

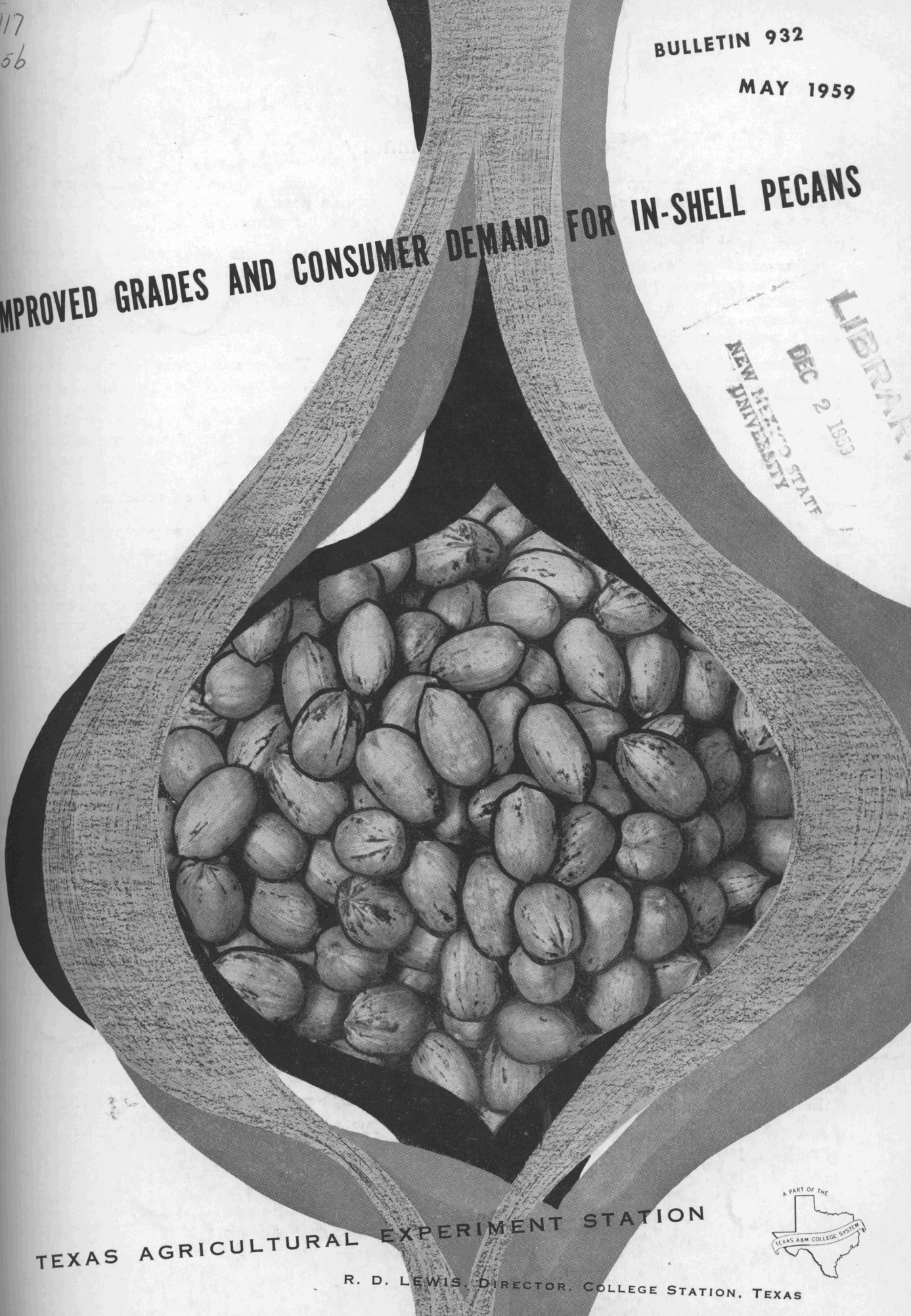
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BULLETIN 932

MAY 1959

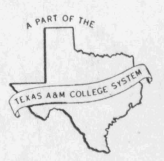
IMPROVED GRADES AND CONSUMER DEMAND FOR IN-SHELL PECANS

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R. D. LEWIS, DIRECTOR, COLLEGE STATION, TEXAS



Summary

Texas grown pecans obtained from growers during the three seasons of 1955-57 were found to be consistently larger than those found in retail stores in Texas during the same period.

Success, Desirable, Schley, Burkett and several miscellaneous varieties grown extensively in Texas are much superior in kernel percentage, external appearance and kernel quality to the in-shell pecans usually found in retail food stores.

External defects were common among Texas grown pecans but those defects were much more prevalent among the pecans sold in retail stores.

The most serious kernel defects encountered in both store and grower samples were sour kernel, spongy kernel, kernel spot, fuzziness and a varying degree of shriveling and hollowness, in the order named.

About half of the pecans sold in Texas retail stores were U. S. No. 1 grade; about one-sixth were U. S. Commercial and almost one-third were below grade.

Two-thirds of the grower samples were U. S. No. 1 grade; one-ninth were U. S. Commercial and slightly less than one-fourth were below grade.

Substantial quantities of above grade grower sample pecans were encountered, and there is no grade that properly reflects their true quality.

A new grade index with emphasis on kernel percentage, kernel quality and kernel size is proposed.

There was very little relationship between U. S. grades and prices of in-shell pecans in the retail stores. This was also true for prices as related to the proposed grade index presented in this report.

On the basis of the proposed grade index, Success and Mahan retail store samples that were below grade according to USDA grade standards, were actually superior to the U. S. No. 1 grade store samples of Stuart and mixed varieties.

The lowest net prices per pound of pecan kernels were for small-size pecans.

This study shows that serious consideration should be given to a re-evaluation of grade standards for in-shell pecans to make available more uniform high-quality pecans for sale in retail stores.

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IMPROVED GRADES AND CONSUMER DEMAND FOR IN-SHELL PECANS

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THE AVERAGE ANNUAL U. S. PECAN CROP for the 10-year period ending with 1956 was about 148 million pounds (1). The principal producing states in order of importance are Georgia, Texas, Oklahoma, Alabama, Louisiana, Mississippi, Arkansas and Florida, with limited production in some of the bordering states. Texas crops range from 30 to 55 million pounds annually. Approximately 87 percent of the Texas production is native or seedling pecans; 13 percent is standard (improved) varieties.

Native pecans are sold mostly to shellers. Only a few are sold on an in-shell basis at retail food stores.

The principal market outlets for Texas standard variety pecans are in-shell direct sales, in lots of 10 to 100 pounds, to special customers for individual use or gifts; in-shell sales through retail food stores to consumers; and sales to pecan crackers who shell the nuts and market only the separated kernels. The first two groups are commonly designated in-shell pecans in contrast with the kernels of the latter group.

Of these merchandizing methods, pecans sold in-shell to consumers bring the greatest return to growers. However, a comparatively small percentage of the pecans produced are sold on this basis. Since 1948 the percentage of U. S. pecans marketed annually in-shell has ranged from 21 to 12 percent, with some indication of a downward trend, Table 1. During the same period standard varieties, which are on the increase, represented 48 percent of the total production. In contrast, during the 1948-53 period, 60 percent of the U. S. grown English (Persian) walnuts, which are produced in about the same quantity as pecans, were marketed as in-shell nuts (3). This indicates that pecan growers may not be making maximum use of the market that yields the greatest profit. Retail stores appear to be the most logical channel for the sale of increased quantities of in-shell pecans.

Preliminary observations of pecans sold in Texas retail stores were made to determine possible factors responsible for the small supply of nuts marketed through this channel. It was found that most stores stock in-shell pecans only in the late fall and early winter. Pecans rarely

are available from February through September. Other nuts often are offered by these stores during a greater part of the year. This is true even in areas where pecans are grown locally and where the culinary values of the nut are known and appreciated.

