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To the Graduate Council:

I am submitting herewith a thesis written by William M. Walker entitled "Measurement of Soil Productivity on Selected Soils in Terms of Corn Yields." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agronomy.

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SOILS IN TERMS OF CORN YIELDS

A THESIS

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CHAPTER I

INTRODUCTION

Many different soil mapping units¹ occur in Tennessee, and the soils making up these units vary greatly in their capacity to produce crops. These variations in productivity result from differences in physical, chemical, and biological characteristics of the soil, climatic factors, soil and crop management practices, and other ecological conditions.

For some time there has been a recognized need for obtaining information so that crop yields could be estimated with greater accuracy. In the 1930's, investigators in several states (2, 5, 12, 18) studied soil productivity and certain of these investigators developed soil productivity ratings. As management practices are important in soil productivity, crop yield information should be obtained from soil mapping units at defined levels of management inputs. More recently investigators (1, 8, 10) have obtained data from certain soils at different management levels. As different crops have different soil requirements, yield information for each crop on each soil mapping unit is more useful than a general soil rating and, whenever possible, productivity ratings should be expressed in absolute units such as bushels per acre or tons per acre for each specified crop.

Soil productivity and management data can be used to predict the mean expectable yield of a particular crop on a given soil mapping unit

¹Soil mapping units are cartographic separations of soils usually based on soil type, slope gradient, and degree of erosion.

at defined levels of management. It can be used also to evaluate management practices, to achieve the best allocation of soil resources among competing crops within a farm unit, and to make more accurate fertilizer recommendations.

In this study no attempt was made to set up a numerical index for the soil mapping units, such as the Storie index (12). Yield and management information were obtained from selected farms and certain criteria were defined to set up different management levels.

Corn is a good crop to use to measure soil productivity in Tennessee for a number of reasons. It is a crop that is widely grown throughout the state and will, therefore, occur on practically every farm. Since the data for this study were to be obtained from corn fields located on private farms in East Tennessee rather than from experimental plots, a crop that is widely grown was necessary. Corn is a high-value crop (13), ranking third in total value among crops in Tennessee and first in total value among grain crops. Corn is also a crop that occurs on widely varying soil mapping units, thus one crop can be used to test the productive capacity of many different soil mapping units.

The objectives of this study were: (1) to evaluate three methods of obtaining yield estimates and to determine which of the three would be the best to use in subsequent investigations; (2) to compare soil productivity as measured by corn at different levels of management on the same or similar soils; (3) to compare soil productivity as measured by corn at the same level of management on different soil groups; and

(4) to partially characterize the environmental conditions where yield estimates were obtained and relate these to yields.

CHAPTER II

PROCEDURES AND METHODS

A soil productivity and management study cooperative between the Agronomy Department of the University of Tennessee and the Soil Conservation Service was conducted in fifteen counties in East Tennessee, from the Southeast boundary to the Northeast boundary of the state. The plots were selected by Work Unit Conservationists from corn fields of cooperating farmers.

Each field was checked with respect to soil homogeneity to determine whether it was suitable for this study. In order for a plot¹ to be satisfactory, 90 per cent of its area must be of one soil mapping unit with less than 10 per cent of inclusions of a second soil mapping unit.

An average of three plots per county was obtained. An attempt was made to select the plots on the basis of three soil groupings. One of the plots was to be on an "excellent corn soil" such as Huntington A1² (15). This soil mapping unit is usually uneroded and has very desirable physical and chemical properties. A second plot was to be located on a "good corn soil" such as Etowah B2. This soil mapping unit has desirable physical and chemical properties and is usually only

¹As used in this study a plot was defined as a soil mapping unit from which harvest data were obtained.

²Letters denote slope gradient and the following number denotes degree of erosion.

moderately eroded. The third selection was to be a "poor corn soil" such as Montevallo D3. This soil mapping unit has undesirable physical and chemical properties and is usually moderately to severely eroded.

Personnel of the Soil Conservation Service selected the plots, assisted in obtaining harvest samples³ from the plots, collected soil samples, and procured aerial photographs of each farm where a plot was located. The author, in cooperation with members of the Agronomy Department, developed the "Soil Management and Productivity Schedule," made laboratory determinations, assisted in obtaining harvest samples, developed the harvest procedures, and tabulated and analyzed the information gathered.

Harvest Methods

An important phase of this study was the development of a practical method of obtaining accurate yield information. As some method of obtaining acreage data must be used and since it was not practical to have each cooperator harvest and weigh all of the corn from each plot, it was decided that three different methods of harvest would be attempted in 1956 and the best method selected upon the basis of the data obtained. The methods of harvest that were compared were the "row method," "wagon bed method," and "crib method."

³A harvest sample was defined as that portion of a corn row (measured with tape), which was harvested and weighed.

Row Method

Many problems are involved in the use of a "row method" for determining corn yields. If corn rows are selected for harvesting after reaching the field, the results may be biased because of the selection of the "best" or "worst" rows. If only one row of corn is selected in the field, there may be little likelihood of selecting a row that will be representative of the whole field. If too many rows are selected from the field, too much time will be required to obtain the harvest sample. The number of harvest samples per plot and the length of the row to use for each harvest sample were arbitrarily selected. For this study six harvest samples were selected from each plot following a systematic, predetermined plan. The combined area of the six harvest samples ranged from three to four hundredths of an acre.

