potatoes were getting them from the Assorted display at a lower price.

During the seventh week, sales volume in chain A was more nearly comparable for all sizes than at any other time. With comparable prices the objective of equal sales in all sizes was fairly well accomplished, the proportion being 22, 25, 25, and 28 per cent of the total for Small, Medium, Large, and Assorted, respectively.

For Chain B, variable price-volume-size relationship data are available for only three weeks (fourth through sixth week of test) The variance for interaction of prices with sizes was higher than the variance for error, but it did not reach a significant level.

Following a week of a chain-wide special price of 4.9 cents a pound for all

sizes the price was set at 5.6 cents for Small, 6.3 cents for Medium, 6.0 cents for Large, and 5.8 cents for Assorted. During the fourth week of the experiment (first week of variable prices for Chain B), proportionate purchases of Small and Assorted increased, while those of Medium dropped sharply. Even though the price of Large had advanced 1.1 cents, the slight price advantage apparently influenced customers to buy more Large at 6 cents than Medium at 6.3 cents.

During the fifth week of the test (second week of variable prices in Chain B), the price for Small and Assorted was lowered 0.3 cent and Large, 0.1 cent. Medium remained unchanged. During that week there was a very slight increase in sales of Small, but sales of Assorted, with an identical 0.3 cent drop, increased 5.3 per cent. These gains were made at the expense of Medium and Large, whose prices remained essentially unchanged. During the same week in Chain A, Small potatoes sold best and Large potatoes poorest.

With a continuation of the same prices into the sixth week (third week of variable prices in Chain B) the percentage of sales of Small, Medium, and Assorted potatoes in Chain B increased slightly and that of Large dropped 3.3 per cent. Thus, during the three-week period of the test, there was no significant difference in sales in Chain B because of price changes.

The total volume of sales in Chain C was about the same as in Chain A. Both sold about half as many potatoes in each of their three stores as Chain B. Large potatoes from Car 8 sold in Chain C looked only slightly larger than Medium because most of the Large tubers were nearer to the lower than the upper limit in size.

A new objective was introduced during the second week in Chain C. Prices of the various sizes were adjusted with a view to equalizing the ratio of sales to production in each size in the Red River Valley. Consequently, the price of the large volume of Medium was lowered to 5.4 cents a pound to enhance its popularity and that of Large was increased to 6.6 cents. Small was also priced at 6.6 cents, and Assorted was sold at 5.8 cents, the same price as the previous week. Although these price changes were rather drastic, they caused little change in distribution of sales. There was a very slight increase in the percentage of Medium sales and a decrease in Large. There was also a slight, unexpected increase in sales of Small potatoes, making them exceed the sales of Large even though the price of the two was the same.

Continuing these prices into the next week resulted in a decrease in percentage of sales for all sized potatoes and an increase of 9.4 per cent in sales of Assorted. The volume of Medium, which was the most favorably priced, decreased 5.9 per cent.

In the fourth week the prices of both Small and Large were lowered 0.4 cent and that of Assorted was raised 0.8 cent in order to divert interest from that size. The price of Medium was not altered. The response to these changes was a 10.3 per cent drop in sales of Assorted. Strangely enough, sales of Large and Small dropped slightly in spite of the price decrease, but the sale of Medium increased by 13.9 per cent. When the same prices were continued into the fifth week, most of the trends of the previous week continued. The sales of Medium increased still further to 54.7 per cent of total sales, and those of the Small dropped sharply. Except for the Small, the distribution of sales now almost conformed with the desired, or production, pattern.

During the sixth week, in conformance with the general market advance, prices of all sizes except Medium were advanced 0.4 cent. The price of Medium

was advanced 0.8 cent, but nevertheless, it was still lowest of the four groups. The response to this shift was surprising. Sales of all classes except Medium increased at once. Assorted at 7.0 cents a pound advanced 13.5 per cent to a high of 42 per cent of total sales. During this week sales of Medium dropped 11.8 per cent to 32.9 per cent of total sales.

Thus, in Chain C, with prices of Medium from 5 to 9 cents below the average price of the other three sizes, neither significant increases in the sales of Medium nor significant decreases in the sales of either Small, Large, or Assorted were obtained. In all cases the sales of Medium were below, and the sales of Small the same or substantially higher than the production.

The low volume of Small potatoes and the small preference for them in Chicago makes this an expensive item to be handled by most shippers and distributors. However, on some other large markets there seems to be a large demand for these Small potatoes at certain times of the year.

Price differentials had less effect on relative volume of sales of the four sizes in Chain C than in Chain B. In Chain C they reached the 20 per cent level of significance.[6] The price differential required to increase the sales of the popular Medium size and decrease the sales of the less popular Small size indicates the strong preference of customers for a particular size. It seemed to be just as difficult, if not more so, to decrease the sales of Small and increase the sales of Medium in this chain as it was to achieve the reverse effect in Chain A, that is, to increase the sales of Small and decrease the sales of Medium.

Effect of Sizing on Sales Volume

In the three experimental stores of Chain B, volume of sales increased in three out of four weeks when prices varied for different sizes of Triumph potatoes (figure 6). In the Chain C stores, however, there was no indication that volume either increased or de-

[6] Krantz, *op. cit.*

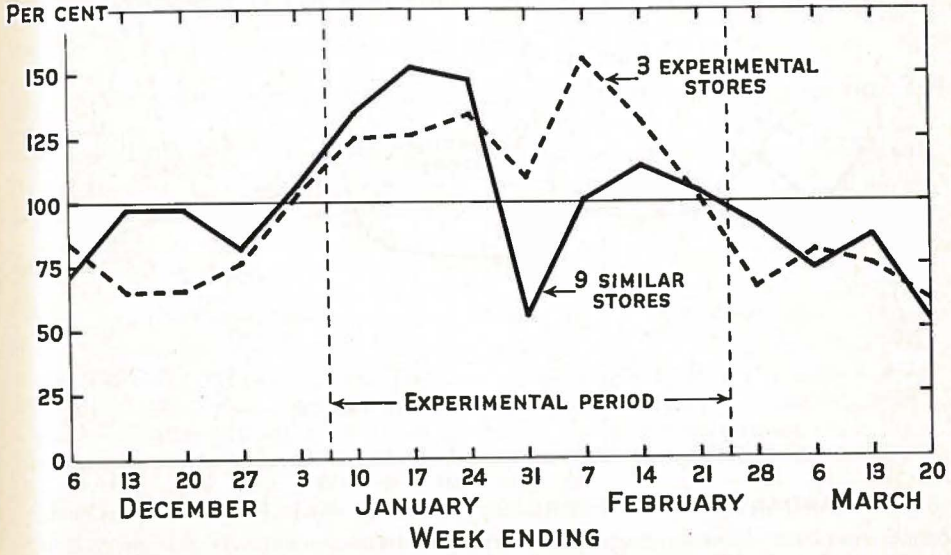


FIG. 6. Index of weekly potato deliveries, December 6, 1947, to March 20, 1948, in three experimental stores and nine similar stores of Chain B. (Average weekly delivery equals 100.)

creased (figure 7). No comparable records of sales were available for the nonexperimental stores in Chain A.

