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REPORT

AN ANALYSIS OF LABOR
REQUIREMENT AND MARKET PRICE
DIFFERENCES FOR TIED AND
UNTIED FLUE-CURED TOBACCO

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INTRODUCTION

Until 1962, untied tobacco could be sold only on Georgia–Florida (Type 14) markets. Starting in that year, untied leaves were eligible for price supports during the first 5 sale days on the Virginia, North Carolina, and South Carolina markets. The time allowed for untied sales on these four belts subsequently was increased to the first 7 sale days in 1963 and to the first 12 days for the 1966 season. Then, in 1967, untied leaves were price supported for the first 95 hours of sale on the Type 11a, 11b, 12 and 13 markets. Starting in 1968, untied leaves received price supports for the entire season.

Because of this increased time for untied sales over these years, more farmers decided to sell their tobacco in an untied form. Untied leaf sales as a percentage of total gross offerings on the Virginia, North Carolina, and South Carolina markets increased from 3.7 percent (49 million pounds) in 1962 to 35.7 percent (364.6 million pounds) in 1966. This trend accelerated in 1967 when 66.6 percent (727.8 million pounds) of gross marketings was sold in the untied form on these markets.

The Problem

This rapid change in marketing procedure gave rise to several new marketing questions in which farmers, warehousemen, and processors showed a great deal of interest. Selling leaves in an untied form appeals to farmers for several reasons. Many farmers contend that

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untied sales offer substantial labor savings because the tying process, as well as a large proportion of the sorting labor, is eliminated. This reduction in necessary market preparation labor is of value during early sale days when most of the farm labor is still engaged in harvesting. It is more profitable for producers to sell tied tobacco rather than untied tobacco only if the market price for tied leaves exceeds the price for untied leaves by more than the cost of additional labor required for tying leaves. On the other hand, processors have expressed dissatisfaction with untied leaves because of the increased waste associated with handling the leaves. Many processors had also found that untied leaves require more labor for movement. This general difference in preference between farmers and processors seemed to be diminished somewhat by the experiences of the 1967 season. It appeared that many buying companies had converted their processing facilities in order to handle increased quantities of untied tobacco especially early in the season.

Because of this background and the interest shown in these matters on the part of the tobacco industry, this study was initiated and conducted during 1967. Even though the benefits of selling tobacco in an untied form had been expressed by farmers in many statements of opinion, developments since 1962 warranted a quantification of these marketing phenomena. By the start of the 1967 season, a definite need had arisen to analyze price and labor requirement differentials existing between untied and tied leaves to determine the most profitable form in which each producer should sell his tobacco. Such an analysis was useful to farmers producing any farm product; the nature of tobacco as a high-gross-return and a high-cost-per-acre crop made precise knowledge of the market very valuable both to farmers and to other sectors of the tobacco industry.

Review of Previous Work

Crawford studied some of these questions concerning untied and tied tobacco marketing.[1] However, his study was carried out at a

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[1]D. E. Crawford, Marketing Flue-Cured Tobacco, Tied and Untied, A. E. Information Series No. 206, Department of Agricultural Economics, Clemson Agricultural College, Clemson, South Carolina, 1961.

time when loose-leaf tobacco could be sold only on the Georgia-Florida markets--all other belts were restricted to tied leaves only. Therefore, Crawford did not have any direct price comparisons between tied and untied tobacco sold on the same day in the same belt. Brooks and Toussaint carried out an extensive study measuring the labor requirements of tied and untied tobacco.[2] This study compared market preparation requirements of both tied and untied leaves within a set of farms in North Carolina. Their study used 1962 data and, consequently, many of their results were found to be good comparisons with the data found in this study. This problem has also been studied in work which has not yet been published by J. S. Chappell, Associate Professor, Department of Economics, North Carolina State University. He has investigated the impact of expanded loose-leaf sales on the orderly flow of tobacco through marketing channels. All of this research reflects the interest generated by these marketing questions and, as the situation has changed, there has arisen the need for answering new questions currently being raised about the relative profitability of untied and tied leaf sales.

<center>Objectives</center>

The first of two primary objectives was to analyze differences in labor requirements for tied and untied tobacco and to determine if these differences were statistically significant. The second primary objective was to analyze price differences between tied and untied tobacco and to determine which (if any) of these differences were large enough to be considered significant. Both labor requirements and price differences were tested by individual stalk positions and for tobacco from the entire stalk.

A secondary objective which followed logically from the two primary objectives was to analyze the differences in net returns to the farmer from selling untied leaves as compared to tied bundles.

Two other secondary objectives dealt with the effects of stalk position on labor requirements and market prices. Specifically, the

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[2]R. C. Brooks and W. D. Toussaint, Labor Requirements in the Market Preparation of Flue-Cured Tobacco, A. E. Information Series No. 98, Department of Agricultural Economics, North Carolina State College, Raleigh, North Carolina, 1963.

first of these two objectives was to determine if labor requirements
were significantly different for leaves from three different portions
of the stalk, <u>viz</u>., lower, middle, and upper stalk positions. Similarly,
the second of these two objectives was to determine if market prices
for leaves from these three stalk positions were significantly
different.