Since a number of different people unaccustomed to experimental techniques participated in obtaining the harvest samples, a systematic method of locating the harvest sample was preferred over one requiring randomization. In a study of sampling methods, Odell (6) found that systematic sampling gave a more accurate estimate of yield than did random sampling, was easier to harvest, was less time-consuming, and was without bias.

Many of the selected plots were irregular in shape, and in order to simplify the use of the systematic method of harvest, the largest possible rectangle or square that could be fitted into the plot was used in setting up a diagram of harvest procedure. The approximate length of the rectangle or square was determined by pacing, the width of the

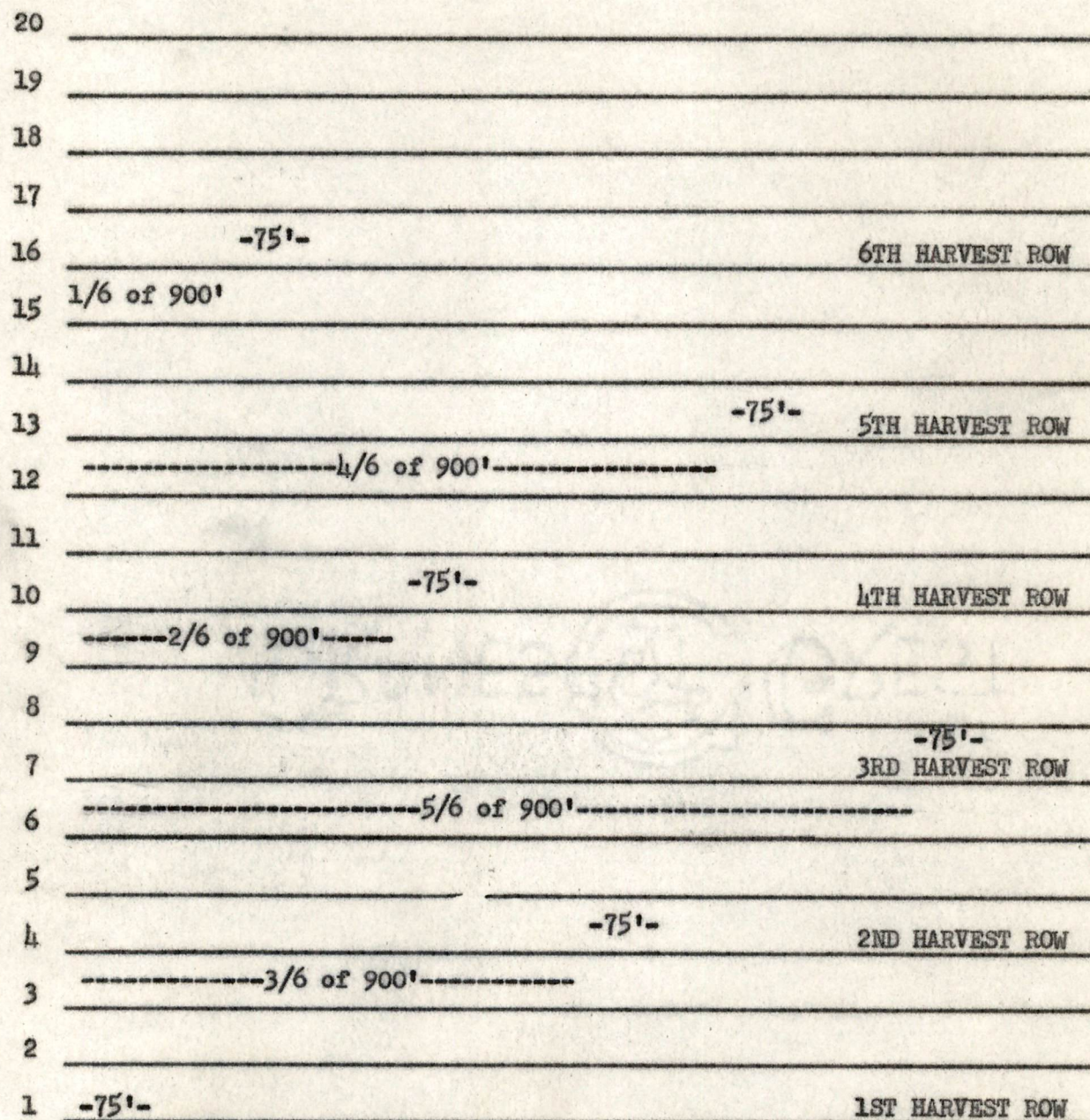
rectangle or square was determined by counting the total number of rows contained in it.

In order to locate the rows that were to contain a harvest sample, the total number of rows located in the rectangle or square were counted and the nearest multiple of six was chosen. This number was divided by six. This value, minus one, gave the total number of rows to skip between each row that contained a harvest sample. For example, a diagram of the harvest procedure (Figure 1) contains twenty rows in the plot. The multiple of six nearest 20 is eighteen. Eighteen divided by six equals three, less one equals two, which is the number of rows to skip between each row that contained a harvest sample.

The location of the first row that contained a harvest sample was determined in the following manner. If there were no noticeable effects on the outside row due to trees, fence rows, or damage from animals, any outside row at any corner of the rectangle or square would be the first row to contain a harvest sample. When the outside rows of the rectangle or square were affected by factors such as trees, fence rows, or animals, the outside row was skipped and another row was selected which had not been noticeably influenced by these factors. As these effects were variable at each site, there could be no systematic determination of which row would be the first row in the plot.

The location of the harvest sample with respect to its position in the row was determined in the following manner. Beginning at a stalk to be harvested, the first seventy-five feet of the first row that contained a harvest sample was measured and harvested. The location of the

Row No.