During the experimental period, the sale of red potatoes in Chain B increased from only half to more than twice that of Idaho Russet Burbanks. In nine similar stores in this chain, a rather constant relationship of sales was found for the period from December 6 to March 20. In Chain C the sales volume increased for reds and decreased for Idaho Russet Burbanks during the experimental period (figure 8). In all other stores of this chain, the sales of the two types were approximately equal. The extent to which increased sales were due to appearance of display, volume of potatoes displayed, or sorting into sizes could not be determined.

Interaction of Price and Sales

Because of variety of choices among four sizes the effect of price differentials on sales of any particular size of potato is extremely difficult to evaluate. In a comparison between any two sizes, the prices of the other two lots influence volume. Just how much influence they exerted was not determined.

At the 1947-48 price level of potatoes in Chicago, a 5 per cent reduction in the price of Small had little, if any, effect. A 10 per cent decrease, or approximately 0.5 cent a pound, changed the volume of sales about 30 per cent of the time (figure 9). When prices were reduced 15 to 20 per cent, sales of Small and Assorted tended to be equal.

In contrast with Small, in all cases where the price of Medium was the same as Assorted, the sale of the Medium was much greater. When Medium potatoes were priced 10 per cent above Assorted, the Medium sold best in two out of three weeks; but when they were 15 per cent higher, the small difference in sales was in favor of Assorted. With 49 and 82 per cent of the crop (the per cent of Medium in the western Nebraska and the Red River Valley lots, respectively) selling at an advance of 15 per cent, the Small and Large potatoes could be moved by selling them at a discount without reducing the net returns per lot. Also, the Large could have been sold at a premium without

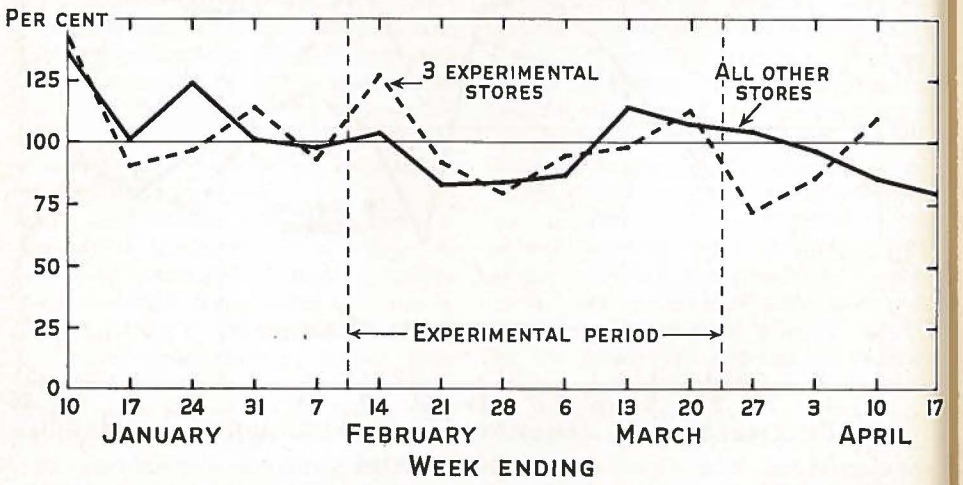


FIG. 7. Index of weekly potato deliveries, January 10, 1948, to April 17, 1948, in three experimental stores and all other stores of Chain C. (Average weekly delivery equals 100.)