PROCEDURES

Experimental Procedures

Controlled experiments were conducted in 1967 on three farms located in three counties of North Carolina. Farms in Columbus, Wilson, and Moore counties were selected for the experiments. Figure 1 shows the location of each of these farms and the markets where the experimental sales were conducted. It should be noted that each of the three farms sold in a different marketing belt.

Experimental plots of 9 acres were used at each farm location. These 9 acres were grown and harvested using identical cultural practices. Soil tests and nematode counts were made prior to planting to determine necessary fertilizer and nematocide treatments. Each priming was harvested and cured as uniformly as possible. On each farm the same labor crews were used for the market preparation of both tied and untied tobacco. These field procedures aided in obtaining tobacco of a fairly homogeneous nature in each experiment.

Experimental units on each farm were constructed by separating each priming into six equal-sized lots on each farm. This was done when the tobacco was removed from the curing barn to the pack house. Information contained in Figure 2 is a graphical presentation of the procedures used to separate each priming into experimental units or lots. The same separation procedure was followed for all primings at each location until six equal-sized and nearly identical lots were prepared. Each lot, thus, was equivalent to 1.5 acres of harvested tobacco. Each of the six lots was further subdivided into two sublots in order to provide a statistical replication for analysis purposes (see the Analytical Procedures section later in this chapter). This replication allowed sales to take place at two different warehouses within each market on any particular day. Each of the sublots, thus, was equivalent to .75 of an acre of harvested tobacco.

There were three sale times for each location during the 95 hours allotted for untied leaf sales in 1967. A process of random selection

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Legend:

X = Farm locations
O = Market locations
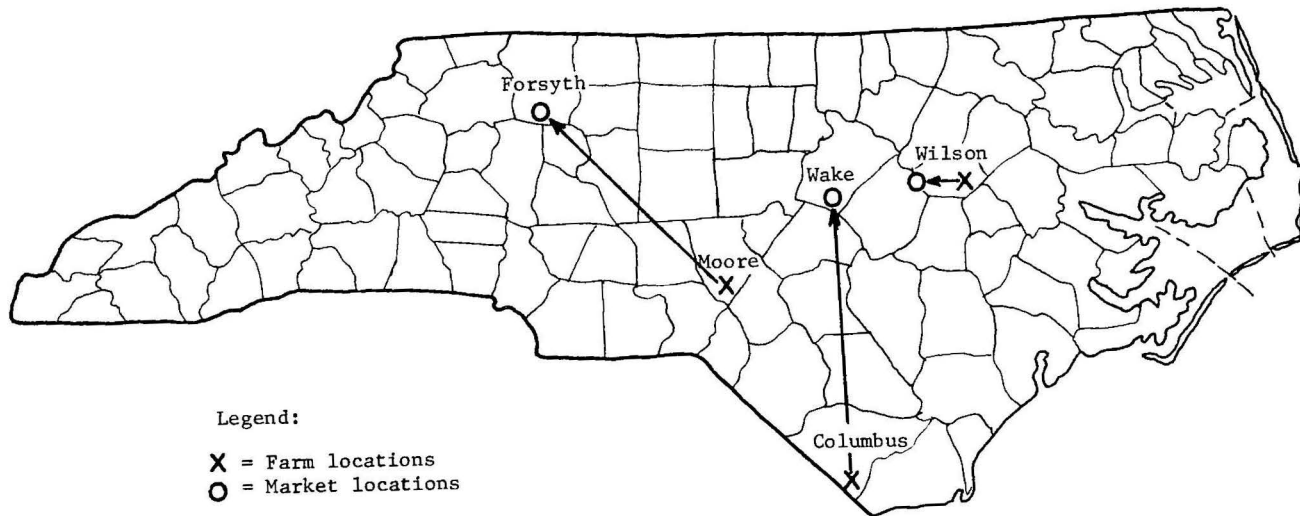
Figure 1. The location of farms and markets used in the experiments

```
          ┌─────────────────┐
          │     9-acre      │
          │    plot at      │
          │ each location^a │
          └─────────────────┘
```

Six lots formed equally from the entire plot (for all cures)

```
┌──────────┐      ┌──────────┐      ┌──────────┐
│ Lot 1    │      │ Lot 3    │      │ Lot 5    │
│ Loose    │      │ Loose    │      │ Loose    │
└──────────┘      └──────────┘      └──────────┘

┌──────────┐      ┌──────────┐      ┌──────────┐
│ Lot 2    │      │ Lot 4    │      │ Lot 6    │
│ Tied     │      │ Tied     │      │ Tied     │
└──────────┘      └──────────┘      └──────────┘
     I                 II                III
```

| Early untied sales period | Midpoint untied sales period | Late untied sales period |
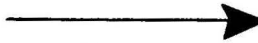
Time →