(75' = 1/2")

Figure 1. Diagram of Harvest Procedure for Each Soil Mapping Unit Sampled

second harvest sample was determined by pacing one-half the length of the row. The location of the third harvest sample was five-sixths the paced length of the row, and similarly, the fourth harvest sample was located by pacing one-third the length of the row. The fifth harvest sample was located by pacing two-thirds the length of the row and the sixth harvest was located by pacing one-sixth the length of the row. A diagram of this harvest procedure is shown in Figure 1.

If an ear of corn were missing from a stalk in the harvest sample due to factors such as wind or rodents, a "competitive" ear was harvested from a stalk in a nearby row. A "competitive" ear was defined as an ear of corn that had grown under environmental conditions similar to those of the missing ear. For example, if an ear of corn was missing from a stalk that contained two ears, a nearby stalk was selected that contained two ears of corn, and the corresponding ear, whether upper or lower, was harvested.

The shucked corn from each of these harvest samples was then weighed and the weight recorded. Three or more ears from each of the harvest samples were then grouped and weighed at the plot and sent to the Agronomy Department for moisture determination with a Steinlite moisture meter (17). Corn yields from which a moisture determination were made were expressed at $15\frac{1}{2}$ per cent moisture. In a few cases moisture samples were not available and the per cent moisture was estimated.

Since measurements were made from a harvested portion of an acre (row width and length), the total amount of corn per acre was

determined by dividing the weight of the corn harvested by the portion of an acre from which it came, giving yield in pounds per acre which was readily changed to bushels per acre. An example of these calculations is shown on page 42 in Appendix B.

Wagon Bed Method

For the "wagon bed method," inside measurements were taken of the farmers' wagon or wagons that were used in harvesting the corn. The farmer kept a record of the number of wagon loads of corn harvested and, using the standard three and one-half cubic feet per bushel of shuck corn, the volume that was occupied by corn was converted to bushels. By the use of an aerial photograph of the plot and an Ott-planimeter, the acreage of the plot was determined. The total yield was then converted to bushels per acre.

Crib Method

The "crib method" is similar to the "wagon bed method" in that crib measurements were taken to determine the volume occupied by the corn. When possible, inside measurements were taken of the crib before the corn was harvested and the depth of the corn in the crib was measured after harvesting; however, in some cases it was necessary to use outside dimensions exclusively. Acreage of the plot was determined by the use of an aerial photograph and an Ott-planimeter. Using the standard three and one-half cubic feet per bushel of shuck corn, the volume occupied by corn was converted to bushels and then the total bushels were converted to bushels per acre.

Collection of Climatic Data

In order to determine rainfall, "Rainmeter" rain gauges were placed with each cooperator and he was asked to record rainfall data throughout the growing season. This information was supplemented with rainfall data of the United States Weather Bureau and various TVA stations throughout the Tennessee Valley.

Collection of Soil Samples and Procedures for Laboratory Determinations

A surface soil sample composite of approximately twenty borings was collected from each plot by Work Unit Conservationists and Soil Scientists and sent to the laboratory for soil test determinations. These samples were then tested for pH, available phosphorus, exchangeable calcium, exchangeable potassium, and per cent organic matter. The methods and instruments used for these determinations were:

- (1) pH--Beckman pH meter using a soil paste
- (2) Available phosphorus--Modified Truog procedure (4)
- (3) Exchangeable cations (Ca and K)--Beckman flame photometer using ammonium acetate extraction (9)
- (4) Organic matter--Walkley-Black rapid oxidation procedure (16).

Collection of Crop and Management History

A schedule of questions⁴ was asked each owner or operator of each selected plot by the Work Unit Conservationist to determine the more significant soil and crop management practices. Some of the practices that were recorded were the date of planting, method of planting, variety planted, cropping history of the plot, present and past fertilization, liming history, and cultivation practices.

⁴A copy of the complete schedule of questions is found in Appendix A.

CHAPTER III

RESULTS AND DISCUSSION

The number and per cent of yield estimates obtained by each method of harvest is shown in Table I. Yield estimates were obtained from only 28.6 per cent of the plots by the "wagon bed method" and from only 20.4 per cent of the plots by the "crib method." There are several reasons for the small number of reported yield estimates by these two methods. In some cases the selected fields contained two or more soil mapping units and the corn could not be harvested separately from each plot. In other instances, the corn was never gathered but was "hogged off." Some cooperators shocked their corn and fed it from the shock and others harvested a wagon load or portion of a wagon load and fed it from the wagon.

The discrepancies in yields among the three harvest methods are presented in Table II. These discrepancies may have been due to many factors. The volume per bushel estimate was an average value and did not take into consideration the degree of packing, heaping, or moisture content of the corn. Farmer records and estimates of partial loads may have been inaccurate. Some discrepancies may have been due to corn-picker loss when a mechanical cornpicker was used to harvest the plot. Many errors could have occurred in plot acreage determinations as a result of planimentering, drawing in the soil mapping unit or errors in the scale of the aerial photograph.