Casual inspection of store displays revealed that many in-shell pecans had external defects, detracting from the general appearance and attractiveness of the product. In many cases the quality of the pecans stocked appeared to be poor. The Stuart was the most common variety handled. It has acceptable but not superior eating and shelling qualities. Shelled nuts of various kinds, including pecans, conveniently packed for prompt use were available during all seasons in retail stores that handled in-shell nuts.

Research Procedure

Following these preliminary observations, investigations were conducted during 3 successive crops years, beginning in 1955, with pecans that were handled by retail stores and with those grown in important pecan areas of Texas.

Specific objectives were (a) to compare the quality of pecans grown in Texas with that of pecans sold in Texas retail stores, (b) to determine the inter-related factors of quality, marketing practices and consumer demand and acceptance that may be responsible for the comparatively limited sales of in-shell pecans and (c) to suggest standards of quality that could insure better pecans in retail channels.

TABLE 1. PECAN QUANTITIES SOLD IN THE UNITED STATES, SHELLED AND IN-SHELL MARKETS, 1948-57

Season	Quantity shelled commercially	Quantity marketed in-shell	Total sales	Quantity sold in-shell as percent of total sales
	----- 1,000 pounds -----			Percent
1948	134,500	29,653	164,153	18.1
1949	100,350	15,780	116,130	13.6
1950	93,740	21,168	114,908	18.4
1951	114,790	30,985	145,775	21.3
1952	118,420	23,456	141,876	16.5
1953	170,450	32,170	202,620	15.9
1954	74,220	12,640	86,860	14.6
1955	121,400	18,480	139,880	13.2
1956	140,800	23,360	164,160	14.2
1957	117,000	16,680	133,680	12.5

Source of data: USDA. AMS Crop Reporting Board "Tree Nuts: Production, Use and Value" (2).

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During the 3-year period, 745 random samples of pecans were purchased from approximately 200 retail stores throughout Texas for a study of quality and other factors that influence market acceptability. These stores were selected on a stratified probability sample basis to give representation to national, regional and local chain food stores as well as to independent retailers. Efforts were made to determine the place of origin of each sample. This information was not generally available, but the identity of the variety often indicated the general area in which it was grown. Interstate traffic in pecans is common, thus pecans in Texas retail stores may have been grown locally or imported from other states.

Pecan samples from the retail stores were assembled at College Station and analyzed for quality. Pending analysis they were kept under favorable storage conditions. The quality of all samples was determined for the following factors:

1. Size — determined by the number per pound.
2. Specific gravity.
3. External appearance:
 - Insect damage.
 - Oil soaked.
 - Dark color.
 - Pops.
 - Broken or split shells.
4. Kernels:
 - Percentage of total weight of nut.
 - Moisture content.
 - Oil content.
 - Color—bright, cream, amber, dark, black.
 - Plumpness—or shriveling.

- Texture—crisp or spongy.
- Surface texture—smooth, crinkled, fuzzy.
- Solidity—or hollowness.
- Taste—sour kernel, rancid.
- Other factors—insect and disease damage.

During the same period, 1,237 random samples of pecans were collected from growers and wholesale buyers for comparison with the samples from retail stores. Samples were stratified in proportion to the importance of the leading varieties and to represent the most important producing areas. The distribution of varieties collected is shown in Table 2. All samples were taken as they came from the groves, with no extra culling or other special preparation for market. The identity of the grove and general, or river, location was recorded for each sample. All samples were collected during the harvest season and assembled at College Station. They were held under proper storage conditions, and analyzed within 6 or 8 weeks for the same quality factors as the retail store samples were.

Quality Comparison of Retail Store Pecans with Growers' Pecans

For convenience, the term "store samples" will be used to designate pecans collected from retail stores, and "grower samples" to indicate those obtained directly from Texas growers. Size, kernel percentage, external defects and kernel defects are a convenient basis for comparison of the quality of the two groups of samples.

The Stuart variety (and Stuart mixtures with other varieties designated as "mixed" in Table 3 and hereafter) constituted 61 percent of the store samples, Table 3. Success, Stuart, Mahan, Schley, Burkett and Western Schley, in that or-

TABLE 2. COMPARATIVE IMPORTANCE OF DIFFERENT IMPROVED PECAN VARIETIES GROWN IN TEXAS IN SELECTED YEARS

Variety	Samples							
	1955		1956		1957		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Success	60	23	131	21	78	23	269	22
Stuart	45	17	103	16	57	17	205	16
Mahan	49	19	70	11	50	15	169	14
Schley	35	13	53	8	43	13	131	10
Burkett	11	4	58	9	27	8	96	8
Western Schley	15	6	56	9	27	8	98	8
Texas Prolific	1	²	45	7	1	²	47	4
Delmas	3	1	14	2	18	5	35	3
Desirable	1	²	22	3	9	3	32	3
San Saba Improved			27	4	3	1	30	2
Halbert			12	2			12	1
All others ¹	41	16	49	8	23	7	113	9
Total	261	100	640	100	336	100	1237	100

¹Ideal, Moneymaker, Moore, No. 3, Onliwon, Nugget, Dependable, Kline, Jersey, Longfellow, Zenith, Williamson, Selected Seedling, Van Deman, Bass Paper Shell and Teche.

²Less than 1 percent.

TABLE 3. DISTRIBUTION OF PECAN VARIETIES SOLD IN TEXAS RETAIL STORES, 1955-57

Variety	Year			Average
	1955	1956	1957	
	----- Percent -----			
Standard				
Success	8	8	23	12
Stuart	17	44	18	27
Mahan	5	2	10	6
Mixed ¹	51	27	22	34
Other	13	13	18	14
Subtotal	94	94	91	93
Native	6	6	9	7
Total	100	100	100	100
Number of samples	259	266	220	745

¹Mixtures primarily of Stuart with other improved varieties.

der, are the varieties produced in the greatest quantities in Texas, Table 2. These two groups are emphasized in making comparisons of quality between the store and grower samples.

SIZE

For pecans the common measure of size is the number required to weigh a pound. A small number per pound indicates large pecans, and, conversely, a large number indicates small pecans. Size is very important in the evaluation of pecans by purchasers.

The average nut sizes of the store samples and grower samples by production area are shown by varieties in Table 4. Average sizes vary widely among years, varieties and locations, and between the store samples and grower samples. In 1955, store samples of Stuart averaged 54 per pound and mixed, 63 per pound. Stuart pecans averaged 50 per pound from the Brazos River and 52 per pound from the Guadalupe. Success from the Guadalupe averaged 47 per pound, and Mahan from the Guadalupe and Red Rivers averaged 42 and 43, respectively. Similar differences existed for 1956 and 1957. Only wide differences are significant statistically, but the grower samples are consistently larger and that is considered to be of real and practical significance.

The size distribution of store and grower samples is shown graphically by varieties in Figures 1 through 9. The graph for the Stuart variety—3 years combined, Figure 1—shows the nuts in the upper half of the size range for the grower samples ranged from 37 to 52 per pound, whereas the upper half for the store samples ranged from 43 to 56 per pound.