Each lot equivalent to 1.5 acres was divided into two sublots and sold on two warehouse floors.

```
┌────────────────────────────┐
│       Warehouse 1          │
│  (.75 acre equivalent)     │
├────────────────────────────┤
│       Warehouse 2          │
│  (.75 acre equivalent)     │
└────────────────────────────┘
```

Figure 2. The experimental plot design and sales plan at each location

[a]Three locations were utilized in this study, i.e., 27 acres total tobacco.

of the six 1.5-acre lots was then made to conform with the following
sales schedule at each location. Two lots were selected and sold
during the first week of sales in each belt (I in Figure 2). One of
these lots was sold in tied form while one was sold in untied form.
Both the tied and untied lots were divided so that .75 of an acre of
tied leaves and .75 of an acre of untied leaves were sold at each of
two warehouses on the same day. A similar division of two other lots
was made during the third sales week or as near as possible to the
midpoint of the untied period (II in Figure 2). Finally, during the
fifth sales week, or near the end of the untied price-support period,
one other lot of tied and a lot of untied were sold (III in Figure 2).
Sales dates and market locations for each farm are shown in Table 1.

Measurement Procedures

Two types of primary data were collected at the three farm
locations or at the three markets. These consisted of market prepara-
tion labor records for untied and tied leaves and market price data
as well as government and buying company grade data.

Labor records were kept for the first two sales times or the first
four 1.5-acre lots (two tied and two untied lots). Market preparation
times for tied tobacco were broken down into three stages. These were
removing from the stick, grading and tying, and sticking up and packing
down. The data presented throughout this report, however, are summa-
tions of these three stages. Market preparation of untied tobacco was
measured as a single operation. Labor times were kept for the individual
stalk positions and for the entire stalk.

Data on market prices, basket weights, government grades, the
buying company and company grades were recorded for each basket sold
in the experiment. These data were obtained for each of the six 1.5-
acre lots (see Figure 2). Price observations were recorded immediately
following the sale of individual baskets. All baskets weighed ap-
proximately 200 pounds and each basket was identified as to its cure
and stalk position. This identification of the particular tobacco being
sold allowed weighted averages to be computed for these categories as
well as for the entire stalk.

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Table 1. The Sales Schedule, 1967 Season

Time of sale[a]	Date of sale by farm and market location		
	Wilson County Farm, Wilson Market, Eastern Belt	Columbus County Farm, Fuquay Market, Middle Belt	Moore County Farm, Winston-Salem Market, Old Belt
Early, I	Wednesday, August 30	Wednesday, September 13	Thursday, September 28
Midpoint, II	Wednesday, September 20	Wednesday, October 4	Wednesday, October 11
Late, III	Wednesday, October 4	Wednesday, October 18	Wednesday, November 1

[a]See Figure 2 for more information about the three sales periods as designated by Roman numerals.

Each experiment was developed so that analysis of variance statistical techniques could be used to analyze and test market factors such as form of sale, time of sale, and location. It was hypothesized that the effects of these factors could vary greatly for different stalk positions. Hence, in fulfilling the two primary objectives, data for each stalk position as well as data for the entire stalk were analyzed in order to determine the effect of each factor upon labor requirements and market prices.

The stalk position division was made to achieve a more uniform basis for analyzing data pooled across locations than that offered by an analysis of individual primings only. That is, stalk position divisions were used to reduce variability in the number of harvested leaves among comparable stalk positions across locations. The method which achieved this uniformity was to assign the first three cures at the Moore County and Columbus County locations to the lower stalk position, while at the Wilson County location the first two cures constituted the lower stalk position. The middle stalk position in- ✓ cluded the fourth cure at the Moore and Columbus locations, while it included the third cure at the Wilson location. The upper stalk position included the fifth cure at the Moore County and Columbus County farms and the fourth and fifth cures at the Wilson location. Analyses of market price and labor data were then carried out with these categories used as the stalk position divisions.

Weighted averages were used when computing stalk position and stalk total averages from the basket data gathered at the market. How- ever, the means shown throughout this report that represent averages for several sale times for any form or stalk position were computed as simple arithmetic averages. The randomization criteria for selling the tobacco made it such that there were only very small differences between the poundage sold of any one stalk position at different times. There- fore, it was assumed that no serious weighting problem existed for particular stalk positions sold throughout time and that arithmetic averages were not significantly different from weighted averages for these data. Price averages across locations also were computed as simple arithmetic averages, but, again, the absence of weighting was not

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important because of the randomization procedures which made the quantities of tobacco from each stalk position at each location nearly the same. That is, differences in sale weights for each stalk position were not statistically different among locations.

In order to fulfill the two primary objectives of this study, for testing purposes each was stated in the following null hypothesis form:
(1) There were no labor requirement differences between tied and untied forms of market preparation.
(2) There were no market price differences between tied and untied forms of market preparation.

In like manner, the two secondary objectives concerning differences in stalk positions were stated in the following null hypothesis form:
(3) There were no labor requirement differences among the lower, middle, and upper stalk positions.
(4) There were no market price differences among the lower, middle, and upper stalk positions.