TABLE I

NUMBER AND PER CENT OF CORN PLOTS HARVESTED BY THE ROW,
WAGON BED AND CRIB METHODS

	Row Method	Wagon Bed Method	Crib Method
Number of plots	49	14.0	10.0
Per cent of total	100	28.6	20.4

TABLE II

YIELDS OF CORN OBTAINED BY THE ROW, CRIB,
AND WAGON BED METHODS^a

Key Number of Soil Mapping Unit	Bushels Per Acre Row Method	Bushels Per Acre Wagon Bed Method	Bushels Per Acre Crib Method
34	147	--	169
75	132	--	55
33	116	57	58
71	106	70	--
100	95	78	110
92	86	75	48
41	82	69	47
3	65	62	56
111	64	66	--
15	62	64	--
113	55	48	--
19	51	41	42
35	43	34	--
115	38	21	--
17	32	48	--
13	14	17	19

^aOther yield estimates which are not reported in this table were obtained from additional plots by the row method.

Odell's work (6) showed that a systematic method of obtaining yield estimates was accurate and without bias, so the "row method" was considered the most accurate of the three methods used. Although data were not available to show the amount of time spent in obtaining yield estimates by each of the three methods studied, the Work Unit Conservationists of the Soil Conservation Service were practically unanimous in their belief that the "row method" required less total time than either the "wagon bed method" or the "crib method." In addition, when the "row method" is used, the cooperator does not have to keep records of harvest information; it is easier to get a uniform area with respect to one soil mapping unit; it is fairly easy to obtain plant population and lodging information at the time of harvest, and it can be used when two or more soil mapping units occur in the same corn field.

Soil Groups

As there were not sufficient plots to compare individual soil mapping units, the soil mapping units were placed into a number of major groups for a comparison of soil data, management information, and yields. These groups were bottomland soils, soils derived from terrace and old colluvial deposits, and two upland groups.

Bottomland soils comprise a group of soils that have an A-C profile. Most bottomland soils selected were well-drained. Representative series are Huntington, Congaree, and Staser. Soils derived from terrace and old colluvial deposits have an A-B-C profile and a moderately developed textural "B" horizon. Representative series

selected were Etowah, Waynesboro, and Sequatchie. The upland groups selected were the Fullerton group and the Decatur-Dewey-Cumberland group. Although the Cumberland soil is a terrace soil, it was placed in the Dewey-Decatur group because it is similar in profile properties to these two soils. The Fullerton group and the Dewey-Decatur-Cumberland group have an A-B-C profile and well-developed textural "B" horizons.

Comparison of Soil Data

The surface soil tests, fertilizer applications and other management information along with yield per acre of corn by the "row method" are shown on page 44 in Appendix B. The mean soil test values in the selected soil groups are presented in Table III.

An analysis of variance of the means was tested at the .01, .05, .10, and .20 probability levels. The mean pH values and the mean percent organic matter were not significantly different for any of the soil groups at these probability levels. There was a significantly greater amount of exchangeable calcium in the bottomland plots at the .01 probability level than in any of the other soil groups. The terrace soils contained a significantly greater amount of exchangeable calcium at the .01 probability level than did the Fullerton or Dewey-Decatur-Cumberland group. The Dewey-Decatur-Cumberland group contained a significantly greater amount of exchangeable calcium at the .01 probability level than did the Fullerton group.

TABLE III

MEAN SOIL TEST VALUES IN SELECTED
SOIL GROUPS

	pH	Exchange- able Ca in lbs/A	Exchange- able K in lbs/A	Available Phosphorus in lbs/A	Per Cent O.M.
Bottomland group	6.01	2663	295	17.70	2.5
Terrace group	5.86	2205	240	19.34	2.7
Fullerton group	5.63	1360	191	36.30	2.4
Dewey-Decatur- Cumberland group	5.93	1843	433	16.14 ^a	2.4

^aOne soil test was not used in calculating the available phosphorus average because of its high pH.

Recent applications of lime may have been the cause of the differences in the mean amounts of exchangeable calcium found among the soil groups; however, there are other factors which should be considered. The significantly greater amount of exchangeable calcium found in bottomland soils may have been due to calcium in drainage water from calcareous parent material, or to movement of applied lime from upland soils to the bottomland soils. The significantly greater amount of exchangeable calcium in the terrace group than on the Dewey-Decatur-Cumberland group or the Fullerton group may have been due to a smaller leaching loss and to the fact that the terrace soils are younger soils than the upland groups. The significantly greater amount of exchangeable calcium in the Dewey-Decatur-Cumberland group than in the Fullerton group may have been due to the greater degradation of the Fullerton soils. (14)

A significantly greater amount of exchangeable potassium was found in the Dewey-Decatur-Cumberland group at the .05 probability level and a significantly greater mean amount of available phosphorus was found in the Fullerton group at the .01 probability level than in any of the other soil groups. These greater mean amounts are probably due to recent fertilizer applications of these elements.

Comparison of Mean Amounts of Applied Fertilizer

The mean amounts of applied nitrogen, potash, and phosphorus were compared and no significant differences between the amounts applied to the different soil groups were found. When the rate of nitrogen applied

per acre was calculated manure was assumed to contain five pounds of nitrogen per ton.

Lodging

The mean per cent lodging on bottomland soils was 7.04 per cent, on terrace soils it was 9.30 per cent and on the Dewey-Decatur-Cumberland group it was 13.8 per cent. Lodging per cent was not computed on the Fullerton group because several plots in this group were planted to open-pollinated varieties whereas all other groups were planted to hybrids. There was significantly less lodging on the bottomland soils than on the Dewey-Decatur Cumberland group. No significant differences were found in mean per cent lodging between the terrace group and the bottomland group or between the terrace group and the Dewey-Decatur-Cumberland group.