The distribution of store and grower samples of Success is shown in Figure 2. Here again, the grower samples are larger. Slightly more than half of the grower samples were of a size represented by 47 or less per pound; the

TABLE 4. SIZE (NUMBER PER POUND) OF PRINCIPAL PECAN VARIETIES PRODUCED IN DIFFERENT AREAS OF TEXAS AND THOSE SOLD IN-SHELL IN TEXAS RETAIL STORES

Source of sample	Pecan varieties											
	Success		Stuart		Mahan		Burkett		Mixed		Desirable	
	No.	Std. dev.	No.	Std. dev.	No.	Std. dev.	No.	Std. dev.	No.	Std. dev.	No.	Std. dev.
	1955											
Grower samples												
From												
Colorado	51	4.9			42	3.7	51	1.6				
Guadalupe	47	5.2	52	2.9	53	1.3						
Brazos	64	1.2	50	3.2	43	.4						
Red												
Retail store samples	57	1.5	54	7.1	49	8.1	51	3.7	63	18.0		
	1956											
Grower samples												
From												
Colorado	41	4.3	49	1.0	51	6.8					45	.4
Guadalupe	47	1.2	52	1.0	68	1.3					37	.6
Brazos	59	6.1	72	4.0	61	8.8						
Little	51	9.2	60	0.8			53	3.9			53	1.2
Red	48	1.1	57	8.6	54	1.0						
San Saba			54	1.8			51	4.5				
Pecan Bayou	58	3.1	54	.6			57	3.0				
Sabine	47	.6									43	1.5
Retail store samples	53	6.1	59	9.1	56	7.8	67	1.3	67	20.0		
	1957											
Grower samples												
From												
Colorado	50	3.8	46	5.1	44	7.7	56	10.0				
Guadalupe	50	3.1	49	4.0	42	4.2					44	6.1
Brazos	48	4.9	52	3.9	49	6.0					44	1.2
Little	41	3.0	45	9.4	41	9.2	52	7.9			42	1.1
Red			53	2.6	59	9.4						
Retail store samples	52	6.7	56	9.0	48	7.3	55	6.9	57	11.0		

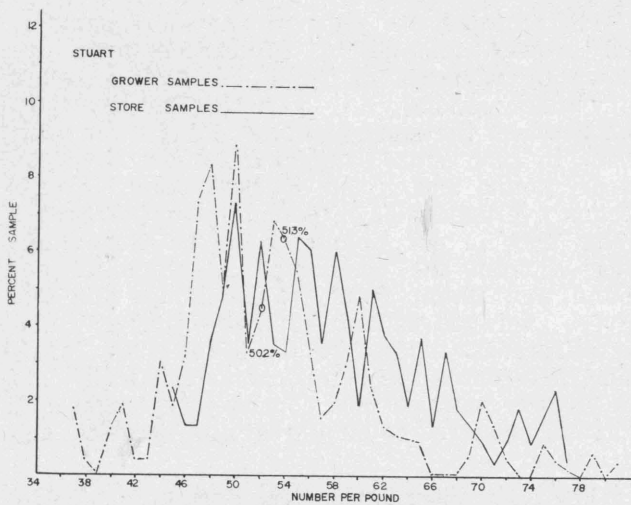


Figure 1. Size (number per pound) of store samples and grower samples of the Stuart variety, 1955-57.

most common size was 45 per pound and the largest weighed 34 per pound. The graph shows that there were fewer store samples at all the larger sized levels and more at most smaller sized levels. One-half of these weighed from 41 to 52 nuts per pound, and the two most common sizes were 50 and 54.

Fifty-one percent of the Mahan grower samples, Figure 3, ranged in size from 35 to 46 per pound, but only 38 percent of Mahan store samples were within the same range. More than half of the store samples ranged in size above 48 per pound.

The Stuart and "mixed" varieties (the latter being primarily Stuarts) constitute most of the pecans sold in retail stores, Table 3. The size data for these two were combined, Figure 4. Since Success and Desirable are similar in size

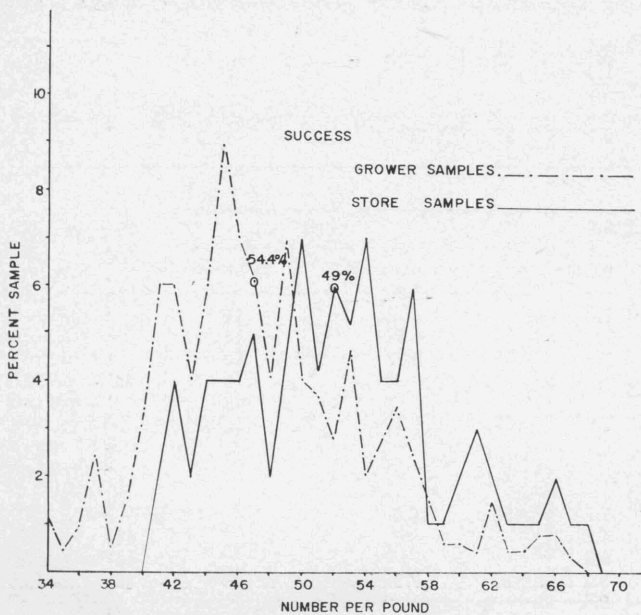


Figure 2. Size (number per pound) of store and grower samples of the Success variety, 1955-57.

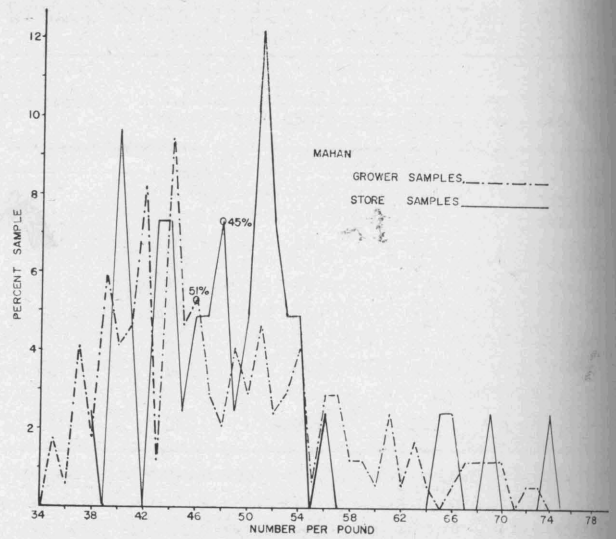


Figure 3. Size (number per pound) of store and grower samples of the Mahan variety, 1955-57.

and are grown extensively in Texas, they are combined on the same graph. The prevailing sizes of Success and Desirable are larger than Stuart and mixed pecans. The median line for Stuart and mixed pecans is at the 56 nuts per pound level, while that for Success and Desirable is at the 48 level. Half of the Success and Desirable ranges in size from 36 to 48 nuts per pound, but only 11.4 percent of Stuart and mixed are within the same range. Likewise, the size bracket up to 56, which includes 50 percent of the Stuart and mixed, includes 77.4 percent of the Success and Desirable. Fifteen percent of Success and Desirable range from 36 to 42 nuts per pound. There are no Stuart and mixed varieties in this range.

Pecan growers are fully aware of the importance of large size in the marketing of in-shell pecans. Purchasers are influenced heavily by size, the larger sizes being preferred. The data presented show that the prevailing sizes of several varieties of pecans grown in Texas are larger than those commonly sold in retail stores in Texas. This suggests that the larger sizes in Texas are marketed through channels other than retail stores.

KERNEL PERCENTAGE

Pecan nuts consist of varying proportions of shells and kernels, but only the kernels are useful to the consumer. Kernel percentage, therefore, is most important in evaluating in-shell pecans.

The ranges of kernel percentages for the store and grower samples of the Stuart variety, the most widely grown variety in the United States, are shown in Figure 5. The values for the two follow a fairly close parallel.

For Success the kernel percentages for one-half of the Texas grower samples were 50 or more, while only one-fourth of the store samples

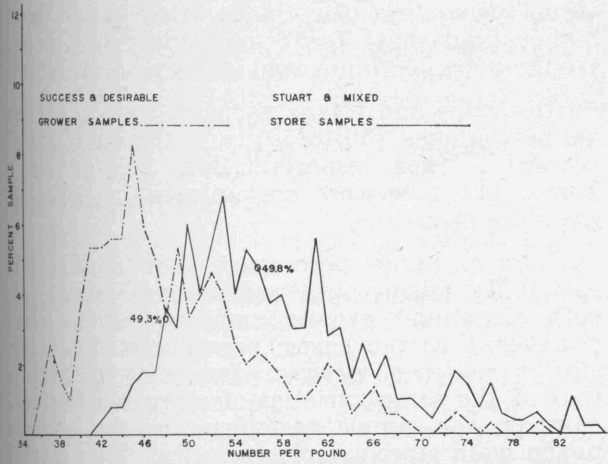


Figure 4. Size (number per pound) of store samples of Stuart and mixed varieties combined and grower samples of Success and Desirable combined, 1955-57.

ranked this high, Figure 6. There were more grower than store samples at every point above the 49 percent kernel level. Thus, the kernel percentage of grower samples of the Success variety was appreciably higher than samples of this variety obtained from retail food stores.