A completely random design was used for the experiment to test these four null hypotheses; warehouse effects were not identified as a separate source of variation in any of the analyses. To test the significance of stalk position in affecting labor requirements and prices of tied and untied tobacco, a split plot design was used. Stalk position was considered to be the subplot factor for these analyses. Statistical F tests were used to judge the significance of various market factors, and LSD's (least significant differences) were used to analyze the differences between individual means for price and labor use data. Details of the application of these tests and other statistical procedures are given by Nicholson.[3]

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[3]R. H. Nicholson, An Analysis of the Cost of Market Preparation and Market-Price Effects of Selling Flue-Cured Tobacco in Tied and Untied Forms at Various Points during the Marketing Season, M. S. thesis, Department of Economics, North Carolina State University, Raleigh, North Carolina, 1968, pp. 13-16.

LABOR REQUIREMENT DIFFERENCES

The primary purpose of this section is to report and discuss differences in market-preparation labor requirements for tied and untied tobacco. A secondary purpose is to report and discuss differences in labor requirements for lower, middle, and upper stalk positions.

In analyzing market preparation labor differentials, the tied versus untied, or form factor was tested by using F values. An F value greater than the tabular value at the .05 probability level was considered to be significant, while a value greater than the tabular value at the .01 level was considered to be highly significant. In like manner, various analyses were carried out to test the significance of the stalk position factor.

Tied-Untied Differences

Stalk Total Differences

Table 2 contains a summary of tied and untied market preparation labor requirements. Average requirements per 100 pounds of tobacco are shown for each form (tied and untied). They are shown for each of the farm locations and for the three locations combined. Differences between these requirements also are shown. These differences may be compared with the 5-percent and/or 1-percent LSD's. As previously noted, differences which exceeded LSD's at the 5-percent level were judged significant. Those which exceeded LSD's at the 1-percent level were judged highly significant.

Tied preparation required significantly more labor at all three farm locations. Across all locations, tied preparation required an average of 5 hours per 100 pounds compared to less than 2 hours per 100 pounds for untied preparation. Labor savings with untied preparation were substantial for each of the three experiments; in short, these findings were quite consistent with opinions voiced by flue-cured tobacco farmers and with results of previous production cost studies.

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Table 2. Market-Preparation Labor Requirements for Tied and Untied
Leaves, Stalk Total Averages, Within Locations and All
Locations Combined

Location	Tied	Untied	Tied-Untied Difference	LSD .05 level	LSD .01 level
			(hours per 100 pounds)		
Wilson County	5.69	1.70	3.99	1.02	2.35
Columbus County	5.93	3.06	2.87	2.07	4.76
Moore County	3.38	1.06	2.32	1.03	2.36
All Locations[a]	5.00	1.94	3.06	0.48	0.72

[a]Arithmetic averages of the labor requirements found at the three
farm locations.

The absolute market preparation times found in this study were
somewhat lower than those found in the Brooks and Toussaint study.[4]
The Brooks and Toussaint study found that in 1962 tied leaves over the
entire stalk required 7.93 labor hours per 100 pounds while untied
leaves required 3.80 hours per 100 pounds, for a differential of 4.13
hours per 100 pounds of tobacco. Labor requirements per 100 pounds
of tobacco were reduced comparably for both tied and untied preparation
in this 1967 study indicating a possible overall increase in the ef-
ficiency of market preparation labor over the past five years. This
was not an unreasonable finding given the increases in wage rates paid
by flue-cured tobacco farmers and given increases in labor efficiency
which have occurred for practically all agricultural products. Of
course, it should be pointed out that these two studies used different
farms for the purpose of collecting data. Thus, any inferences drawn
for all farms from such a comparison must necessarily be hedged by
this fact.

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[4]Brooks and Toussaint, op. cit.

<u>Tied-Untied Differences by Stalk Position and Locations</u>

A further comparison of market preparation results is found in Table 3 which shows average labor requirements for tied and untied tobacco grouped by three stalk positions. As can be seen in the table, all time differentials are significant at the 5-percent level except for lower leaves at the Columbus County location and middle leaves at the Moore County location. When all three locations were combined, the time differential was found to be highly significant for each of the three stalk positions. Only at the Columbus County location was the time differential not significant at the 1-percent level for at least one of the three stalk positions. This finding could be attributed to this particular farmer's use of more time for the grading of tobacco in both sale forms.

The Moore County location also was noteworthy because of lower labor requirements for both tied and untied preparation. This efficiency at the Moore location could be attributed to cultural practices employed by this operator which tended to produce a crop which needed little grading and to the use of an automatic stringing machine which lowered market preparation time by facilitating the removal of leaves from the sticks. It should be noted, however, that a stringing machine also was used at the Wilson location.

