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THE EFFECT OF GRADE ON RETAIL  
SALES OF FRESH TEXAS GRAPEFRUIT

A Report to the  
Texas Valley Citrus Committee

November, 1969

From the  
Texas Agricultural Market Research and Development Center  
Department of Agricultural Economics and Sociology  
Texas A&M University

Texas Agricultural  
Extension Service

Texas Agricultural  
Experiment Station

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THE EFFECT OF GRADE ON RETAIL  
SALES OF FRESH TEXAS GRAPEFRUIT

John P. Nichols\*

I. Introduction

The Texas citrus industry represents a relatively small share of the total citrus production in the United States. It currently accounts for approximately 2.6 percent of the total U.S. orange production and 12.2 percent of U.S. grapefruit production.<sup>1</sup> In the past a major share of this production in Texas has been marketed in the fresh form.

The grade standards under which this fresh citrus has been marketed have varied in the past. In the recent past, for example, a large share of fresh oranges and grapefruit were shipped under a U.S. Combination grade. This combination grade consists of a mix of fruit meeting U.S. No. 1 grade specifications and U.S. No. 2 fruit with a specified minimum percentage of No. 1 fruit. Additional citrus was marketed under the U.S. No. 2 grade. Starting with the 1968-69 season a combination type grade was in effect only for oranges. The U.S. Combination grade for grapefruit was not permitted.

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<sup>1</sup> Connolly, G., T. L. Sporleder and J. P. Nichols, Prospective U.S. Citrus Supply and Consumption and Implications for Processing in Texas. Texas Agricultural Market Research and Development Center, Texas A&M University (Technical Report in Preparation).

In the past, under conditions of limited supply, the Texas citrus industry hypothesized that total revenue to the industry would be greater if the No. 2 fruit were mixed and sold with the No. 1 fruit in a combination pack. With rapidly increasing supply and greater competition in the markets, the industry decided in 1968 that total returns for grapefruit would be greater if the combination grade was discontinued and the best fruit were marketed as U.S. No. 1 grapefruit. It was this decision by the industry that provided the stimulus for the research project discussed in this report.

It is the purpose of this research study to examine these two alternative grade systems for marketing grapefruit. With this examination, additional information for decision making may be provided. More specifically it is the objective of this study to determine the effect on volume of grapefruit sold per customer at retail level resulting from the change in grading scheme from a U.S. Combination - U.S. No. 2 system to a U.S. No. 1 - U.S. No. 2 system.



## II. METHODOLOGY

An experiment was designed to provide information concerning the research objectives noted earlier. Data were gathered from an actual test market situation where control over variables could be exercised. The design of the experiment, methods of collecting data and analytical procedures are discussed in this section.

### Design

#### Markets

Two cities were selected for study, Dallas, Texas, and Kansas City. They were selected to provide differing market environments. The Dallas market is characterized by little competition from Florida grapefruit. The Kansas City market, however, may be typified by a great deal of strong competition from Florida grapefruit. Texas grapefruit controls the majority of the Dallas market while Florida grapefruit holds the largest share of the Kansas City market (Table 1). Factors such as income levels and distribution, population, geographic location, and availability of cooperating stores were considered in the selection of these markets.

#### Stores

The same supermarket chain cooperated in both cities. This provided some degree of uniformity concerning management practices and operational philosophy although they are maintained as separate divisions. A total of twelve stores were chosen in each market. Four of these were located in relatively low income neighborhoods, four in medium income areas and four in relatively high income sections of each city. Thus

TABLE 1.  
TEXAS GRAPEFRUIT AS A SHARE OF  
TOTAL GRAPEFRUIT UNLOADS, BY CITY,  
1965-1968.

	Dallas	Kansas City
	(percent)	
1965	53.2	6.5
1966	74.8	23.8
1967	88.6	25.5
1968	77.4	20.1
Average	74.8	19.6

Source: Fresh Fruit and Vegetable Unload Totals for  
41 Cities. U.S.D.A., Consumer Marketing  
Service. Fruit and Vegetable Division.  
Washington, D.C., 1965-68.

there was a total of 24 stores involved in the test.

#### Time Period

The experiment was conducted over an 11 week period starting in late January 1969 and ending in Mid-April. This period was selected as it coincided with the season of peak grapefruit marketing and at the same time avoided conflicts with the Christmas and New Year holiday. Of the 11 weeks, three were used as trial weeks during which time the data collection techniques could be checked and planned switch-overs in the design could be completed. The other eight weeks were divided into two periods of four weeks each which were then actually used in the experiment.