For the Mahan variety, kernel percentage values for the grower samples were slightly larger than for the store samples, Figure 7.

Small-sized in-shell pecans tend to be lower in price than large-sized nuts. As will be shown later, however, the actual net cost per pound of kernels is less for small-sized pecans than for large ones. Among the Texas-grown smaller sized pecans are the Nugget, San Saba Improved, Texas Prolific, Ideal, Halbert, Zenith, Jersey and Onliwon. These are grown extensively in certain parts of the State. No single one of these

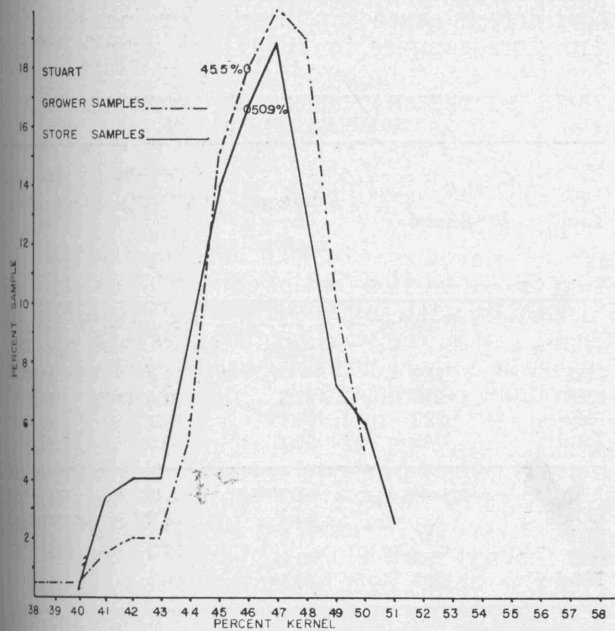


Figure 5. Kernel percentage of store and grower samples of the Stuart variety, 1955-57.

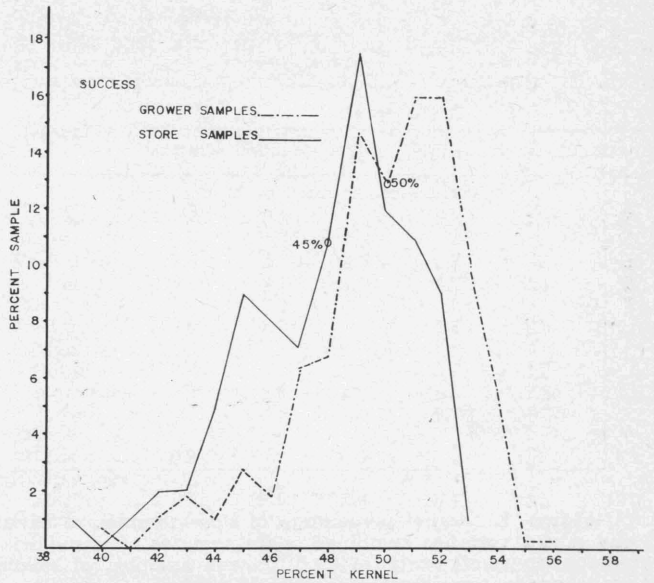


Figure 6. Kernel percentage of store and grower samples of the Success variety, 1955-57.

varieties is grown over a wide area, but collectively they are important. The kernel percentages for growers' pecans of this class, together with percentages for the store samples of the same varieties, are compared with the combined store samples of Stuart and mixed pecans, Figure 8.

The grower samples of the miscellaneous small varieties are far superior in kernel percentage to those obtained from the retail stores. The kernel percentages of slightly more than half (53 percent) of the grower samples of these varieties range from 55 to 62. Store samples of these same varieties, or mixtures of them with other varieties, have lower levels of kernel percentage. Only about one-fourth had kernel percentages of 55 to 60; none were above 60.

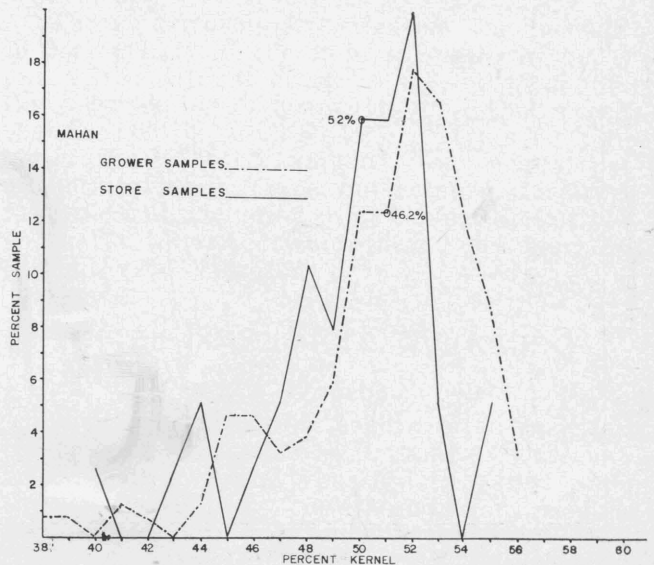


Figure 7. Kernel percentage of store and grower samples of the Mahan variety, 1955-57.

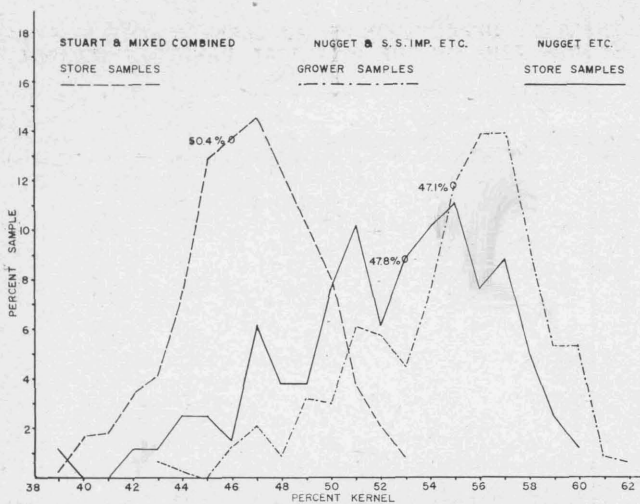


Figure 8. Kernel percentage of store samples of Stuart and mixed varieties combined, store samples of mixed miscellaneous small varieties and grower samples of mixed miscellaneous small varieties, 1955-57.

The best of these small, high-quality pecans are rarely marketed in retail channels; they frequently are blended with inferior pecans. The superiority in kernel percentage of these small varieties is shown when they are compared on the graph with store samples for combined Stuart and mixed, Figure 8. In this latter group—Stuart and mixed—the median line of the kernel percentage is at the 46 percent level, and none was more than 53. In contrast, nearly three-fourths of the grower sample small varieties had kernel percentages above 53.