Comparison of location LSD figures (not shown here) to the average labor requirements per 100 pounds of tobacco showed locations to be significantly different from each other with respect to the required market preparation times. The Columbus County location exhibited a significantly higher labor requirement per 100 pounds (tied and untied combined) than either the Wilson or Moore locations. At the same time, labor requirements for the Moore County location were significantly lower than labor requirements from the Wilson location. Such results reflected the differences in labor efficiency from farm to farm and pointed out why across-location data alone were not considered sufficient for this labor time analysis.

Differences Attributable to the Stalk Position

Labor use averages presented in Table 3 also were used to determine if there were significant labor requirement differences attributable to

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Table 3. Market-Preparation Labor Requirements for Tied and Untied
Leaves, Stalk Position Averages, Within Locations and All
Locations Combined

Stalk Position and Location	Tied	Untied	Tied-Untied Difference	LSD .05 level	LSD .01 level
			(hours per 100 pounds)		
Lower					
Wilson	5.92	2.01	3.91	1.82	4.21
Columbus	6.03	3.21	2.82	2.92	6.74
Moore	3.80	1.14	2.66	0.70	1.61
All Locations	5.25	2.12	3.13	0.67	1.01
Middle					
Wilson	4.61	1.15	3.46	2.64	6.11
Columbus	5.87	3.02	2.85	1.61	3.71
Moore	2.67	1.05	1.62	1.90	4.38
All Locations	4.38	1.74	2.64	0.69	1.04
Upper					
Wilson	6.05	1.70	4.35	1.11	2.57
Columbus	5.84	2.88	2.96	1.90	4.37
Moore	3.64	0.96	2.68	1.79	4.12
All Locations	5.18	1.85	3.33	0.54	0.81

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the stalk position of the leaves. This was done for both tied and
untied leaves for each location and for all locations combined. These
results are summarized in Table 4. The averages, of course, are simply
a rearrangement of the first two columns of Table 3. The LSD's, how-
ever, are different computations, based on a split-plot analysis of
variance similar to that reported in detail by Nicholson.[5]

Table 4. Market-Preparation Labor Requirements by Stalk Position

Form of Market Preparation and Location	Stalk Position			LSD	
	Lower	Middle	Upper	.05 level	.01 level
	(hours per 100 pounds)				
Tied					
Wilson County	5.92	4.61	6.05	0.579	1.336
Columbus County	6.03	5.87	5.84	1.043	2.405
Moore County	3.80	2.67	3.64	1.030	2.375
All Locations	5.25	4.38	5.18	1.004	2.078
Untied					
Wilson County	2.01	1.15	1.70	0.914	1.516
Columbus County	3.21	3.02	2.88	1.017	1.989
Moore County	1.14	1.05	0.96	1.076	2.119
All Locations	2.12	1.74	1.85	1.016	1.944

[5] Nicholson, op. cit., p. 29.

MARKET PRICE DIFFERENCES

Labor time differentials reported and analyzed in the previous section become more relevant when analyzed in the context of market price differences (if any) for tied and untied tobacco. In this section, differences in market prices received for tied and untied tobacco will be reported and analyzed. Also, market price results and market-preparation labor differentials will be combined in a manner which will allow the analysis of differences in net returns from selling tied versus untied tobacco. In other words, the form of sale most profitable to farmers will be determined.

Background Information

Government support prices have been $3.00 per 100 pounds more for tied tobacco than for similar grades of untied tobacco for the past several years. During the 1967 season, untied sales were supported for the first 95 hours of sale on Type 11a, 11b, 12, and 13 markets. During this period, untied sales constituted 98 percent of the total poundage sold on these four belts. The Market News Service of the U. S. Department of Agriculture reported that untied leaves brought an average price of $64.20 per 100 pounds during this time period while tied leaves brought a price of $64.55 per 100 pounds.[6] Data collected in this study were consistent with this small price difference, a finding which led to several interesting marketing and policy implications.

Tied-Untied Differences for the Entire Stalk

Market prices for comparable tied and untied leaves were, on the average, not significantly different. This conclusion was borne out

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[6]U. S. Department of Agriculture, Flue-Cured Tobacco Market Review, TOB-FL-11, Consumer and Marketing Service, Tobacco Division, Washington, D. C., 1968.

by the results presented in Table 5. Average prices per 100 pounds, over all three stalk positions (stalk total results), are presented in this table for each of the three experimental locations and for the locations combined.

Table 5. Average Market Prices for the Entire Stalk, by Location and Locations Combined

Location	Tied	Untied	Tied-Untied Difference	LSD	
				.05 level	.01 level
			(dollars per 100 pounds)		
Wilson County[a]	64.56	66.23	-1.67	2.22	3.36
Columbus County[a]	64.76	62.29	2.47	0.83	1.26
Moore County[a]	67.87	66.88	0.99	1.60	2.42
All Locations[b]	65.73	65.13	0.60	8.95	12.26

[a]Weighted averages of prices received for all tobacco sold at each of the locations.

[b]Arithmetic averages of the prices received at the three locations.