#### Grades Tested

The most important factor under consideration in this study is grade of the fruit. This is the key variable. Two grades were set up to use during the test. A No. 1 grade which conformed to the current market order standards was one grade. The alternative was a combination grade made up of 60 percent No. 1 fruit and 40 percent No. 2. These were supplied by the packers in the Rio Grande Valley to both markets. Only the U.S. Combination grade had to be specially packed for the test as the No. 1 grade was the same as that being generally shipped to all markets. Due to the differing requirements of the two markets the test was conducted with size 48 grapefruit in Kansas City and with size 36 grapefruit in Dallas.

### Price

Price was not controlled between the two cities. Within each city, however, uniform grapefruit prices were maintained across all the stores in the test. Price was allowed to vary from week to week. The price of the "test grapefruit" relative to No. 2 grapefruit was varied so that several price differentials, large and small, occurred. The "test grapefruit" was that grapefruit which was actually involved in the grade variation being tested. As noted above this was the size 48 Texas grapefruit in Kansas City and the size 36 in Dallas. The prices of other grapefruit items either Florida or Texas, and the price of competing fruits offered in the stores were not controlled.

### Organization

The twelve stores in each city were divided into two groups of six stores. Each group had a similar composition of stores in low, medium and higher income areas. During the entire test all stores offered their normal line of fresh fruit except for the "test grapefruit" item. The grade of "test grapefruit" offered was varied according to the following design.

#### Time Period

		Period 1	Period 2
Store Group	A	Combination Grade	No. 1 Grade
	B	No. 1 Grade	Combination Grade

The time periods were of four weeks duration and the relative price of the "test grapefruit" was varied from week to week within each period. The same design was employed in each city.

#### Data Collection

Information for the analysis was collected in several ways and from several sources. Audits were taken in each store on Monday or Tuesday of each week. At this time an inventory of all fresh grapefruit, apple, orange and banana products was taken. Deliveries of these products during the preceding week were also recorded. From this information sales for each product for each week of the test were calculated.

On Thursdays and Fridays of each week visits were also made to each store. At this time the price and shelf allocation for each fresh grapefruit product was recorded. The food advertisements were checked on a weekly basis and the amount of advertising for fresh grapefruit was recorded for both the test stores and for competing stores. Transactions per store per week (customer count) were obtained from management records.

#### Analysis Procedure

Collection of data by the above procedure provided weekly observations, for each store, on sales of all fresh grapefruit products, and several competing fresh fruit items, price, shelf space, advertising and transactions count. There were 12 stores in each city and a total of 8 weeks in the test, thus 96 observations in each city were available for each of the factors mentioned above (sales, price, advertising, etc.).

The models used to examine the data were of the analysis of

covariance type. The sales volume of grapefruit was examined as the dependent variable with the independent variables including both continuous and discrete types. Price, display space and explanatory variables of this type were included in their usual continuous form. Qualitative variables such as grade and income level of the shopping area, were included as discrete (dummy) variables. Thus the variations which occurred in the volume of grapefruit sold were "explained" by a series of variables included in the equation.

### III. RESULTS

The data are first examined by looking at the average sales per customer of fresh grapefruit products in each market (Table 2). Total grapefruit sales per customer are higher in the Dallas test stores than in Kansas City. This is the result of two factors. First the average absolute pounds sold in Dallas is greater and secondly the average number of transactions per week is a little smaller in Dallas. The effect of both factors is evident in the larger average sales per customer in the Dallas stores.

The most important difference between the markets is apparent when the relative sales per customer of Texas and Florida grapefruit is examined. Sales per customer of Texas grapefruit in Dallas averaged about 0.28 pounds per week while in Kansas City it averaged about 0.15 pounds per week. At the same time the average sales of Florida grapefruit per customer was about 0.004 pounds per week in Dallas and 0.10 in Kansas City. The average per customer sales of Florida grapefruit in Dallas is only about four percent of that in Kansas City.

In total then Florida grapefruit made up about 1.5 percent of all grapefruit sales in the Dallas test stores while it represented 40 percent of total grapefruit sales in the Kansas City stores (Table 3). The Dallas test stores represented a market situation where very little competition existed between Texas and Florida grapefruit. These observations support the information on carlot unloads presented earlier (Table 1).