The kernel percentages of Burkett store and grower samples are shown in Figure 9. The median value for both is about the same, almost 53 percent kernel. Relatively few Burkett pecans were found in retail stores. The values for

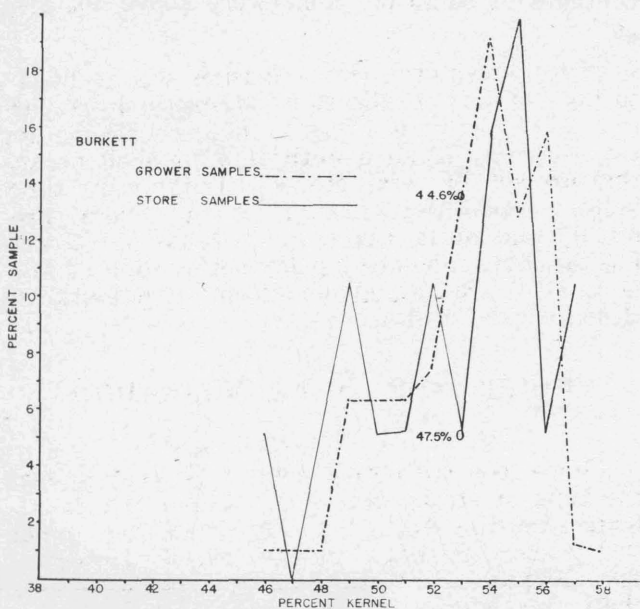


Figure 9. Kernel percentage of store and grower samples of the Burkett variety, 1955-57.

kernel percentage for this variety range much higher than those for Stuart and mixed which are the principal kinds sold in Texas retail stores.

Desirable and Evans varieties have high kernel percentages (50 to 55), and the nuts are superior in other respects. Both are grown in Texas, but few were encountered in collecting the store samples.

Data on kernel percentage show considerable variability among lots and among varieties of both store and grower samples. It is clear, however, that the kernel percentage of all principal varieties of grower samples is as high as that of the same varieties of store samples, and most grower sample varieties were far superior to the main store sample varieties. It is evident that pecan varieties with superior quality from the standpoint of kernel percentage are produced in commercial quantity in Texas, but they apparently are marketed through channels other than Texas retail stores.

NUT DEFECTS

The attractiveness of a product has a direct bearing on merchandizing. Shuckworm damage, pops and dark and oily color were external defects noted particularly during the 3 years of research. Shuckworm damage detracts from appearance, and pecans showing this defect are likely to have poor kernel quality. Pops have no kernels and are worthless. Dark color and oily appearance are caused by deterioration of the kernel which releases oil and saturates the shell. Such pecans are worthless, and they make a package containing them unsightly.

The percentage of store samples containing nuts with external defects, during the 3-year survey, was greater than that for the grower samples, Table 5. This was true despite the fact that defects caused by insects were not recorded for store samples in 1955; nor were oily and

TABLE 5. EXTERNAL DEFECTS OF STORE AND GROWER SAMPLES OF PECANS

Year	Samples	Damaged by insects	Adhering hulls, broken shells, pops, oily	Total
Store				
1955	259	¹	53.3	53.3 ²
1956	266	42.5	41.0	83.4
1957	220	59.5	13.0 ³	72.7 ²
Total	745	50.2	37.0	87.2
Grower				
1955	261	53.2	14.2	67.4
1956	640	41.6	19.8	61.4
1957	336	43.2	36.3	79.5
Total	1237	44.5	23.1	67.6

¹Not recorded.

²Incomplete data.

³Oily and dark defects not recorded.

dark color recorded in 1957. Although grower samples had not been given any preparation for market, the percentages are notably lower for each defect than for the store samples. These differences are clearly reflected in the average for the 3-year period.

KERNEL DEFECTS

Sour kernel, black color and kernel spot are defects that impart a bitter unpleasant taste and detract seriously from the acceptability of pecans. Other defects affect the taste and flavor to a smaller degree but render the kernels less valuable. The percentages of defects of various kinds for the principal varieties of grower and store samples for 1955-57 are shown in Table 6. Since many kernels had more than one defect, some of the total defects recorded for a variety are more than 100 percent. With the exception of Mahan, the total defects for store samples are greater than those for corresponding varieties of grower samples.

U. S. Grades of Grower and Retail Store Samples

All samples were examined for factors and defects that influence grade. The samples were classified into three grades on the basis of U. S. Standards for Pecans in the Shell (4)—U. S. No. 1, U. S. Commercial and below grade.

The percentages of samples in the various grades are about the same for the store samples for each of the 3 years, Figure 10. The averages are U. S. No. 1, 50 percent; U. S. Commercial, 17 percent; and below grade, 33 percent.

In comparison, the 3-year averages for the grower samples are U. S. No. 1, 65.2 percent; U. S. Commercial, 11.4 percent; and below grade, 23.4 percent. It again should be remarked that the grower samples had no special preparation for market. A high percentage of the U. S. No. 1 samples would have qualified for this grade even with lower tolerances for defects. This shows that there are many above-grade pecans grown, and there is no recognized grade that adequately reflects their exceptional quality.

Common external defects responsible for the below-grade classification of both store samples and grower samples were insect damage (particularly shuckworm damage), adhering hulls, pops and oily appearances. Pecans having these defects are easy to detect and remove by hand culling and mechanical equipment. Of 81 below-grade grower samples in 1955, 23 were so classified because of external defects alone. Fourteen of 102 samples in 1956 and 13 of 65 in 1957 were below grade because of external defects. Careful culling and grading would have reduced the 3-year average below-grade percentage of grower samples from 23.4 to 18.6.

Sour kernel and spongy texture were the two defects of kernels responsible for most below

TABLE 6. DEFECTS OF PECAN KERNELS SOLD IN RETAIL STORES AND OF THE PRINCIPAL VARIETIES GROWN IN TEXAS, 1955-57

Defects	Varieties					
	Success	Stuart	Schley	Mahan	Burkett	Mixed
Sold in retail stores, percent						
Sour kernel	.6	3.8	.3	3.2	1.4	1.5
Black	.9	1.4	.6	.4	.1	1.1
Kernel spot	1.8	1.7	7.8	1.2	1.5	1.0
Amber	10.9	10.7	2.9	8.7	9.1	8.7
Dark	.8	.1		.2	.1	.2
Spongy	2.8	9.8		2.4	10.5	9.3
Shriveling						
Slight	2.7	3.9	0.7	5.7	1.2	2.8
Moderate	5.5	6.8	4.8	18.5	2.5	4.6
Severe	7.7	4.6	3.0	9.1	1.7	5.3
Fuzzy kernels	8.2	67.7	.3	13.2	32.6	21.2
Hollowness						
Slight	1.1	28.9	19.8	9.8	38.9	12.7
Moderate	3.8	37.9			5.6	14.7
Severe		7.7			4.9	0.7
Total	46.8	185.0 ¹	40.1	72.4	102.1 ¹	93.7
Grown in Texas, percent						
Sour kernel	0.2	1.8	0.7		3.4	
Black	0.6	0.2	0.3	0.3	0.2	
Kernel spot	1.3	1.8	2.8	1.1	0.7	
Amber	7.3	34.3	1.6	5.7	2.9	
Dark	0.5	0.2	0.3	0.5	1.1	
Spongy	4.8	13.3	5.1	12.2	6.4	
Shriveling						
Slight	2.0	3.4	2.4	14.7	1.8	
Moderate	3.0	2.8	1.5	12.1	2.5	
Severe	3.9	1.2	1.8	7.7	1.9	
Fuzzy kernels	2.2	44.9	2.0	5.3	19.1	
Hollowness						
Slight	0.9	24.1	9.1	7.5	33.1	
Moderate	1.3	25.1	1.3	3.5	12.6	
Severe	0.5	1.7		4.5	1.0	
Total	28.3	154.8 ¹	28.9	78.5	87.9	

¹Total defects greater than 100 percent are due to duplication of defects on kernels.

grade classifications. Excessive shriveling, hollowness and fuzzy kernels also were important contributing defects to a below grade classification.

Throughout this investigation the mediocre to poor quality of the store samples was apparent. This without doubt is a basic reason for the relatively small quantities of in-shell pecans that are sold in retail stores. At the same time, better pecans were available from several producing regions in Texas, but because of marketing practices, including price competition of lower quality pecans, few of them were marketed through retail stores.