Rainfall

Total rainfall during the months of June, July, August, and September ranged from 10.2 inches in Monroe County to 20.4 inches in Sevier County. Rainfall was quite variable among counties as shown in Appendix B on page 38.

During the growing season, July was the month having the greatest amount of precipitation. This is usually the period during the growing season which immediately precedes "silking," a critical time during the growth of the corn plant. Favorable moisture conditions at this time

favor high yields in corn production when other factors are not limiting.

Yield Comparisons at Field Weight and at Fifteen and One-half Per Cent Moisture

The discrepancy between yields expressed with no moisture determination and expressed at fifteen and one-half per cent moisture are presented in Table IV. The importance of moisture determinations is apparent and the importance of expressing yields at a constant moisture per cent cannot be over-emphasized.

Yield Comparisons Among Soil Groups Before Management Classification

As shown in Table V corn yields on the bottomland group of soils averaged 83.0 bushels per acre, the terrace group averaged 76.7 bushels per acre, the Fullerton group averaged 36.0 bushels per acre and the Decatur-Dewey-Cumberland group averaged 63.0 bushels per acre. There were no significant differences among the mean yields of the terrace group, the bottomland group and the Dewey-Decatur-Cumberland group. The bottomland soils had a significantly greater mean yield than the Fullerton group at the ten per cent level of probability, and the terrace group had a significantly greater mean yield than the Fullerton group at the twenty per cent level of probability.

TABLE IV

CORN YIELDS EXPRESSED AT FIELD WEIGHT AND
AT $15\frac{1}{2}$ PER CENT MOISTURE

Key Number of Soil Mapping Unit	Yield in Bu/A with No Moisture Determination	Yield in Bu/A at $15\frac{1}{2}$ Per Cent	Difference
85	164	83	81
7	142	90	52
79	161	113	48
121	142	108	34
15	93	62	31
57	91	62	29
17	61	32	29
63	71	44	27
61	108	82	26
41	108	82	26
1	69	43	26
53	78	54	24
43	117	93	24
51	113	90	23
19	73	51	22
45	94	75	19
39	68	50	18
25	43	26	17
35	58	43	15
21	77	52	15
87	85	71	14
23	43	31	12
38	60	49	11
55	95	85	10
13	23	14	9
89	38	32	6
75	138	132	6
65	56	51	5
3	69	65	4
73	25	23	2

TABLE V

MEAN YIELD COMPARISONS AMONG CERTAIN SOIL GROUPS
BEFORE MANAGEMENT CLASSIFICATION

Soil Groups	Mean Yield Bu. Per Acre	Differ- ence Between Means	No. of Plots	L.S.D. at Probability of			
				.01	.05	.10	.20
Bottomland	83.0	6.3	18	--	--	--	NS
Terrace ^a	76.7		12				
Bottomland	83.0	47.0	18	NS	NS	43.5	--
Fullerton	36.0		5				
Bottomland	83.0	20.0	18	--	--	--	NS
Decatur-Dewey- Cumberland	63.0		6				
Terrace	76.7	40.7	12	NS	NS	NS	32.8
Fullerton	36.0		5				
Terrace	76.7	14.7	9	--	--	--	NS
Dewey-Decatur- Cumberland	63.0		6				

^aOld colluvial soils are included in the terrace group.

Management Levels

In order to compare differences in yields among the soil groups and variations in yields within soil groups, it was necessary to specify certain management levels to be used as criteria for management separations. The plots within each soil group were separated into "A" management as a high level of management and "B" management as a low level of management. "A" management was defined as a plot with a population of eight thousand plants per acre and one that had received an application of forty pounds or more of nitrogen per acre during the 1956 growing season. Where manure was applied it was assumed to contain five pounds of nitrogen per ton. If the corn crop followed a legume that was turned under as a green manure crop and nitrogen was the only limiting factor of management separation, then the plot was placed in "A" management. If another crop was grown concurrently with the corn crop, the plot was placed in "B" management, regardless of nitrogen applications or plants per acre. If a plot had received less than forty pounds of nitrogen per acre or had a population of less than eight thousand plants per acre, it was placed in "B" management.

Yield Comparisons Among Soil Groups After Management Classification

Mean yield comparisons of the two management levels are presented in Table VI, and mean yield comparisons of different soil groups at the same level of management are shown in Table VII. Significant differences

TABLE VI

MEAN YIELD COMPARISONS BETWEEN "A" AND "B" MANAGEMENT LEVELS

Management	Mean Yield Bu/A	Differ- ence Between Means	No. Plots	L.S.D. at Probability of			
				.01	.05	.10	.20
"A" No soil group- "B" ing	101.4 52.3	49.1	17 32	28.8	--	--	--
"A" Bottomland "B" soils	114.3 63.2	51.1	7 11	NS	42.8	--	--
"A" Terrace soils "B"	104.0 57.0	57.0	5 7	50.7	--	--	--
"A" Dewey-Decatur- "B" Cumberland	101.5 43.5	58.0	2 4	NS	NS	NS	43.7