TABLE 2.  
 GRAPEFRUIT SALES PER CUSTOMER BY PRODUCT  
 AND MARKET, JANUARY 25 - APRIL 15, 1969

Product	Dallas	Kansas City	Average
Total grapefruit avg. sales/cust./wk. (lbs)	0.2830	0.2452	0.2641
Texas grapefruit avg. sales/cust./wk. (lbs)	0.2790	0.1478	0.2134
Florida grapefruit avg. sales/cust./wk. (lbs)	0.0040	0.0974	0.0507
"Test grapefruit" avg. sales/cust./wk. (lbs)	0.0629	0.0414	0.0522
U.S. No. 2 grapefruit (20# bag) avg. sales/cust./wk. (lbs)	0.1621	0.1056	0.1338



TABLE 3.

GRAPEFRUIT SALES BY CITY AND ORIGIN,  
24 SUPERMARKETS, JANUARY 25, 1969 - APRIL 15, 1969

	Dallas	Kansas City
	--Percent--	
Texas Grapefruit	98.5	60
Florida Grapefruit	1.5	40

The average sales of "test grapefruit" were 0.06 pounds per customer per week in Dallas and 0.04 pounds in Kansas City. The "test grapefruit" comprised 22 percent of the grapefruit market in Dallas and 17 percent of the total grapefruit market in Kansas City (Table 4). Average sales per customer of the No. 2 grapefruit was approximately 0.16 pounds per week in Dallas and Kansas City. The 20 pound bag represented the largest share of the grapefruit market in both cities. This latter item was usually No. 2 grapefruit although on occasion the quality was higher because of temporary shortages of No. 2 grapefruit when the orders were filled at the shipping point. The No. 2 grapefruit was not sold in any form other than the 20 pound bag in either market. The 20 pound bag represented over 55 percent of the grapefruit sold in the Dallas test supermarkets and about 42 percent of the grapefruit sold in Kansas City.

TABLE 4.  
 "TEST GRAPEFRUIT" AS A SHARE OF TOTAL  
 GRAPEFRUIT MARKET, BY CITIES

	Percent
Dallas	22
Kansas City	17

Effect of Grade

Several equations were estimated to examine the effect of grade on the retail sales of Texas grapefruit. Because of the differing characteristics of the two markets separate analyses were made for each city. The important factors in this decision were the differing amount of competition from Florida and the different sizes of "test grapefruit" used in the two markets.

Examination of the sales of "test grapefruit" to determine the effect of grade requires that many additional factors (variables) be taken into consideration. These include price, advertising, shelf space, income level of the shopping area, competing fruit, and size of store as indicated by number of transactions or customers per week. Many combinations of these variables were tested in order to obtain the best possible group of factors to "explain" the sales of "test grapefruit." Only the final models chosen are shown in this report but it should be recognized that they represent the end product of a long and thorough searching process.

Analysis for the Dallas Market

The final equation for the Dallas market is presented in Table 5. Pounds of "test grapefruit" sold per customer is examined in relation to the following variables:

1. Price of "test grapefruit" measured in cents per pound.
2. Shelf space allocated to "test grapefruit" measured in square feet.
3. Grade of the "test grapefruit"; this is the variable of central importance in the analysis. There are two alternatives, No. 1 grade and combination grade; represented by a "dummy" variable.
4. Income level of the shopping area; represented by a set of dummy variables.
5. Volume sold of Florida grapefruit measured in pounds per customer.
6. Volume sold of fresh apples measured in pounds per customer.
7. Volume sold of oranges measured in pounds per customer.
8. Volume sold of bananas measured in pounds per customer.

All of these variables are included in order to "account for" their effect on sales of test grapefruit. For this analysis it is the grade variable which is the most important. The values in the coefficient column of Table 5 reveal the relationships between the variables and sales of "test grapefruit". These coefficients have been tested for statistical significance with the results indicated by the asterisks attached to them. Most variables were tested by using a standard "t" test. Due to the fact that the grade and income variables are specially constructed "dummy" variables, an "F" test was employed in examining their statistical significance.

This analysis for Dallas indicates several significant variables.