Retail Food Store Marketing of Pecans

Since food marketing policies often vary with the type of store, the pecan samples were analyzed according to the types of outlets from which they were obtained. The classifications used for this purpose were national, regional and local chain food stores and independent stores operating as single units or as members of a voluntary chain.

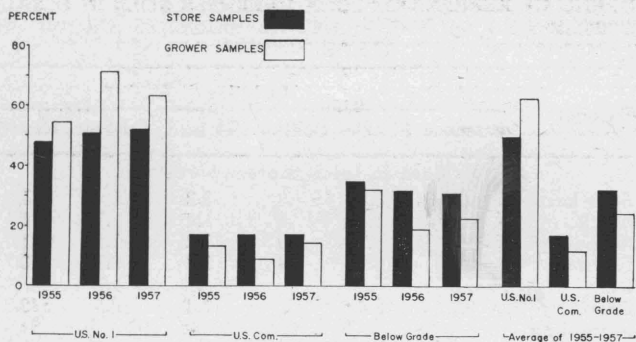


Figure 10. Different grades of pecans sold in retail stores in Texas, and grown in Texas in 1955-57.

VARIETIES HANDLED

The three main varieties in national and regional chain stores, in the order of frequency with which they were found, were mixed (Stuart mixtures), Stuart and Success, Table 7. Stuart and mixed also were predominant among local chain stores, but these stores were more likely to have other improved varieties instead of Success. This probably reflects a difference in procurement policies and suppliers for these local chain store organizations.

With two exceptions native pecans were found for sale only in independent stores. The availability of pecans, by variety, was similar among local chain and independent stores, since these stores frequently buy from the same suppliers.

RETAIL PRICES

Variety is one of a number of factors affecting the pricing of pecans. One of the principal reasons for price difference among varieties is nut and kernel size. Prices are summarized by varieties for each of the five classes of food stores, Table 8. The average for national chain store samples was 59 cents per pound compared

TABLE 7. DISTRIBUTION OF PECAN VARIETIES SOLD IN TEXAS RETAIL STORES BY TYPE OF STORE, average 1955-57

Variety	Type of store					
	Chain			Independent		All stores
	National	Regional	Local	Voluntary chain	Single unit	
	Percent					
Standard						
Success	24	15	11	11	11	13
Stuart	34	28	22	34	24	26
Mahan	4	2	7	5	7	6
Mixed ¹	36	42	37	30	32	33
Other ²	2	12	20	9	16	15
Subtotal	100	99	97	89	90	93
Native	0	1	3	11	10	7
Total	100	100	100	100	100	100
Number of samples	48	122	54	67	454	745

¹Principally Stuart with other varieties.

²Schley, Halbert, Moneymaker, Delmas, Western Schley, Burkett and other improved varieties.

with 53 to 56 cents for all other stores. Mahan prices averaged 60 cents per pound. The averages for the remaining improved varieties indicated ranged from 52 to 56 cents.

Native pecans bring growers lower prices because of their smaller size. This also is reflected at the retail store level where these nuts were priced at an average of 37 cents per pound over the 3-year period 1955-57.

Pecan prices react sharply to changes in the total supply. The sharp drop in the retail store sample prices from 64 to 46 cents per pound for 1956 compared with 1955 was the result of a larger crop, Table 9.

SHELLED PECANS

Many consumers prefer to buy shelled pecans rather than the in-shell nuts. Shelled pecans are packaged in clear film packages that permit the shopper to see the quality of the product. This and convenience and saving of time favor the shelled nuts.

Offsetting these advantages are premium prices consumers pay for shelled pecans. In the spring of 1956, a total of 305 samples of shelled pecans was purchased from the stores where in-shell pecans were bought the previous fall. Packages most commonly available were the 3 and 6-ounce sizes with an average price of \$2.33 and \$2.12 per pound, respectively, Table 10. The average retail store price for different in-shell improved varieties from the same crop ranged from \$1.22 to \$1.40 per pound of kernel, Table 9. Native pecans, used extensively by shellers, had a net cost of only 93 cents per pound of kernel.

Consumers willing to shell their own pecans pay a lower net price for pecan kernels. Yet, in 1957 shelled nuts carried over from the 1956 crop were priced competitively with in-shell pecans. This rarely occurs.

TABLE 8. AVERAGE PRICE PER POUND FOR PECAN SAMPLES PURCHASED IN TEXAS RETAIL FOOD STORES BY VARIETY AND TYPE OF STORE, AVERAGE 1955-57

Variety	Type of store					
	Chain			Independent		All stores ¹
	National	Regional	Local	Voluntary	Single	
	Cents per pound					
Standard						
Success	57	57	55	2	54	54
Stuart	60	54	2	58	55	56
Mahan	2	2	2	2	60	60
Mixed	60	58	50	53	52	53
Other	2	53	51	46	54	52
Average ¹	59	56	53	53	54	54
Native		2	2	43	37	37
Number of samples	48	122	54	67	454	745

¹Averages for each year are weighed in relation to number of stores contacted handling each of the indicated varieties. The 3 years are combined on a single average basis.

²Three or less samples.

TABLE 9. AVERAGE PRICE PER POUND AND NET PRICE PER POUND OF KERNEL OF PECAN VARIETIES SOLD IN TEXAS RETAIL STORES, 1955-57

Variety	Average price per pound				Net price per pound of kernel			
	1955	1956	1957	Average	1955	1956	1957	Average
	-----Cents-----							
Standard								
Success	63	47	53	54	129	96	108	111
Stuart	66	47	54	56	140	100	115	118
Mahan	70	54	57	60	140	108	114	121
Mixed	63	45	51	53	131	94	106	110
Other	60	46	51	52	122	94	104	107
Average	64	46	53	54	133	96	110	113
Native	41	32	38	37	93	73	86	84

Native pecans were the best buy in each of the 3 years in terms of the net price per pound of kernel.

GRADE-PRICE RELATIONSHIP

The pricing system for a product seldom is questioned if it is related reasonably well to quality variations. However, pecans showed no reasonable price-quality relationship at the retail store level.

The highest average price paid for in-shell pecan samples was in national chain stores, Table 8. Yet it appears doubtful that national chains had, on the average, as good a quality of pecans as the other retail outlets, Table 11. Although a smaller number of samples were purchased from national chain stores than from regional chains, quality and pricing among national chains are usually more uniform.

There was a relatively large proportion of below-grade pecans sold by all types of retail stores, Table 11. Table 12 shows that this was prevalent during the 3 years of the study for all in-shell varieties sampled in retail stores.

A lack of relationship between pecan quality and price is shown in Table 13. Many below-grade pecans sold at prices as high as, or higher than, those of U. S. No. 1. This malfunctioning of the grade-price system applies to all varieties. The below-grade pecans for the two important

kinds—Stuart and mixed—had a higher price per pound than corresponding U. S. No. 1 nuts.

Proposed Grade Index for Pecans

The lack of relationship between U. S. grades of in-shell pecans and retail prices presented a question concerning the adequacy of the grading system. A new grade index has been devised to check pecans for quality on another objective basis.

The three basic features of the new grade index are kernel percentage, a kernel quality index and a kernel size index, Table 14.

KERNEL PERCENTAGE

Kernel percentage represents the net weight of the kernels of pecans in relation to the weight of the shells. It is recognized as a basic factor of quality for in-shell pecans.

KERNEL QUALITY INDEX

All factors of quality, including defects, are considered in calculating the kernel quality index. For calculating the index, each defect of kernels is assigned a deduction value that is determined by the extent to which the defect detracts from the acceptability and culinary usefulness of the kernels.