TABLE VII

MEAN YIELD COMPARISONS AMONG SOIL GROUPS AT THE
SAME MANAGEMENT LEVEL

Soil Group	Management Level	Mean Yields Bu/A	Difference Between Means	No. Plots	L.S.D. at Probability of			
					.01	.05	.10	.20
Bottom soils	"A"	114.3	10.3	7	--	--	--	NS
Terrace soils		104.0		5				
Bottom soils	"A"	114.3	12.8	7	--	--	--	NS
Dewey, Decatur, & Cumberland		101.5		2				
Terrace soils	"A"	104.0	2.5	5	--	--	--	NS
Dewey, Decatur, & Cumberland		101.5		2				
Bottom soils	"B"	63.2	6.2	11	--	--	--	NS
Terrace soils		57.0		7				
Bottom soils	"B"	63.2	19.7	11	--	--	--	NS
Dewey, Decatur, & Cumberland		43.5		4				
Bottom soils	"B"	63.2	28.8	11	NS	NS	26	--
Fullerton soils		34.4		5				
Terrace soils	"B"	57.0	13.5	7	--	--	--	NS
Dewey, Decatur, & Cumberland		43.5		4				
Terrace soils	"B"	57.0	22.6	7	--	--	--	NS
Fullerton soils		34.4		5				

were found at the probability levels shown between mean yields at the "A" management level and the "B" management level within the bottomland group, terrace group, and the Dewey-Decatur-Cumberland group. There were no plots at the "A" level of management on the Fullerton group. There was also a highly significant difference between the "A" and "B" management levels when mean yields were compared regardless of soil grouping.

When mean yields of the soil groups were compared at the "A" level of management, no significant differences were found. As there were no Fullerton soils at the "A" level of management, it was not possible to compare them with the other soil groups at this level of management. There was a significant difference between mean yields of bottomland soils and the Fullerton soils at the "B" level of management. The lack of differences between soil groups at the "A" level of management may have been due to the favorable moisture conditions throughout the 1956 growing season. Because of favorable moisture conditions, it appears that those farmers using a high level of management obtained a favorable crop response regardless of the soil mapping unit on which the corn was grown. The significant difference at the "B" management level between the Fullerton group and the bottomland group may have been due to the more favorable physical properties of the bottomland group which will allow a more extensive root development of the corn plant and thus a greater available nutrient supply.

CHAPTER IV

SUMMARY AND CONCLUSIONS

A systematic "row method" of harvest sampling was developed.

This method along with the "wagon bed and crib methods" were used to obtain yield estimates. Due to discrepancies in yields, the low number of reported yields by the "wagon bed and crib methods," and other factors cited, it was concluded that the "row method" should be the method used in further investigations. Furthermore, all mean yield group comparisons in this study were made using yield estimates obtained by the "row method."

Yield estimates were obtained with no moisture determinations and at $15\frac{1}{2}$ per cent moisture. From the data presented, it is evident that yield comparisons between soil mapping units should be made at the same moisture per cent.

Selected soil mapping units were placed in groups according to similarities in profile properties. Specified management levels were then chosen in order to compare different soil groups at the same specified management level and to compare different management levels on similar soil groups.

Significant differences were found between mean yields of corn obtained by the "row method" at specified levels of management among the soil groups. Few significant differences were found among the soil groups when they were compared at the same specified level of management.

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1. The Commission on the Status of Women, established in 1946, was the first of its kind. It was created by the United Nations to study and report on the status of women in all countries.

2. The Commission's work is based on the principle that women's status is a matter of international concern and that it should be improved by international cooperation.

3. The Commission's work is based on the principle that women's status is a matter of international concern and that it should be improved by international cooperation.

4. The Commission's work is based on the principle that women's status is a matter of international concern and that it should be improved by international cooperation.

5. The Commission's work is based on the principle that women's status is a matter of international concern and that it should be improved by international cooperation.

APPENDIX A

6. The Commission's work is based on the principle that women's status is a matter of international concern and that it should be improved by international cooperation.

7. The Commission's work is based on the principle that women's status is a matter of international concern and that it should be improved by international cooperation.

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SOIL PRODUCTIVITY AND MANAGEMENT
SCHEDULE

1. Owner _____ Address _____
2. Operator _____ Address _____
3. Location of Test plot (describe briefly location of the plot in the county and on the farm).

I. FERTILIZATION

1. Fertilization at planting. Number of bags on plot _____
Wt. of each bag _____ Analysis (3-9-6 or 6-12-12 etc. _____
Manure (Total on plot in tons) _____
2. Sidedressing. Number of bags on plot _____ Wt. of each bag _____
Analysis _____
3. Briefly describe the placement of fertilizer at planting and sidedressing _____
4. Liming _____ Date (year) _____ Amt. per acre _____
5. Previous fertilization. (Give approximate amounts and analysis).
1953 _____ 1954 _____
1955 _____
6. Cropping system for the last 5 years on test plot. List the crops in order of their appearance on the land by years. If more than one (1) crop was grown in any one year, list the order of occurrence that year. If the variety is known, record it also. Note: An illustrative method of recording the cropping system indicating the use of the crop is shown below.*

*See next page.

Year	Crop and use of crop	Year	Crop and use of crop
1951	_____	1954	_____
1952	_____	1955	_____
1953	_____	Crop Use Legend:	_____

* Illustrative method of recording the cropping system.

Year	Crop and use of crop	Year	Crop and use of crop
1951	corn (g) wheat (p)	1954	same as 1951
1952	wheat (g) Korean les- pedeza (h) oats (p)	1955	same as 1952
1953	oats (p, gm) corn (g)		

Crop use legend: g - grain; p - pasture; h - hay; gm - green manure; - overseeded

7. How was previous crop grown on this field used? Hay _____
- Grazed _____ Turned under _____
- Other (burned, etc.) _____ Silage _____

II. SEEDBED PREPARATION

1. Date turned or plowed _____ Depth of plowing _____
2. Briefly describe the method of seedbed preparation _____

III. PLANTING AND CULTIVATION

1. Variety _____ Source of seed _____
Was seed certified? _____.
2. Seed treatment (briefly describe) _____
3. Date of last planting _____ Was corn replanted? _____
4. What is the width between the "shoes" on the corn planter? _____ in.