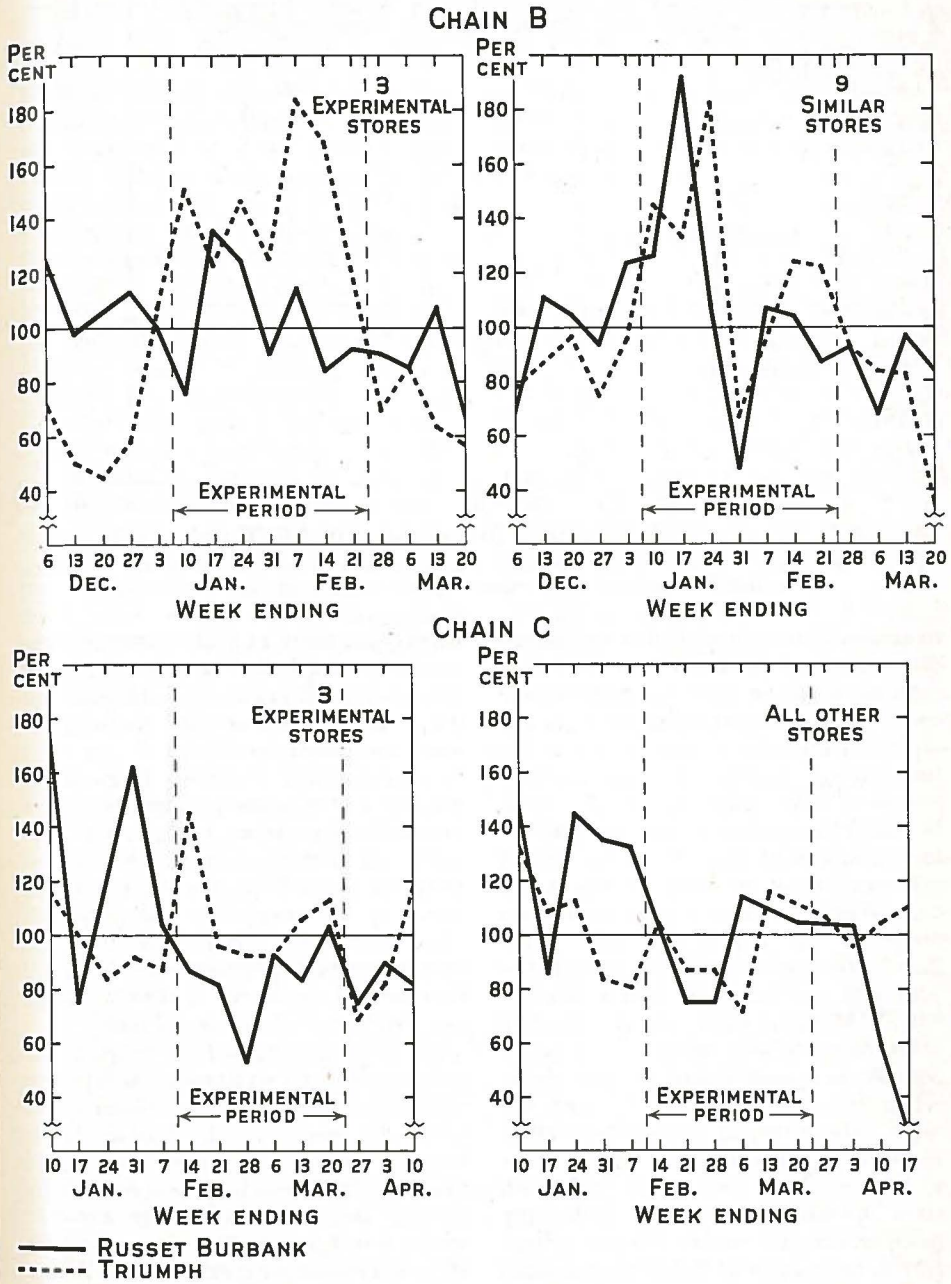


FIG. 8. Index of weekly deliveries of Idaho Burbank and Triumph potatoes to three experimental and nine similar stores of Chain B and to three experimental and all other stores of Chain C. (Average weekly delivery equals 100.)

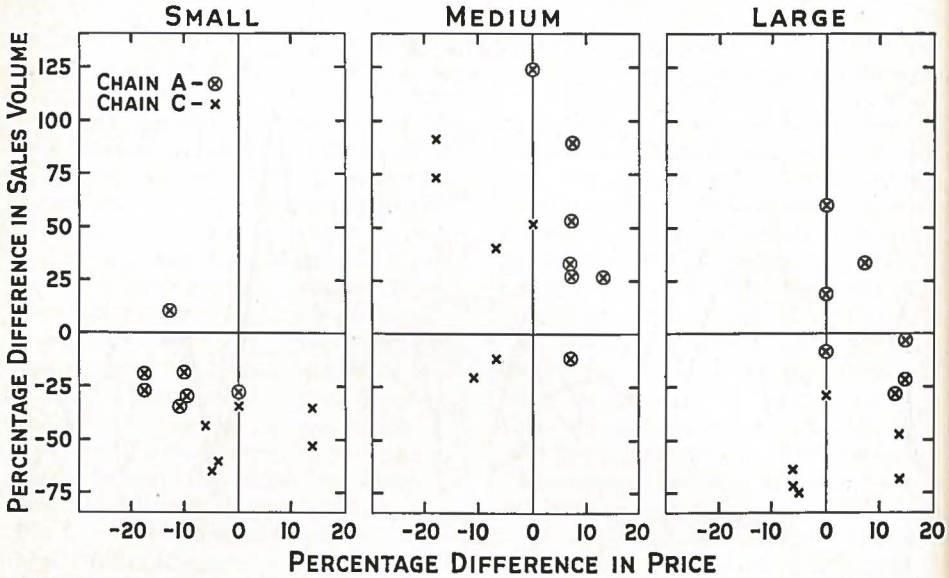


FIG. 9. Correlation between weekly price and volume of sales of each size of potato in Chains A and C, expressed as percentage of deviation from Assorted.

reducing their volume below the extent to which they occurred.

Sales of Large and Assorted tubers were about equal when prices were the same. During only about one fifth of the time while the price of Large was above Assorted were sales of Large ahead. However, Large tubers sold in about the same proportion when the price was 14 per cent above as when it was 6 per cent below Assorted. Some customers preferred the Large size even when they had to pay a premium for them.

In only one week did Small potatoes outsell Medium even though for two consecutive weeks the price of Small was 24 per cent lower in one chain. When the two sizes were priced the same, sales of Small ranged from 56 to 78 per cent less than Medium. In order to sell an equal volume of these two sizes, it was necessary to lower the price of Small 1 to 1¼ cents a pound. But to keep sales of Small to the same ratio in which they were produced, it was necessary to increase the price above that for Medium. When prices were increased 15 per cent or more above and kept at this level for four weeks in Chain C, the sales of Small decreased to 83 per cent of Medium, but that was still greater than the production ratio shown in table 1.

A comparison of weekly sales shows that sales of Medium potatoes exceeded those of Large when the price of Medium was higher and also when prices were the same. When the price of Large was 5 to 7 per cent less, sales ran both above and below those of Medium. At 1947-48 prices this price decrease would represent from ¼ to ½ cent a pound less for Large than for Medium.

There seemed to be little relation between price and consumers' acceptance of Small or Large potatoes. When prices were the same, Small outsold Large half of the time. When Small was priced 10 or 11 per cent less, sales were greater than those of Large for two weeks and less for three. But when the price decreased as much as 16 to 29 per cent, fewer Small potatoes were sold every week. On the other hand, in some cases sales of Small increased as the price increased.

Consumer Preference for Size

INFORMATION about the potato-buying habits of customers in Chicago was obtained by interviewing purchasers in retail stores. During the last three weeks of the experiment (starting on February 28), a home economist interviewed potato buyers in the stores of Chain C that were used in the experiment. The survey was then continued for five weeks in chain and independent stores in several parts of Chicago. The sales record reported in the preceding section reveals a discrepancy in the percentage of potatoes of each size actually sold and the preferences of customers for sizes as reported by a consumer survey.

No attempt was made to obtain a representative sample of customers. In many cases the number of respondents was so small that the differences indicated may be due to chance.

The following interpretations should be considered the same as results from a pretest. The potatoes in Chain C were those which had been sized as part of the price-quality relationship study. It was, therefore, possible to "observe" the size of the potatoes purchased by customers. In the nonexperimental chain and independent stores sized potatoes were not being sold so these data are based on the customers' concept of the size purchased.