Examples of several defects and the deduction value assigned each are shown in Table 15, columns 1 and 2. Deductions for each defect are calculated by multiplying the percentage of defective kernels (column 3) by its deduction value

TABLE 10. AVERAGE PRICE PAID FOR SHELLED PECAN SAMPLES PURCHASED IN TEXAS RETAIL STORES, BY PACKAGE SIZE, 1955

Package size	Number of samples	Price per pound
Ounces	Number	Dollars
1	4	\$ 3.20
2	35	2.40
3	82	2.33
4	19	1.98
6	72	2.12
7	35	1.95
8	27	1.78
10	3	1.97
12	21	1.82
15	1	1.71
16	6	1.58
Total or average ¹	305	2.13

¹Average weighted by number of samples of each size purchased.

TABLE 11. DISTRIBUTION OF PECAN GRADES SOLD IN TEXAS RETAIL STORES BY TYPE OF STORE, AVERAGE, 1955-57

Type of store	Number of samples	U. S. #1	U. S. Commercial	Below grade
Chain				
National	48	39	26	35
Regional	122	48	15	37
Local	54	50	17	33
Independent				
Voluntary	76	55	15	30
Single	454	52	17	31
Total or average	745	50	17	33

TABLE 12. DISTRIBUTION OF PECAN GRADES SOLD IN TEXAS RETAIL STORES BY VARIETIES, BY YEARS, 1955-57

Variety	Grade											
	U. S. #1				U. S. Commercial				Below grade			
	1955	1956	1957	Average	1955	1956	1957	Average	1955	1956	1957	Average
	----- Percent -----											
Standard												
Success	52	50	40	47	19	30	16	22	29	20	44	31
Stuart	32	42	51	42	14	18	21	17	54	40	28	41
Mahan	50	83	48	60	42		24	22	8	17	28	18
Mixed	49	50	50	50	13	17	12	14	38	33	38	36
Other	54	72	50	59	26	11	28	22	20	17	22	19
Average	47	50	48	48	17	17	19	18	36	33	33	34
Native	76	64	95	78	13	14		9	13	22	5	13

(column 2). The total deductions are calculated and then subtracted from 100 to arrive at the kernel quality index. An example of Success pecans of good quality, except 8 percent sour kernels and 19 percent ambers, is cited in Table 15. These would have a kernel quality index of 90.1, calculated by subtracting $100 \times .08 = 8.0$ for sour kernel, and $10 \times .19 = 1.9$ for ambers, a total of 9.9, from 100.

KERNEL SIZE INDEX

The number of kernel halves, commonly called "kernels," per pound is a standard measure of size of kernels. Pecans that have large size kernels are usually preferred by retail customers. The kernel size index is calculated by using 197 kernels per pound as the base value, in this investigation. This value was arbitrarily selected since the largest kernels in this analysis were of that average size. The kernel size index of a given sample is calculated by dividing 197 by the number of kernel halves per pound for the sample. Thus, if the number per pound of Success pecan kernels, in the example in Table 15, is 246, the kernel size index would be $197 \div 246 = 80$.

Incidentally, kernel size is calculated by multiplying the number of in-shell nuts per pound by 2, and dividing the product by the kernel percentage of the lot. Thus, for pecans testing 48 nuts per pound and 52 percent kernel, the kernel size would be $48 \times 2 \div 52 = 185$.

The grade index is determined by multiplying the kernel percentage by the kernel quality

TABLE 13. AVERAGE PRICE PER POUND OF PECAN VARIETIES SOLD IN TEXAS RETAIL STORES BY GRADE, AVERAGE 1955-57

Variety	Grade		
	U. S. #1	U. S. Commercial	Below grade
	----- Cents -----		
Standard			
Success	55	52	55
Stuart	55	55	57
Mahan	58	70	54
Mixed	52	52	55
Other	56	55	54
Average	54	54	57
Native	37	46	36

index by the kernel size index. The Success pecans cited as example in Table 15 would have a grade index of $48.9 \times 90 \times 80 = 37$. Data on external characteristics and defects to derive an index of external quality are not considered, but such an index could be easily incorporated in this suggested model.

A comparison of the grade index with the price per pound of retail store samples reveals that native pecans are low priced not as a result of their quality index (93) but because of their low size index (43). The combination produces a grade index of only 18—the lowest of the group. It is not surprising, therefore, that the price of these native pecans in retail stores was the lowest.

This type of objective grade index, at the same time, also reveals that the wide variance in quality among improved pecan varieties found in retail stores is not adequately reflected in the retail prices. If Success with a grade index of 41 is worth 54 cents per pound, Table 14, obviously Stuart with a grade index of only 24 is not worth 53 cents per pound. Prices of mixed (Stuart mixtures) and of the "other" improved varieties are also overvalued in relation to their objective quality.

These findings suggest that a reappraisal of the present USDA pecan grading system and handling practices in general might have profitable advantages for growers, handlers, shellers, retailers and consumers. More attention to pecan quality would result if the price structure adequately reflected quality differences.

TABLE 14. AVERAGE PERCENT KERNEL, KERNELS PER POUND, QUALITY INDEXES AND PRICE PER POUND OF PECAN VARIETIES SOLD IN TEXAS RETAIL STORES, AVERAGE 1955-57

Variety	Average percent kernel	Quality index	Kernels per pound	Size index	Grade index	Cents per pound
Standard						
Success	49	92	218	90	41	54
Stuart	47	64	243	81	24	53
Mahan	50	88	197	100	44	60
Mixed	48	85	259	76	31	56
Other	49	88	265	74	32	52
Average	48	81	247	80	31	54
Native	44	93	455	43	18	37

TABLE 15. FACTORS CONSIDERED IN CALCULATING KERNEL QUALITY INDEX FOR IN-SHELL PECANS

Defect	Deduction value for each percent of defective kernels	Example: Success pecans 48.9 percent kernels	
		Percent defective	Deductions
(1)	(2)	(3)	(4)
Sour kernel	100.0	8	8.0
Amber	10.0	19	1.9
Fuzzy	10.0	0	0
Slight hollowness	5.0	0	0
Moderate hollowness	7.5	0	0
Severe hollowness	10.0	0	0
Slight shriveling	5.0	0	0
Moderate shriveling	7.5	0	0
Severe shriveling	10.0	0	0
Total			9.9
Kernel quality index, 100 - 9.9 = 90.1			

Comparison of Proposed Grade Index and USDA Grades

Since the prices paid at Texas retail stores for pecans were not related satisfactorily to USDA grades nor to the proposed grade index, there remained another possibility. The USDA

TABLE 16. RETAIL STORE SAMPLES BY USDA GRADES COMPARED WITH PROPOSED GRADE INDEX

Variety	Number of samples	USDA grade	Proposed grade index	Retail price
Standard				
Success	41	#1	47	54
	18	#2	41	52
	32	B.G.	39	56
Total or av.	91	1.9 ¹	43	54
Stuart	80	#1	27	51
	35	#2	23	51
	81	B.G.	21	56
Total or av.	196	2.0 ¹	24	53
Mahan	21	#1	44	58
	10	#2	50	70
	8	B.G.	35	55
Total or av.	39	1.7 ¹	44	60
Mixed	123	#1	33	54
	35	#2	27	53
	92	B.G.	30	60
Total or av.	250	1.4 ¹	31	56
Other	64	#1	33	52
	24	#2	32	56
	22	B.G.	26	53
Total or av.	110	1.4 ¹	31	53
Av.	329	#1	34	53
	112	#2	31	54
	235	B.G.	27	57
Total or av.	686	1.8 ¹	31	55
Native	40	#1	17	37
	4	#2	23	46
	6	B.G.	18	39
Total or av.	50	1.3 ¹	19	39

¹Based on a value of 3 for below grade (B.G.), 2 for 2 (U.S. commercial) and 1 for U.S. #1.