5. Was a row marker used on the planter? _____
6. Number and kind of cultivations (briefly describe) _____
7. Depth and kind of last cultivation. shallow (0-2 inches) _____
 medium (2-4 inches) _____ deep (4 inches) _____
8. Date of last cultivation _____
9. Chemical weed control _____ Dates _____
 No. of applications _____ Chemical used _____
 Rate per acre _____

IV. HARVESTING

1. Estimated yield in bushels of corn (on this plot) per acre in
 1955 _____ 1954 _____ 1953 _____
2. Presence of weeds at harvest. Very weedy _____ weedy _____
 few _____.
3. Damage due to insects and/or disease (briefly describe) _____
4. How was the corn gathered? corn picker _____ hand _____
 Date gathered _____
5. Is the corn shelled _____ shucked _____ not shucked _____

V. MEASUREMENT OF YIELD

A. WAGON BED MEASUREMENT METHOD

1. Wagon bed length* _____ ft. and inches. width* _____ inches
 depth* _____ inches.

*Note: inside measurements.

2. Were the wagon bed sideboards raised when corn was gathered? (example: such as putting an ear of corn between the sideboards _____ (yes or no).
 3. Were additional sideboards used? _____ If so, depth of the additional sideboard _____ inches.
 4. Number of wagon loads from test plot. _____
 5. Were all the wagon loads full loads? _____. If not, how many were not full loads? _____. Indicate a fraction for each partial load (as $1/2$, $2/3$, $3/4$, $1/4$). For example, 1 wagonbed $1/2$ full; 2 wagon beds $3/4$ full). _____
-

B. CRIB MEASUREMENT METHOD

1. Crib measurements occupied by corn after it is leveled. (corn must be leveled in the crib before measuring depth of corn to obtain accurate yield records) Length* _____ ft. and inches. width* _____ ft. and inches. Depth of corn in crib* _____ ft. and inches.

C. FIELD MEASUREMENT METHOD

1. Determine row width by measuring distance between 6 rows and dividing by 5. Row width _____.
2. (1) Measure 75 feet of row, (2) shuck and record weight of corn harvested from measured area. At this time count the number of erect and lodged** plants in each plot. Repeat this as many times as necessary to make sure a representative sample of entire field is obtained. Eight (8) to ten (10)

*Note: inside measurements.

**A lodged plant is one that is leaning more than 45° or broken below the ear.

measurements are preferable. The number of measurements obtained should not be less than 6.

3. Shucked weight, number of erect plants per 75 feet of row, and number of lodged plants per 75 feet of row from sample areas are as follows:

<u>Sampled area</u>	<u>Pounds of corn per 75 ft. of row</u>	<u>No. Erect Plants</u>	<u>No. Lodged Plants</u>
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
9	_____	_____	_____
10	_____	_____	_____

VI. SOIL CHARACTERIZATION

1. Mapping unit (Soil type, slope and erosion) _____
2. Average depth of A horizon on the plot _____
3. Uniformity of plot (describe) _____

VII. REMARKS



APPENDIX B

INCHES OF RAINFALL IN CERTAIN COUNTIES
DURING THE 1956 GROWING SEASON

County	Month				Total
	June	July	August	September	
Greene	--	7.4	3.8	--	11.2
Union	2.5	4.7	1.9	1.3	10.5
Hamilton	1.6	5.7	3.7	1.3	12.3
Meigs ^a	--	--	--	--	11.4
Bradley	3.7	4.3	3.2	1.3	12.5
Johnson	--	6.3	4.5	1.2	12.0
Monroe	2.4	3.9	0.7	3.2	10.2
Knox	3.6	6.1	1.9	1.8	13.4
Morgan	1.8	7.5	3.4	2.2	14.9
Sevier	4.1	6.9	4.1	5.3	20.4
Polk	3.4	5.2	3.4	4.0	16.0
Blount	2.7	4.5	1.5	1.7	10.4
McMinn	1.6	5.4	2.4	4.6	14.0
Washington	3.5	5.5	2.6	2.1	13.7
Hamblen	3.9	4.1	2.5	1.9	12.4
Grainger	1.4	5.1	2.2	2.0	10.7
Total	36.2	82.6	41.8	33.9	

^aWas not reported on a monthly basis.

CORN YIELD DATA SHOWING HARVEST SAMPLE WEIGHTS, TOTAL
WEIGHT OF THE HARVEST SAMPLES FROM EACH PLOT, ROW
WIDTH, AND TOTAL FRACTION OF AN ACRE HARVESTED
BY THE ROW METHOD ON BOTTOMLAND SOILS