Size Purchased

In Chain C 60 per cent of the customers who were observed buying potatoes purchased Medium, and 19, 14, and 7 per cent bought Assorted, Small, and Large potatoes, respectively (table 5). The retail store sales records for this period indicated that 46 per cent of the potatoes sold were Medium, 32 per cent Assorted, 13 per cent Small, and 9 per cent Large. Although the percentage distribution varied, the order in which the sizes sold was the same.

In the nonexperimental stores 60 per cent of the customers interviewed stated that they purchased Medium, and 15, 13, and 12 per cent bought Small, Assorted, and Large, respectively.

Size Usually Bought

Although the percentage of the different sizes of potatoes that customers reported they usually purchased was

Table 5. Customers Purchasing Specified Sizes of Potatoes in Different Situations

Size	Experimental stores			Nonexperimental stores		Household consumer survey†
	Observed purchase	Usual purchase	Sizes sold*	Stated purchase	Usual purchase	Usual purchase
	per cent					
Small	14	14	13	15	22	13
Medium	60	69	46	60	59	71
Large	7	10	9	12	15	5
Assorted	19	7	32	13	4	20
Total	100	100	100	100	100	100‡
No. customers interviewed	257	166		411	117	255

* Data from retail store price—quality relationship experiment.
†*Potato Preference among Household Consumers*, Misc. Pub. No. 667, U. S. Department of Agriculture, August 1948.
‡ One per cent not ascertained.

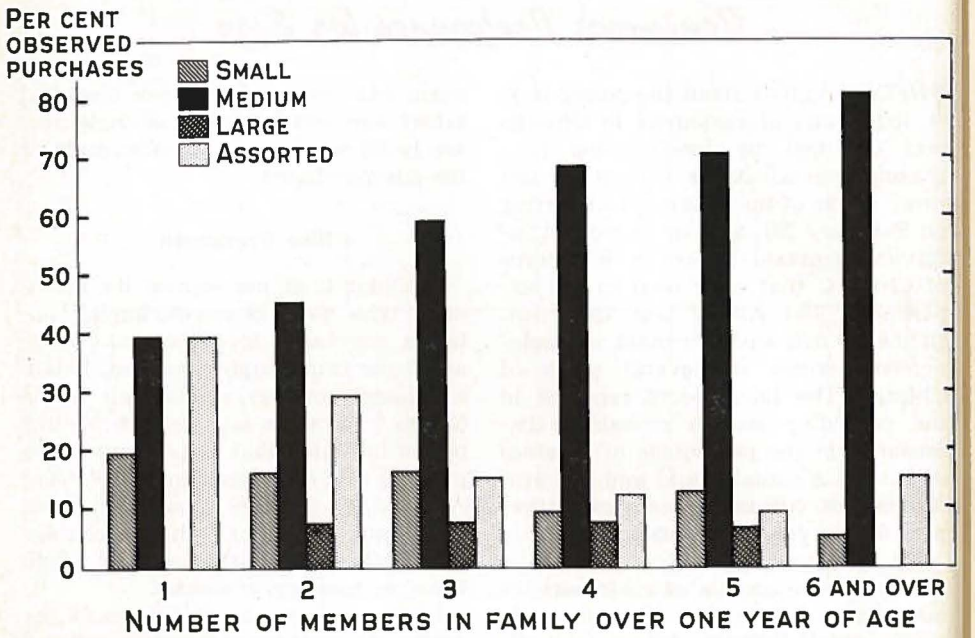


FIG. 10. Percentage of observed purchases of sized potatoes in experimental stores in Chain C according to number of members in family over one year of age.

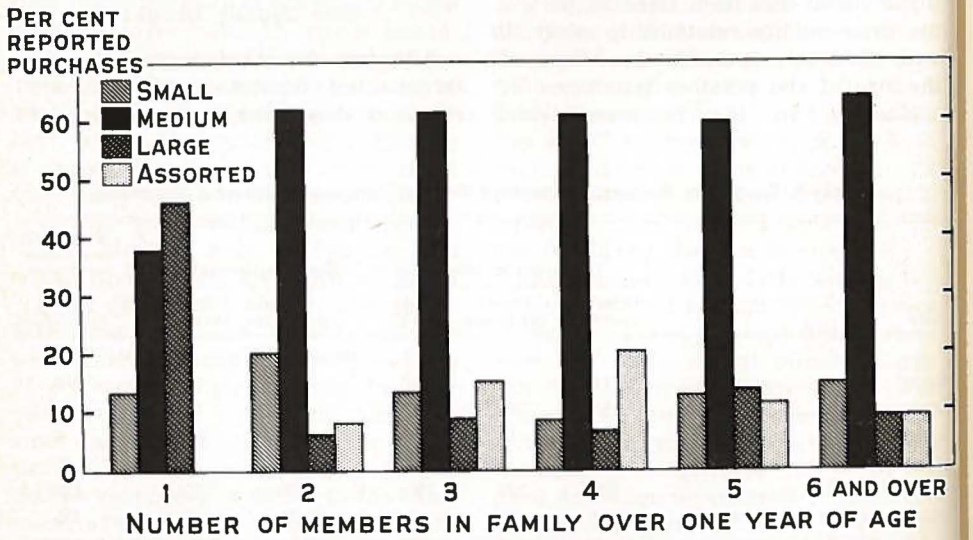


FIG. 11. Percentage of customers in chain and independent nonexperimental stores in Chicago reporting sizes of potatoes usually purchased according to number of members in family over one year of age.

not identical for all stores, the order of preference was the same. Medium size potatoes were usually bought in the largest quantity, Small were second, followed by Large and then Assorted.

Results of a survey made of a selected sample of household consumers in January 1948[7] show that the largest proportion of Chicago consumers usually bought Medium size potatoes with Assorted, Large, and Small potatoes following in that order. The Medium size was consistently first in all data. The different time of the year in which the surveys were made and the differences between sampling customers in stores and consumers in the household may have partly accounted for the difference between these data.

Effect of Family Size

The effect of number in family on the size of potato selected as shown by observed purchases and by stated preferences is not in complete agreement. Based on observed purchases of potatoes in Chain C stores, as family size increased, the percentage of customers purchasing Medium potatoes also increased (figure 10). Twice as many bought Medium when there were six or more members than when there was only one person in the family. As family size increased, the percentage purchasing Large remained the same; those purchasing Small decreased gradually; and those purchasing Assorted potatoes dropped decidedly.