Over all three locations, tied leaves sold for only $.60 per 100 pounds more than untied leaves. This difference was far from being statistically significant, as can be seen in Table 5 by comparing it with the 5-percent LSD of $8.95 per 100 pounds. Only at the Columbus County location was the price difference significantly large--tied leaves sold for $2.47 per 100 pounds more than did untied leaves. In contrast, at the Wilson County location untied leaves sold for $1.67 more--a difference, however, which was not statistically significant. At the Moore County location, tied leaves brought a premium of $.99 per 100 pounds--a difference which also was not large enough to be significant.

It should be reiterated that these results were compiled from data collected from "regular" auction sales during the 1967 season (as was explained previously in the Procedures section). At each farm and

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sales location, tied and untied tobacco received the same treatment, i.e., it was identically produced, harvested, graded, etc.

Tied-Untied Differences by Individual Stalk Positions

When the price data were compiled by individual stalk positions, several additional interesting results were found. Table 6 shows the average market prices and price differentials for tied and untied leaves by each stalk position within each location.

Prices were only slightly higher for tied tobacco sold from the lower stalk position, and this premium was significant at only the Columbus County location. Tied tobacco was somewhat higher priced for the middle stalk position at the Columbus County and Moore County locations; these results were significantly different at the 5-percent probability level. A highly significant price premium for tied leaves from the upper stalk position was found at the Columbus County location ($3.85 per 100 pounds). In contrast, at the Wilson County location untied leaves sold for $5.27 per 100 pounds higher than did tied leaves. In general, tied price premiums for some stalk positions at some locations were offset by untied price premiums for other stalk positions and locations, resulting in virtually no differences for the entire stalk (as shown in Table 5).

Implications of Tied-Untied Price Comparisons

Several implications of importance to the tobacco industry were drawn from this discussion of tied and untied price differentials. First, these results were consistent with USDA Market News Service reports which showed that untied leaves brought a price almost equivalent to tied prices during the first 95 hours of sale on each tobacco belt during the 1967 season. Possibly this indicated a greater willingness on the part of buying companies to purchase untied leaves at the market. Increased acceptability of untied leaves may have been related to the conversion of equipment at the processing facilities which enabled companies to handle untied leaves more easily. Therefore, because of this apparent change in buyer attitudes, it appeared that farmers were acting to maximize their net returns when, during the

Table 6. Average Market Prices of Tied and Untied Tobacco by Stalk
Positions Within Locations[a]

Location and Stalk Position	Tied	Untied	Tied–Untied Difference	LSD .05 level	LSD .01 level
			(dollars per 100 pounds)		
Lower					
Wilson County	72.81	71.40	1.41	3.37	5.10
Columbus County	69.33	68.31	1.02	0.51	0.78
Moore County	70.55	69.91	0.64	1.97	2.98
Middle					
Wilson County	58.68	59.16	−0.48	1.35	2.04
Columbus County	62.59	59.70	2.89	1.94	2.94
Moore County	67.28	65.05	2.23	2.17	3.28
Upper					
Wilson County	60.17	65.44	−5.27	9.47	14.34
Columbus County	59.81	55.96	3.85	0.88	1.34
Moore County	64.86	65.12	−0.26	2.91	4.40

[a]Weighted averages of the prices received for baskets of tobacco
sold in each form at three sales times.

untied sales period, they marketed 98 percent of their total offerings in an untied form.

Untied-tied price comparisons, specified in Tables 5 and 6, also suggested some interesting implications about differences among farm locations during the first 95 sale hours. It was found that the difference between tied and untied tobacco prices could vary widely from location to location. The significant differential between tied and untied prices at the Columbus County location was in marked contrast to the nonsignificant differentials at the other two locations. This could demonstrate different buying patterns at different sales locations, especially with regard to buyers' desires to purchase tied leaves.

Market Price Differences among Stalk Positions

In general, it was found that stalk position was a highly significant price-influencing factor during the three sales conducted during the untied period within each belt. Table 7 shows the mean prices for the three stalk positions within each location as well as the LSD figures corresponding to these means. These means are averages of both tied and untied leaves sold from each stalk position. They are arithmetic, not weighted, averages of the three sales conducted during the untied period. Since the weights of tied and untied tobacco sold at each location for each stalk position were not significantly different, this eliminated the need for weighting these figures.

Tobacco from the lower stalk position sold for higher prices than tobacco from the middle or upper positions at each of the three locations. For the three locations combined, the average price for lower leaves was $8.30 per 100 pounds higher than for middle leaves and $8.49 higher than for top leaves. Price differences between middle and upper leaves were significant (5-percent level) at both the Wilson County and Columbus County locations, but the direction of differences was opposite. For the Wilson County farm, upper leaves brought $3.88 per 100 pounds more than middle leaves, whereas middle leaves brought $3.26 more than upper leaves for the Columbus County farm. At the Moore County location, the average prices received for middle and top leaves were not significantly different.