TABLE 5.  
ANALYSIS OF VOLUME SOLD PER CUSTOMER  
OF "TEST GRAPEFRUIT" IN DALLAS:  
FINAL ANALYSIS OF COVARIANCE MODEL

Variable	Mean	Coefficient
"Test Grapefruit" (lbs./customer/wk.)	0.0629	0.1009
Price (cents/lb.)	11.556	-0.0068***
Shelf Space (ft. <sup>2</sup> )	8.755	0.00074
Grade	0.552	0.00023
Income (High)	0.333	0.0176
Income (Low)	0.333	-0.0295
Sales of Florida Grapefruit (lbs./customer/wk.)	0.00401	-1.492 ***
Sales of Apples (lbs./customer /wk.)	0.1495	0.3087***
Sales of Oranges (lbs./cust./wk.)	0.1938	0.0981**
Sales of Bananas (lbs./customer/wk.)	0.3252	-0.0654

$$R^2 = .55$$

\*\* Significant at 95% level.

\*\*\* Significant at 99% level

The price of "test grapefruit" is significantly associated with its sales. The sign of the coefficient is negative which indicates that as the price per pound is increased, sales of "test grapefruit" decrease, if everything else is held constant. The price elasticity, which is a measure of the relationship between price and quantity sold, is -1.25 for "test grapefruit". This means that a change in price of 1 percent is associated with a change in volume sold of 1.25 percent in the opposite direction.

Income level of the shopping area also shows a significant relationship with high income areas having a positive association with sales and the low income areas having a negative relationship.

Florida grapefruit, although a small factor in the Dallas stores, is apparently negatively related to the sales of the "test grapefruit". Apple sales per customer and orange sales per customer are also significantly associated but in a positive manner. As the sales per customer of either of these items increased the sales per customer of "test grapefruit" also increased. Volume of bananas sold per customer was not significantly associated with sales per customer of "test grapefruit".

The variable for display space in the Dallas equation was not significant. More important, however, the variable for grade shows no significant relationship with sales of "test grapefruit". The volume of "test grapefruit" sold per customer is not dependent on the grade in this analysis for Dallas. The variables included in this analysis "explain" about 55 percent of the total variation in "test grapefruit" sales per customer.

Analysis for the Kansas City Market

The analysis of "test grapefruit" sales in Kansas City includes the same variables as described earlier for the Dallas analysis (p.13 ). The coefficients for this analysis are shown in Table 6 and have been examined statistically as discussed earlier.

Price and display space are both highly significant factors. The sign of the price coefficient again indicates that as the price increases sales of "test grapefruit" per customer decreases. The price elasticity computed from this equation for "test grapefruit" in the Kansas City market is -1.27. Thus a one percent change in price is associated with a 1.27 percent change, in the opposite direction, in quantity sold. Also indicated is the fact that as the size of display space increases sales per customer increases.

Income level of the shopping area is again a significant factor in explaining the sales of the "test grapefruit" per customer. With regard to the sales of other fresh fruit products, only Florida grapefruit has a significant relationship with the sales of "test grapefruit". The other fresh fruits included show no significant association with "test grapefruit" sales.

Examining the grade variable, it is apparent that there is a highly significant relationship between the sales of "test grapefruit" and grade. The magnitude of the coefficient indicates that the volume sold per customer of "test grapefruit" was 0.01178 pounds greater with the U.S. No. 1 grade than with the U.S. Combination grade. This represents an increase of about 28.5 percent when compared with the average

TABLE 6.  
ANALYSIS OF VOLUME SOLD PER CUSTOMER OF  
"TEST GRAPEFRUIT" IN KANSAS CITY MARKET;  
FINAL ANALYSIS OF COVARIANCE MODEL.

Variable	Mean	Coefficient
"Test Grapefruit" (lbs./cust./wk.)	0.0414	.0746
Price (cents/lb.)	9.032	-0.00584***
Shelf Space (ft. <sup>2</sup> )	7.135	0.00208***
Grade	0.500	0.01178***
Income (High)	0.333	0.01939
Income (Low)	0.333	0.00104***
Sales of Florida Grapefruit (lbs./cust./wk.)	0.0974	-0.1009 **
Sales of Apples (lbs./cust./wk.)	0.1469	-0.0443
Sales of Oranges (lbs./cust./wk.)	0.1710	0.0424
Sales of Bananas (lbs./cust./wk.)	0.1001	0.0059

$$R^2 = .37$$

\*\* Significant at the 95% level.

\*\*\* Significant at the 99% level.

sales per customer of 0.0414 pounds.