Responses by customers in the nonexperimental stores indicated that family size had little effect on size of potatoes usually purchased (figure 11). Medium was indicated in about the same proportion regardless of family size. There was a slight but not a significant fluctuation by family size in the percentage of customers who said they usually purchased Small potatoes.

[7] USDA, *op. cit.*

Effect of Income

Chain C experimental stores were located in medium and high income areas.[8] In these stores nearly 27 per cent more customers purchased Medium size potatoes in the medium income areas than in the high (figure 12). Sales of each of the other three sizes were greater in the high than in the medium income areas.

The difference in size of potato purchased in the different income areas was not so pronounced in the nonexperimental chain and independent stores as in Chain C stores. These results may be partly due to the fact that potatoes were sized in Chain C and the interviewer observed the size purchased, while in the nonexperimental stores the customer reported her own concept of the size purchased.

In these latter stores the number of customers reporting that they bought Medium decreased slightly from low to medium income areas and then increased slightly in high income areas. No Assorted potatoes were reported purchased in low income areas and fewer were bought in the high than in the medium income areas. Purchase of Small increased from low to high income areas and sales of the Large size decreased.

Customers' Reasons

Portion control and ease of preparation were the most frequent reasons given for purchasing a particular size potato. Of 427 customers interviewed in the nonexperimental chain and independent stores 33 per cent purchased a specified size because of better portion control, 30 per cent because of greater ease in preparation, and 11 per cent for specific uses (table 6).

Income seemed to have little effect on the reasons given for selecting potatoes

[8] Income areas based upon 1940 Census.

Table 9. Customers Reporting Specific Uses According to Size of Potatoes Purchased by Type of Store

Intended use	Large	Medium	Small	Assorted	Total
			per cent		
Bake	28	14	15	12	15
Boil—peeled	24	28	16	25	25
Boil—jackets	7	18	47	20	23
Fry	24	9	5	9	9
Salad	5	8	3	9	7
All other	12	23	14	25	21
Total	100	100	100	100	100
Number interviewed	42	197	74	67	380

Customers intended to use Small potatoes most often for boiling with jackets, Medium for boiling peeled, and Large for baking. About one fourth of the customers reported that they purchased Large potatoes for boiling peeled, and another fourth intended to fry them.

Customer Observations

In Chain C 63 per cent of the customers interviewed noticed that sized potatoes were being sold, and 52 per cent had noticed the difference in price according to size. Buyers for large families had noted the variation in prices in relation to size more often than those for small families.

Fifty-four per cent of the customers interviewed objected to the poor quality of the Triumph potatoes, 16 per cent thought the price was too high, 15 per cent would have liked them sized better, 9 per cent criticized the displays, and 6 per cent made miscellaneous comments.

In the nonexperimental stores, although 90 per cent of the customers made their selection from bulk displays, only 75 per cent reported that they preferred bulk to prepackaged potatoes.

Grade Condition, Damage, and Injury from Shipping Point into Retail Store

ALTHOUGH EACH car of potatoes fulfilled U. S. No. 1 grade requirements in all respects, the percentage of defects in certain Nebraska cars slightly exceeded the tolerance in some size groups. As the potatoes moved through the trade channels, the percentage of damage and injury increased, chiefly because of an increase in cracks and bruises (table 10).

In most sizes in all cars the inspectors found that the damage increased slightly between the shipping point and the Chicago warehouse (figure 13). The greatest increase occurred between the warehouse and retail store (figure 14).

Although there was only a slight difference in percentage of damage among tubers of various sizes between the time they were shipped and the time they reached the warehouse, a third inspection in the retail store showed that damage had increased until in all lots it exceeded the 6 per cent tolerance for U. S. No. 1 grade (figure 15). This spection measured the damage betw the warehouse and the retail bin an that caused by handling by customers.

Table 10. Potatoes Damaged or Injured by Bruises and Cracks and Total Defects Determined by Inspections at Shipping Points, Warehouses, and Retail Stores in Chicago

Grade defect	Point of inspection	Size classes: Small	Medium	Large	Assorted
		per cent			
Western Nebraska—Damage					
Bruises and cracks	Shipping*	2.8	2.8	3.0	2.5
	Warehouse	3.7	3.7	3.7	3.8
	Store†	7.1	8.8	13.0	9.0
All defects	Shipping*	6.5	5.6	6.1	5.6
	Warehouse	6.8	6.3	5.9	6.2
	Store†	9.9	10.9	14.4	10.9
Western Nebraska—Injury					
Bruises and cracks	Shipping*	6.7	7.6	9.9	8.2
	Warehouse	20.0	27.1	32.2	24.5
All injury	Shipping*	15.0	16.2	19.9	17.1
	Warehouse	33.1	43.3	46.8	36.9
Red River Valley—Damage					
Bruises and cracks	Warehouse	3.9	4.5	2.4	3.6
	Store†	4.0	6.9	8.7	6.4
All defects	Shipping*	3.6	4.4	5.0	4.4
	Warehouse	4.8	6.5	3.7	5.2
	Store	5.8	7.2	10.0	7.0
Red River Valley—Injury					
Bruises and cracks	Warehouse	29.5	39.0	48.1	37.1
All defects	Shipping*	1.5	2.8	4.3	3.2
	Warehouse	39.0	52.8	56.9	43.9

* Inspected in car.
† From four to 21 inspections were made on potatoes from each car while they were on display. The inspections were made at different times during the day and on different days of the week.

Causes of Damage and Injury[9]

The chief causes of damage were shatter bruising, cracks, and greening (figure 16). Damage from scab, wireworms, rot, and frost was minor. There was a great deal of variation in the amount of cracking and bruising between the Small and Medium and the Medium and Large lots. The greatest amount of such damage was found in the retail stores. Light greening caused more loss of grade in the Small than in the Large groups.

Most of the injury to tubers resulted from bruising and cracking, light greening, and dark sunken areas. The amount of injury increased greatly from shipping point to warehouse.

The percentage of damage due to shatter bruising nearly doubled between the shipping point and the Chicago warehouse (figure 17). Probably most of it occurred in moving the potatoes from the car to the warehouse. With all inspections damage to Nebraska potatoes was slightly greater.