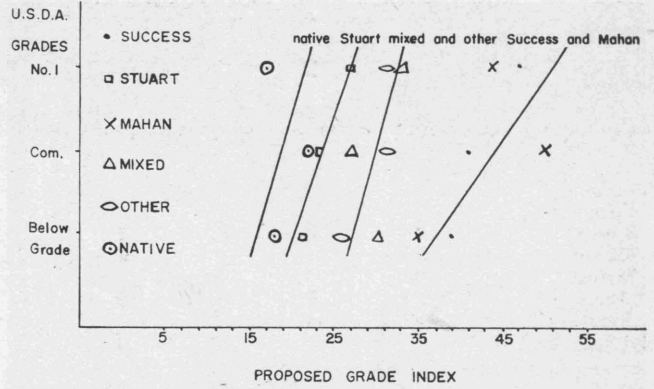


Figure 11. Relationship between proposed grade index and USDA grades.

and the proposed grades might be highly correlated, each substitutable for the other, and therefore neither related to the retail prices.

Table 16 shows that the proposed grade index tends to be correlated with the USDA grades, with three important exceptions. The relationship does not hold for the Mahan, mixed and native pecans. The proposed index for these three varieties is actually more closely related to the market prices than to the USDA grades.

The below-grade samples, according to USDA standards, of Success, Mahan and mixed varieties bought in retail stores have a higher grade index, under the proposed new system, than do U. S. No. 1 grade Stuart samples bought in these stores, Table 16 and Figure 11. This sharp contrast emphasizes the desirability of a grading procedure than can be used by pecan growers, buyers, shellers and consumers to insure more uniform quality nuts for the entire marketing system.

Experimental Retail Sales of High-quality Pecans

A retail store experiment was conducted to determine whether consumers are interested in buying better quality pecans than those usually offered in national chain stores. Cooperation was provided by a major national chain and a cooperative marketing association. A special high quality pack was prepared and placed in selected chain stores in Waco, Texas. Waco's metropolitan population is approximately 106,000 and its previous use for market testing proved it to be a reliable market test area.

A preliminary market test occurred from November 26, 1956, to January 26, 1957. It was followed by a controlled test from November 25, 1957, to January 4, 1958. The same stores participated in the preliminary and final test. The Goldkist Pecan Growers packed the test pecans in 1-pound cellophane bags comparable to those used for the other pecans, Figure 12. These pecans were graded for exterior quality and uniform size. In addition, each pecan was weighed

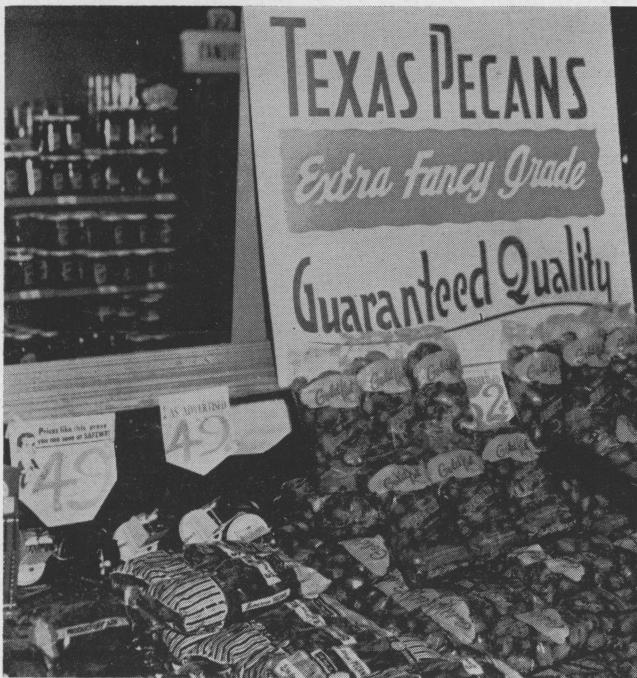


Figure 12. Attractive packaging of pecans permits the customer to appreciate the value of uniform grading.

by machinery specially designed to eliminate pops and any light-weight pecans resulting from poorly filled kernels.

The experimental pack of Goldkist pecans in the preliminary test, 1956-57, were priced at 52 cents per pound while the regular store stock was 49 cents per pound. Store displays were not controlled, thus each store manager used his own merchandising methods. The Goldkist high-quality pecans (at 52 cents) outsold the regular commercial pecans (at 49 cents) 1,048 pounds to 604.

The closely controlled retail test during the winter of 1957-58 limited the Goldkist high-quality pack and the regular commercial-pack pecans to equal size displays. The pecan crop was smaller for the 1957-58 season, resulting in higher prices. The Goldkist package was 60 cents and the commercial pack was 57 cents. The pricing of the test pecans was a disadvantage

from the merchandising standpoint. However, a severe test was desired because marketing of a higher quality pecan probably would encounter this type of pricing relationship.

The Goldkist pecans outsold the Commercial pack pecans 271 pounds to 234. In 1957-58 the margin between prices of in-shell pecans and shelled pecans was narrower than usual, and consequently total sales of in-shell nuts were considerably less than a year earlier.

These retail market tests show that an appreciable number of shoppers are quality conscious and are willing to pay for the extra quality in pecans. These tests point out that the pecan industry needs to have a grading procedure that will emphasize adequately the quality variations in in-shell pecans. This would help prevent substandard pecans from entering retail channels and depressing consumer demand.

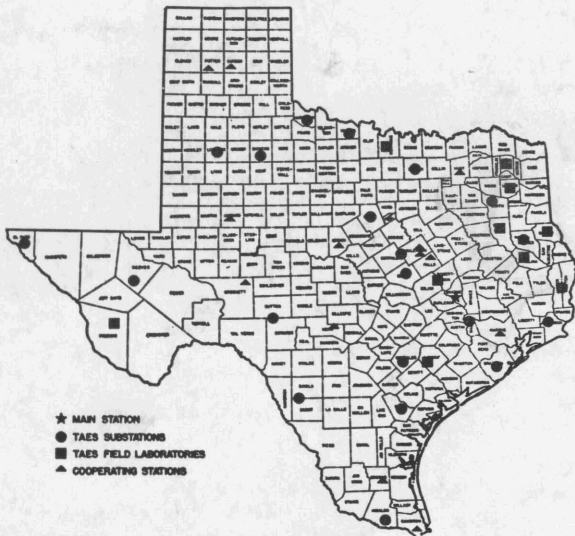
Acknowledgments

The authors hereby express their appreciation and thanks to the Goldkist Pecan Growers, Seguin, Texas, for supplying very generous quantities of pecans for this investigation and the Safeway Stores Incorporated for cooperation in conducting the consumer acceptance studies. The writers also are grateful to many pecan growers who supplied samples of pecans for testing.

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Location of field research units of the Texas Agricultural Experiment Station and cooperating agencies

State-wide Research



The Texas Agricultural Experiment Station is the public agricultural research agency of the State of Texas, and is one of ten parts of the Texas A&M College System

IN THE MAIN STATION, with headquarters at College Station, are 16 subject-matter departments, 2 service departments, 3 regulatory services and the administrative staff. Located out in the major agricultural areas of Texas are 21 substations and 9 field laboratories. In addition, there are 14 cooperating stations owned by other agencies. Cooperating agencies include the Texas Forest Service, Game and Fish Commission of Texas, Texas Prison System, U. S. Department of Agriculture, University of Texas, Texas Technological College, Texas College of Arts and Industries and the King Ranch. Some experiments are conducted on farms and ranches and in rural homes.

THE TEXAS STATION is conducting about 400 active research projects, grouped in 25 programs, which include all phases of agriculture in Texas. Among these are:

- | | |
|--------------------------------------|---------------------------------|
| Conservation and improvement of soil | Beef cattle |
| Conservation and use of water | Dairy cattle |
| Grasses and legumes | Sheep and goats |
| Grain crops | Swine |
| Cotton and other fiber crops | Chickens and turkeys |
| Vegetable crops | Animal diseases and parasites |
| Citrus and other subtropical fruits | Fish and game |
| Fruits and nuts | Farm and ranch engineering |
| Oil seed crops | Farm and ranch business |
| Ornamental plants | Marketing agricultural products |
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| Insects | Rural agricultural economics |
| | Plant diseases |

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