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Table 7. Average Prices for All Leaves (Tied and Untied) by Stalk
         Position and Location

| Location | Stalk Position of Leaves | | | LSD | |
	Lower	Middle	Upper	.05 level	.01 level
	(dollars per 100 pounds)				
Wilson County	72.10	58.92	62.80	3.53	4.95
Columbus County	68.82	61.15	57.89	1.79	2.51
Moore County	70.23	66.17	64.99	2.56	3.59
All Locations	70.38	62.08	61.89	6.74	8.67

Significance and Economic Relevance of Interaction Variation

As was stated in the section on Procedures, in order to test stalk
position as a factor that may have influenced market prices received
for tied and untied tobacco, a split-plot analysis of variance was
incorporated into the study. By following this procedure, significant
differences received for tobacco from various stalk positions could be
detected as could any price premiums for selling in one form for one
stalk position and a different form for another stalk position. If it
were possible, for example, to conclude that (in 1967) it was more
profitable to tie top leaves but sheet bottom leaves, this could be
very useful information for tobacco producers. Or, for example, if
prices were found to be not significantly different for the two forms
within a specific stalk position, this also could have implications for
producers' marketing plans, i.e., they possibly should continue to sell
most of their tobacco in an untied form to take advantage of the lower
labor costs.

One of the more relevant findings in the split-plot analyses was
the absence of a form x stalk position interaction. Parts of each of
the analyses of variance are shown in Table 8, including results for
the residual term. The significance of stalk position as a price-
determining factor is clearly evident in this table. For each of the
three locations, the form x stalk position interaction was not found
to be significant. This implied that, in general, the lack of
significant price differences between tied and untied leaves was

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Table 8. Selected Portions of Split-Plot Analyses of Variance of Market Prices for Individual Stalk Positions, by Location

Source of Variation by Location	Degrees of Freedom	Sum of Squares	Mean Square	F Value[a]
Wilson County				
Stalk position	2	0.1101	0.0551	34.44**
Form x stalk position	2	0.0071	0.0036	2.25 n.s.
Residual	12	0.0189	0.0016	
Columbus County				
Stalk position	2	0.0756	0.0378	94.50**
Form x stalk position	2	0.0012	0.0006	1.50 n.s.
Residual	12	0.0048	0.0004	
Moore County				
Stalk position	2	0.0181	0.0091	11.375**
Form x stalk position	2	0.0009	0.0005	<1 n.s.
Residual	12	0.0099	0.0008	
All Locations				
Stalk position	2	0.1693	0.0846	94.00**
Time x stalk position	4	0.0049	0.0012	1.33 n.s.
Form x stalk position	2	0.0022	0.0011	1.22 n.s.
Location x stalk position	4	0.0346	0.0086	9.67**
Time x form x stalk position	4	0.0052	0.0013	1.44 n.s.
Location x form x stalk position	4	0.0071	0.0018	2.00 n.s.
Location x time x stalk position	8	0.0096	0.0012	1.33 n.s.
Location x time x form x stalk position	8	0.0031	0.0004	<1 n.s.
Residual	36	0.0337	0.0009	

[a] Double asterisks (**) indicate significance at the 1-percent probability level while n.s. indicates nonsignificance at the 5-percent probability level.

quite uniform across stalk positions. Of course, some particular stalk positions within one location showed a significant price difference between tied and untied tobacco. However, within the lower stalk position there were no significant differences between tied and untied tobacco at any location. When all three locations were averaged, prices for tied and untied leaves were, at the greatest, only $1.54 per hundred pounds apart. This difference occurred for middle leaves and was not significant.

The significant interaction between location and stalk position indicated that these two factors were not independent, or, more specifically, that the prices received for tobacco from various stalk positions varied by location. This finding was the primary reason why, in the previous discussion which dealt with results presented in Table 6, price averages for tied and untied leaves were not pooled across locations. In other words, it was not possible to conclude that tied leaves sold higher than untied leaves for all locations and stalk positions. The conclusions which were drawn depended upon the individual location and/or stalk position being analyzed.

PROFITABILITY OF TIED MARKET PREPARATION

The analysis of tied-untied labor requirement differences showed
that untied preparation could result in substantial labor cost savings.
In contrast, the analysis of tied-untied market price differences
generally showed that neither tied nor untied preparation offered any
price (revenue) advantage. In this section, these two earlier analyses
are combined into an analysis which will briefly be concerned with the
profitability of tied market preparation.

Break-Even Wage Rates

Table 9 shows the break-even wage rate per hour that could be
paid to labor for tying leaves to make this form of preparation as
profitable for the farmer as selling untied leaves. These break-even
rates were computed by dividing positive tied-untied price differen-
tials by the tied-untied differential in market-preparation labor
requirements. Thus, they are the maximum rates which could be paid
and still profitably prepare leaves in a tied form. If lower wage
rates could be paid, then tying would be profitable; with higher rates,
given the additional labor needed to obtain the price premiums listed
in Table 9, tying would not be profitable.