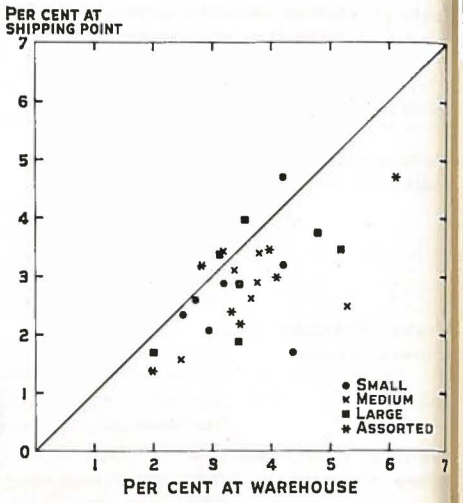
Large tubers showed more shattering as well as more bruising between warehouse and retail store than other sizes in the Nebraska lots. Except for the Large size the inspections revealed less shatter bruising in the retail stores than

[9] *Damage* means any injury or defect which materially injures the edible or shipping quality, appearance of individual potatoes or general appearance of potatoes in the container or which cannot be removed without loss or more than 5 per cent of total weight of the potato including peel covering defective area.

Injury means any defect which more than slightly affects the edible or shipping quality the appearance of the individual potatoes the general appearance of the potatoes in container or which cannot be removed hout a loss of more than 2 per cent of the tal weight of the potato including peel covering defective area. U. S. Standards for Potatoes, Production and Marketing Administration (effective June 1, 1949).

FIG. 13. Percentage of potatoes of each size in seven Nebraska cars that were damaged by bruises and cracks at shipping point and in Chicago warehouses.

Increase in damage is indicated by the distance of the dots from the diagonal line. The greater the damage, the greater is the distance. The decrease is shown in a similar way by dots to the left. If there had been no increase in damage all points would have fallen on the line.



in the warehouse with the Red River Valley potatoes. Fresh breaks increased only slightly in Nebraska potatoes between shipping point and retail destination. The increase in damage between shipping point and warehouse caused Large tubers in some cars to exceed the U. S. No. 1 tolerance.

Air cracks[10] were not a significant cause of injury at the shipping point, but by the time the tubers reached the Chicago warehouse this cause was responsible for one fourth to one half of the total injury. It occurred to about the same extent in all sizes (figure 18). Air cracks are not considered to be a grade defect unless they seriously mar the general appearance of the potatoes. In many lots, however, air cracks and mild shatter bruises were so prevalent as to detract from the displays, and they probably impaired sales. Although injury from air cracks was not reported in store inspections, observation showed that cracking increased in potatoes on display, especially when they had been moved during very cold weather.

[10] Air cracks are considered here as the shallow cracks in the skin that occur when potatoes are held for a period of time in a dry room and that are especially common when tubers are subjected to a sudden change in temperature and humidity as when cold potatoes are brought into a warm dry room. They are generally semi-circular or half moon shape and are sometimes called "thumb nail cracks."

Shrinkage and Discount

Shrinkage averaged 3 per cent in the Nebraska tubers and about 1.9 per cent

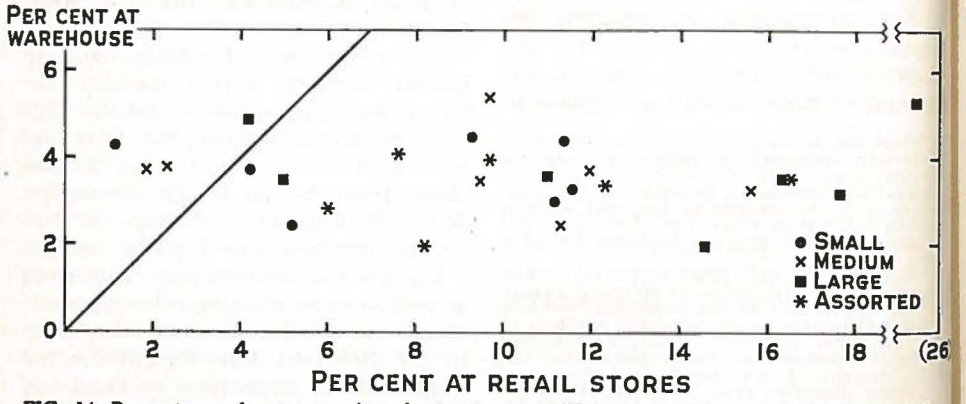


FIG. 14. Percentage of potatoes of each size in seven Nebraska cars that were damaged by bruises and cracks as found in Chicago warehouses and retail stores.

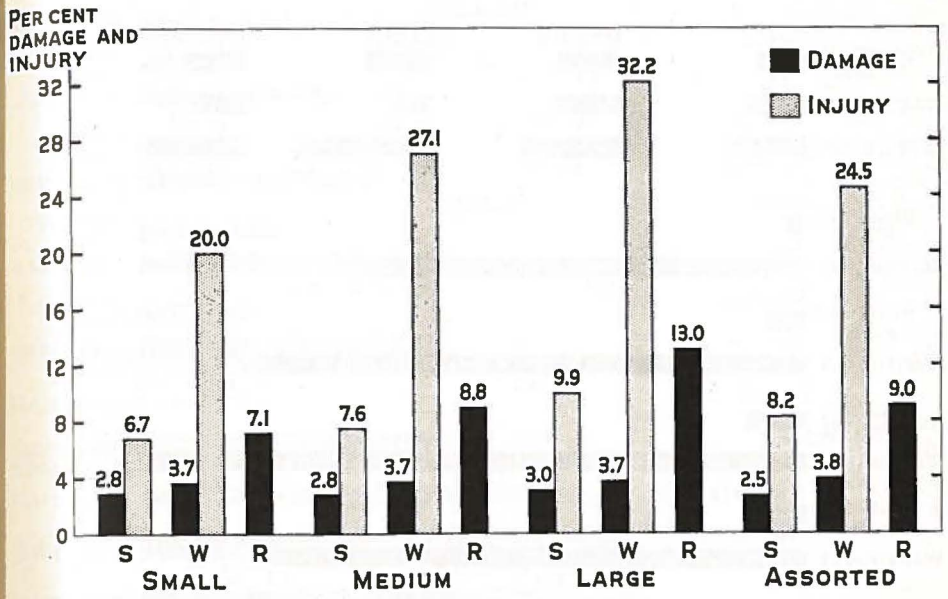


FIG. 15. Percentage of potatoes of each size in seven Nebraska cars that were damaged or injured by bruises and cracks as found at shipping point (s), in Chicago warehouse (w), and in retail stores (r). The amount of injury in retail stores was not recorded.