With this equation the  $R^2$  is lower than the Dallas equation. The variables included "explain" 39 percent of the variation in sales of "test grapefruit" per customer. In light of this lower  $R^2$  an alternative method of analysis was examined to see if this variation in sales could be more fully understood.

The variable examined in this alternative approach reflects the sales of Florida grapefruit. It was felt that the most relevant consideration was the effect of the grade of Texas grapefruit on its sales relative to the volume sold of Florida grapefruit. Thus a ratio of these two variables was constructed and used as the dependent variable in the analysis. The results of this alternative analysis indicates that the grade of Texas grapefruit is strongly associated with the ratio of "test grapefruit" to Florida grapefruit. With the U.S. No. 1 grapefruit the ratio increased thus indicating that either more "test grapefruit" was sold, or less Florida grapefruit was sold, or both. Over 70 percent of the variation in this ratio was "explained" by the same variables included in the earlier analysis. The coefficient for the grade variable was highly significant when tested statistically.

It is evident from both of the analyses of the Kansas City data that grade was associated with a change in sales of the "test grapefruit". The No. 1 grade fruit showed increased sales per customer relative to the U.S. Combination grade. This relationship was not evident in Dallas.

Since grade did effect the sales of "test grapefruit" in Kansas City, it is appropriate here to examine what happened to the volume sold of No. 2 grapefruit relative to the grade of "test grapefruit". An analysis similar to those described above was conducted on the



sales of the 20 pound bag which represented essentially all of the U.S. No. 2 fruit sold in the market. This analysis showed no significant relationship between the grade of "test grapefruit" and the volume of U.S. No. 2 grapefruit sold per customer.

A further analysis was carried out to examine the volume of all Texas grapefruit sold per customer. This analysis indicated a relationship between the grade of "test grapefruit" and the volume sold per customer of all Texas grapefruit. This was significant at the 10 percent level whereas the grade variable was significant at the 1 percent level in the two analyses of "test grapefruit". The coefficient for grade in this analysis indicated that volume of all Texas grapefruit sold per customer increased by about 14 percent when the "test grapefruit" sold was U.S. No. 1 grade.

#### Discussion of Results

It was noted above that one of the basic differences between the grapefruit markets in the two cities is the share of market held by Florida grapefruit. It is evident from both the unload data and actual in-store observations during the test period, that Florida grapefruit is a much stronger factor in the Kansas City market than in Dallas.

The results of the analysis indicate that grade of grapefruit has an effect on sales per customer in the Kansas City market but not in Dallas. This result may be explained by the difference in the market noted above. In that market where competition from Florida grapefruit was the strongest, the effect of grade of Texas grapefruit was evident. The U.S. No. 1 Texas grapefruit indicated a significantly higher level of per customer sales than the U.S. Combination grade in that market

where competition from Florida grapefruit was the greatest. In the Dallas market where competition from Florida is much less important, the effect of grade was not significant.

This relationship is of importance to the industry as it attempts to build a quality image. This is especially true where attempts are being made to regain markets lost previously due to short supplies or where entirely new markets are being penetrated. In these cases where strong competition from other producing areas exists the importance of quality becomes increasingly apparent.

#### IV. CONCLUSIONS

Several specific conclusions may be drawn directly from this analysis concerning the effect of grapefruit grade on the volume of grapefruit sold per customer at the retail level.

1. The sales per customer of U.S. No. 1 grade grapefruit were, on the average, 28 percent greater than sales per customer of U.S. Combination grade in the Kansas City market.
2. There was no significant difference in the volume of U.S. No. 2 grapefruit sold in the market associated with this change in grade.
3. There was an increase in total Texas grapefruit sold per customer in the Kansas City market associated with this change in the grade system.
4. There was no significant effect of the grade change on sales of Texas grapefruit per customer in the Dallas market.
5. This significant effect of grade of grapefruit is evident in a market where there is competition from other grapefruit which has a relatively well established quality reputation.

These conclusions have some important implications to the Texas citrus industry. This industry has in the recent past been recovering from short supply years in the early 1960's. It is presently moving toward a situation where new markets will have to be carved out in areas that in recent years have not been users of Texas citrus. Strong preferences, and supplier arrangements meanwhile have developed for grapefruit from other areas. The competition from the present suppliers of

these markets is, and will continue to be strong.

It is evident from these research findings that in such markets the value of a high quality grade is most apparent. A strong quality reputation is a necessary foundation for, and an integral part of any well organized marketing program designed to regain lost markets or develop new ones.