The break-even wage rates (Table 9) are extremely low for the
lower stalk positions at the Wilson County and Columbus County loca-
tions (an unrealistic $.36 per hour). However, for the middle stalk
position at the Columbus County location, one could pay a $1.01-per-
hour wage; at the Moore location, one would be able to pay a relatively
high $1.38-per-hour wage and still increase net returns by selling
leaves in the tied form. At the Columbus County location, one could
pay a $1.30 hourly wage for the upper stalk position and profitably
sell in a tied form. Wages such as $1.38 and $1.30 per hour are higher
than minimum wages that were in effect during 1968 ($1.15 per hour).
Therefore, it can be concluded that leaves from these stalk positions
were the only ones found for which tied sales possibly could have
increased net revenue.

Table 9. Labor Requirement Differentials, Market-Price Differentials and Resultant Maximum (Break-Even) Wage Rates for Profitable Tied Market Preparation of Leaves at Individual Stalk Positions Within Locations

Stalk Position by Location	Tied-Untied Labor Requirement Difference[a]	Tied-Untied Market Price Difference[a]	Break-Even Wage Rate[b]
	(hrs./100 lbs.)	(dols./100 lbs.)	(dols./hr.)
Wilson County			
Lower	3.91	1.41	0.36
Middle	3.46	-0.48	-
Upper	4.35	-5.27	-
Columbus County			
Lower	2.82	1.02	0.36
Middle	2.85	2.89	1.01
Upper	2.96	3.85	1.30
Moore County			
Lower	2.66	0.64	0.24
Middle	1.62	2.23	1.38
Upper	2.68	-0.26	-

[a]Computed by subtracting the average untied requirement or price from the corresponding average tied requirement or price (see Tables 3 and 6).

[b]Computed by dividing labor differences (shown in the first column) into market price differences (shown in the second column). Results are only shown for those observations where the tied-untied price differential was positive.

Yield Increases with Untied Preparation

Some observers contend that leaves marketed untied rather than tied will weigh more, due to less leaf breakage and to selling more wastes, sand, etc., with the leaves. Others contend this is not the case. It was not a primary objective of this study to test this hypothesis but data were collected which shed some light on it. Average weights per harvested stick for tied compared to untied leaves are shown in Table 10. These are weighted averages across stalk positions within each location; they are not the data which were statistically analyzed, viz., data from individual stalk positions for the first two sales periods. On the average, tied market preparation resulted in nearly the same weight as untied preparation--2.38 pounds per harvested stick for tied compared to 2.42 pounds for untied. In short, it was concluded that there were no significant yield differences. This made it unnecessary to consider yield differences when computing break-even wage rates.

Table 10. Pounds per Harvested Stick for Tied Versus Untied Leaves at Each Location

Location	Pounds per Harvested Stick for:	
	Untied Preparation[a]	Tied Preparation[a]
Wilson County	2.53	2.42
Columbus County	2.35	2.30
Moore County	2.38	2.42
All Locations	2.42	2.38

[a]Weighted averages across stalk positions, i.e., all weights (pounds) divided by total number of harvested sticks for each of the 8 means shown in this table.

SUMMARY

This study tested several widely held hypotheses about the
marketing of flue-cured tobacco. Controlled experiments on three
North Carolina tobacco farms were used as a means of obtaining 1967
data. These experiments made possible the identification in full
of the exact tobacco which was being sold at any given time during
the 1967 season. Factors such as stalk position, farmer grade, farm
location, etc., all important in the marketing of untied and tied
tobacco, were able to be analyzed. With certain controls imposed upon
the experiments, valid tests were made of the profitability of untied
as opposed to tied tobacco which was sold during the 1967 marketing
season.

It was found that the labor required for market preparation of
tied tobacco was significantly higher than the labor requirement for
untied tobacco. For the entire stalk (across all three locations),
tied leaves required 5.00 man-hours per 100 pounds for market prepara-
tion while untied leaves required only 1.94 man-hours per 100 pounds.
Also, for most individual stalk positions (within each location), tying
leaves required more time than preparing leaves for market in untied
form. Most of these results concerning market preparation times were
consistent with earlier work on this same problem area by Brooks and
Toussaint.[7]

In general, there was no significant difference detected between
the prices received for untied and tied leaves sold from these
controlled experiments. For the entire stalk, the average market
price across the three locations was $65.73 per 100 pounds for tied
leaves and $65.13 per 100 pounds for untied leaves. Only one location
(Columbus County) sold tied leaves for significantly higher prices
than untied leaves. At one other location (Wilson County), for the
entire stalk, untied leaves brought a higher price than tied leaves,

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[7] Brooks and Toussaint, op. cit.

but this premium was not large enough to be significant. Overall, tied leaves brought a significantly higher price than untied leaves for only a few individual stalk positions.

It was concluded that lower stalk leaves received a significantly higher price than either middle or upper leaves when all tobacco sold was combined for each location. On the other hand, market prices for middle and upper leaves were not significantly different at one location and were significant at the .05 level at another location.

It was found that wage rates in excess of $1.00 per hour only could be paid in very few instances (stalk positions) and still make it profitable to tie leaves. Given the minimum wage rates of the 1967 season, selling leaves in tied form would have subtracted from net returns for tobacco from most stalk positions.