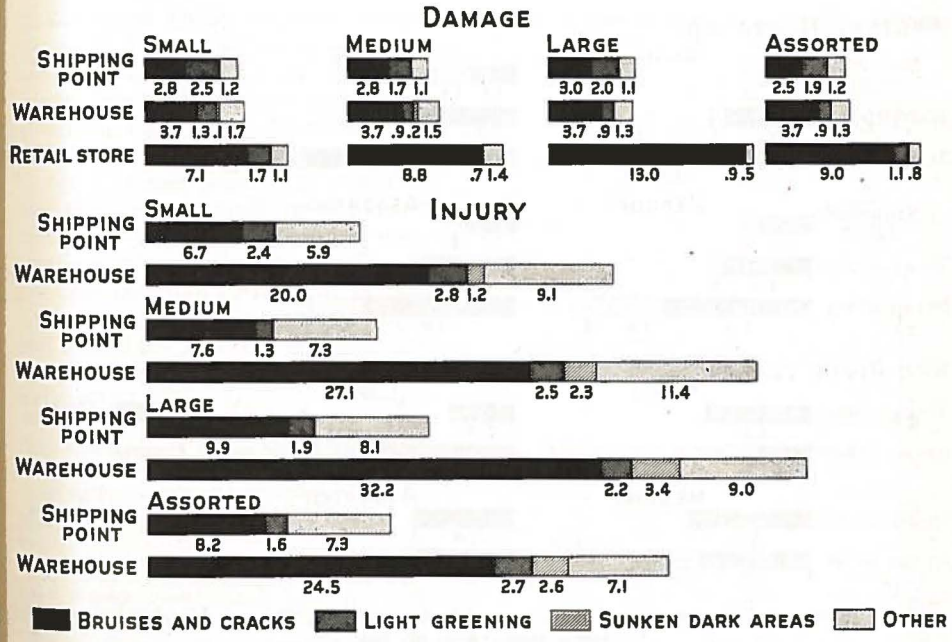


FIG. 16. Cause and percentage of damage and injury to potatoes at shipping point, in Chicago warehouses, and in retail stores with seven Nebraska cars.

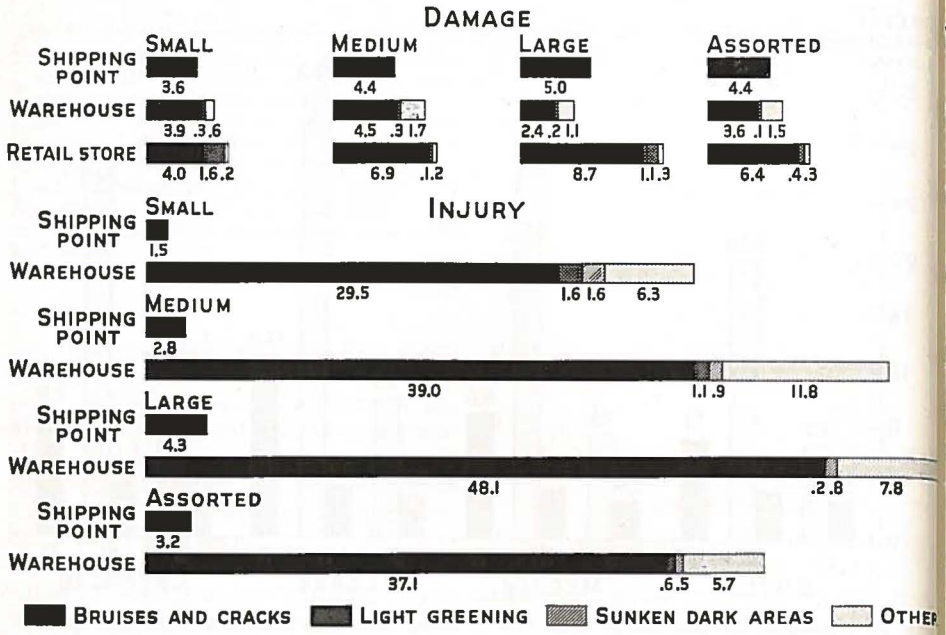


FIG. 17. Cause and percentage of damage and injury to potatoes at shipping point, in Chicago warehouses, and in retail stores with four Red River Valley cars.

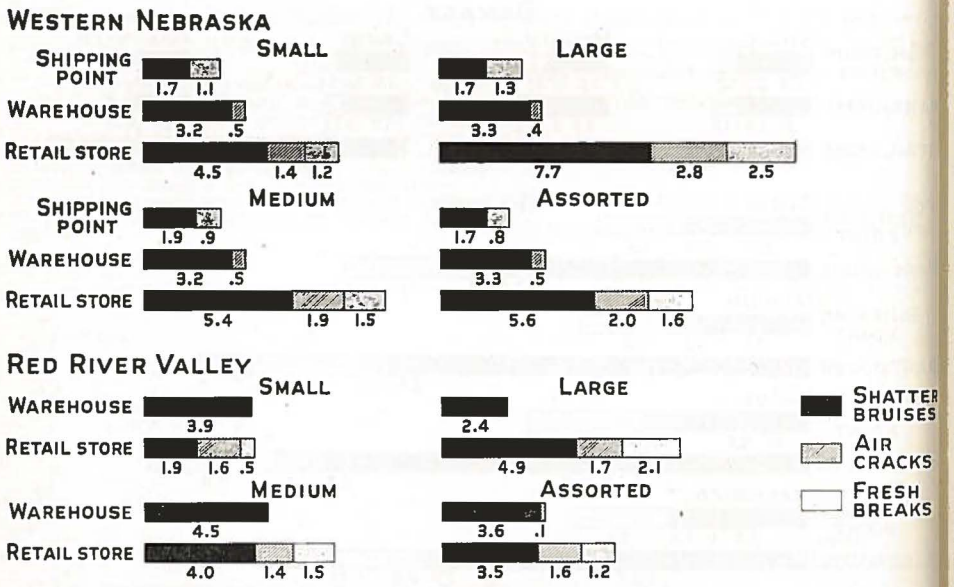


FIG. 18. Cause and percentage of damage at shipping point, in Chicago warehouses, and in retail stores with all lots.

Shatter bruising decreased between the warehouse and retail stores chiefly because damaged potatoes were removed from the lots when tubers were put on display.

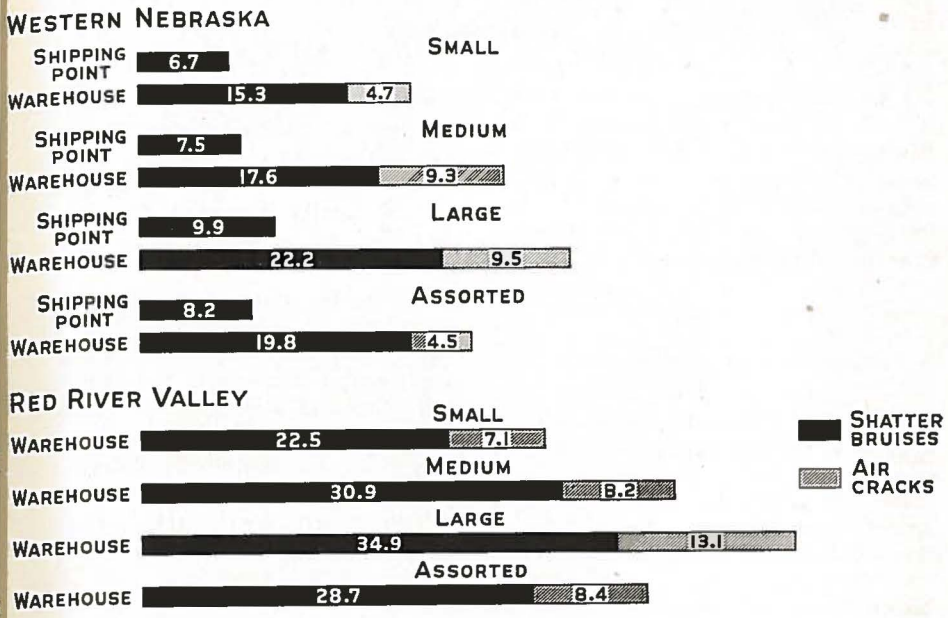


FIG. 19. Cause and percentage of injury at shipping point and in Chicago warehouses with all lots.

in Red River Valley potatoes (table 11). The percentage of shrinkage was less in the Medium than in the Small and Large tubers. The Assorted averaged about the same as the Medium.

The quantity of potatoes discounted in retail stores because of poor condition or to sell old stock by the time the new arrived amounted to 5 per cent in Chain A, 1 per cent in Chain B, and 0.4 per cent in Chain C. More of the Small potatoes had to be sold at a discount and less of the Assorted size than of the Medium and Large sizes.

Table 11. Loss* in Retail Stores in Total Weight of Each Size of Potato Sold

Size	Valley: Chain A (7 weeks)	Valley: Chain B (6 weeks)	Red River Nebraska: Chain C (6 weeks)
	per cent		
Small	2.8	3.0	2.3
Medium	2.5	2.3	1.2
Large	3.8	3.8	4.8
Assorted	2.5	3.2	1.5
All sizes	2.9	3.1	1.9

* Includes potatoes too defective to sell because of spoilage, shattering, and greening, but does not include frozen tubers.

Table 12. Reasons Given by Customers in Chain and Independent Stores for Buying Particular Size of Potato

Reason for buying	Income area: Low	Medium	High	Total
Portion control	29	33	35	33
Ease of preparation	32	31	28	30
Particular use	12	11	12	11
Other	27	25	25	26
Total	100	100	100	100
No. families reporting	78	198	151	427

Summary

1. In general when prices were varied to sell an equal volume of each size potato, the change in price was accompanied by an increase or decrease in volume of sales for each size.

2. When prices were varied to move the sizes in proportion to their production, prices of Small and Large potatoes were increased greatly in comparison with Medium without obtaining either an increase in sale of Medium or a decrease in sales of Small and Large.

3. When sized potatoes were offered, total sales of Triumph potatoes in the experimental stores were greater than before or after the experiment and higher than in the nonexperimental stores of the same chain.

4. When sized potatoes were offered, customers in one chain said their purchases varied slightly from their usual buying custom. A lower percentage bought Medium and Large sizes, and a greater number bought Assorted. In the nonexperimental stores more bought Assorted and fewer Small and Large.

5. As size of family increased, the purchases of Medium size increased, while purchases of the Large size remained rather constant.

6. In the experimental stores nearly 27 per cent more customers in the medium income areas bought Medium size potatoes than in the high income areas. In the high income group sales of other sizes were greater.

7. The principal reasons given by customers for always buying a particular size were portion control, ease of preparation, and specific use.

8. In the experimental stores 84 per cent of the customers preferred sized potatoes, 8 per cent did not, and 8 per cent had no preference. In the nonexperimental stores 80 per cent preferred sized, 3 per cent did not, and 17 per cent had no preference.

9. Three persons out of four bought potatoes in units of 5 pounds or less. The percentage of customers purchasing 10 pounds or more increased as size of family increased. The reverse was true for purchases of less than 5 pounds.

10. In one chain 44 per cent of the customers in the medium income area and 89 per cent in the high income area bought potatoes in 5-pound units. Fifty-five and 9 per cent, respectively, bought 10 pounds or more per purchase. In the chain and independent stores 44 per cent of the customers in the low income area bought less than 4 pounds per purchase. Thirty-eight per cent in the medium income and 58 per cent in the high income groups bought 5-pound units.

11. In order of importance, boiling, baking, frying, and salad were the most frequent uses.

12. Quality was criticized by 36 per cent of the customers, cuts and bruises by 17 per cent, too high prices by 16 per cent, fact potatoes were not sized by 15 per cent, bin displays by 9 per cent, and other things by 7 per cent.

13. Bulk displays were preferred to prepackaged potatoes by 74 per cent of the persons interviewed.

14. The percentage of grade defects increased as the potatoes moved through trade channels. The chief cause was increases in shatter bruises, cracks, and greening. The greatest increase occurred in Chicago between the warehouse and the retail store. In most lots inspected in the stores, "damage" exceeded U. S. No. 1 grade tolerances. "Injury," due chiefly to shatter bruises and cracks, increased greatly between shipping point and warehouse in Chicago. Both damage and injury increased as size of potatoes increased.

Cover photo courtesy of United States Department of Agriculture, Agricultural Extension Service

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Minnesota Cooperative Elevator Associations

REX W. COX