Soil No.	Harvest Sample Number in Pounds						Total	Row Width	Total Fraction of an Acre Harvested
	1	2	3	4	5	6			
97	58.0	60.0	69.0	65.0	73.0	--	325.0	36 in.	.0256
34	75.1	80.5	68.1	73.7	88.2	80.7	466.3	38 in.	.0327
33	62.5	54.6	78.5	51.0	63.0	57.3	366.9	38 in.	.0327
79	78.7	51.8	66.4	64.3	62.9	63.2	387.3	40 in.	.0344
121	16.4 ^a	64.8	70.7	61.2	59.5	41.1	297.3	42 in.	.0300
51	49.8	45.4	42.9	44.8	47.7	54.7	285.3	42 in.	.0360
92	40.0	37.0	32.0	32.0	38.0	37.0	216.0	42 in.	.0360
61	45.5	46.2	41.9	40.6	43.5	43.1	260.8	40 in.	.0344
45 ^b	Two 62 ft. rows						66.0	42 in.	.0100
37	44.0	45.0	34.0	38.5	33.0	56.0	250.5	42 in.	.0360
111	38.0	40.0	42.0	32.0	32.0	39.0	223.0	42 in.	.0360
15	40.0	35.0	42.0	38.0	41.0	39.0	235.0	42 in.	.0360
57	38.0	42.0	44.0	48.0	45.0	38.8	255.8	42 in.	.0360
113	31.0	33.0	30.0	33.0	31.0	35.0	193.0	42 in.	.0360
93	34.0	35.0	23.0	28.0	30.0	27.0	177.0	40 in.	.0344
63	34.9	28.4	28.5	26.1	20.0	28.3	166.2	42 in.	.0360
23	c	c	c	c	c	c	109.0	42 in.	.0360
118	19.0	17.0	18.0	22.0	21.0	23.0	120.0	42 in.	.0360

^aHermitage inclusion atypical of the rest of the field so it was not used in calculation of the yield estimates.

^bTwo 62' rows were harvested.

^cData was not obtained for each harvest sample.

CORN YIELD DATA SHOWING HARVEST SAMPLE WEIGHTS, TOTAL
WEIGHT OF THE HARVEST SAMPLES FROM EACH PLOT, ROW
WIDTH, AND TOTAL FRACTION OF AN ACRE HARVESTED
BY THE ROW METHOD ON TERRACE AND OLD
COLLUVIAL SOILS

Soil No.	Harvest Sample Number in Pounds						Total	Row Width	Total Fraction of an Acre Harvested
	1	2	3	4	5	6			
123	48.5	48.3	42.8	40.5	45.0	56.5	281.6	38 in.	.0327
100 ^a	32.0	33.0	32.0	42.0	37.0	46.0	265.0	40 in.	.0350
71	43.0	40.0	44.0	43.0	45.0	40.0	255.0	40 in.	.0344
43 ^b	Two 62 ft. rows						82.0	42 in.	.0100
7	53.0	60.0	68.0	53.0	70.0	38.0	342.0	40 in.	.0344
85	55.0	50.0	46.0	52.0	43.0	51.0	297.0	30 in.	.0258
29	21.0	46.0	22.0	30.0	42.0	30.0	199.0	42 in.	.0360
77	34.0	30.5	30.0	36.0	33.0	31.0	194.5	42 in.	.0360
109	26.0	23.0	10.0	26.0	15.0	26.0	126.0	42 in.	.0360
31	9.0	20.0	28.0	22.0	24.0	15.0	118.0	42 in.	.0360
1	31.0	43.0	30.0	30.0	27.0	39.0	200.0	48 in.	.0413
105	13.0	11.0	5.0	20.0	12.0	23.0	84.0	37 in.	.0320
25	c	c	c	c	c	c	109.0	42 in.	.0360

^aHad 7 subsamples 65' 5" in length. No. 7 weighed 43.0 pounds.

^bTwo 62' rows were harvested.

^cData were not obtained for each harvest sample.

CORN YIELD DATA SHOWING HARVEST SAMPLE WEIGHTS, TOTAL
WEIGHT OF THE HARVEST SAMPLES FROM EACH PLOT, ROW
WIDTH, AND TOTAL FRACTION OF AN ACRE HARVESTED
BY THE ROW METHOD ON UPLAND AND TERRACE
SOILS PREDOMINATELY ON C AND D SLOPES

Soil No.	Harvest Sample Number in Pounds						Total	Row Width	Total Fraction of an Acre Harvested
	1	2	3	4	5	6			
75	57.6	55.7	62.9	56.4	61.4	53.9	347.9	42 in.	.0360
55	35.5	45.4	35.5	42.6	42.6	27.5	229.1	40 in.	.0344
41	54.8	36.6	43.9	42.7	43.4	39.6	261.0	40 in.	.0344
87	33.6	27.5	43.9	37.9	40.3	31.7	214.9	42 in.	.0360
3	32.2	27.8	24.3	31.7	30.2	28.4	174.6	42 in.	.0360
53	22.1	52.1	23.1	39.0	38.4	22.2	196.9	42 in.	.0360
21	a	a	a	a	a	a	194.0	42 in.	.0360
65	36.1	22.5	17.9	25.6	12.8	25.6	140.5	42 in.	.0360
19	a	a	a	a	a	a	183.0	42 in.	.0360
39	39.8	35.9	25.0	20.5	26.5	23.8	171.5	42 in.	.0360
38	15.2	27.2	30.7	27.3	26.6	24.8	151.8	42 in.	.0360
35	22.1	18.7	23.3	26.0	22.5	26.6	139.2	40 in.	.0344
115	15.0	17.0	17.0	11.0	13.0	16.0	89.0	39 in.	.0336
17	25.0	30.0	23.0	22.0	25.0	28.0	153.0	42 in.	.0360
89	10.9	18.8	14.7	21.0	13.9	16.3	95.6	42 in.	.0360
69	14.0	7.5	9.0	14.5	9.4	20.7	75.1	43 in.	.0370
73	3.5	8.8	8.8	16.8	18.0	9.0	64.9	43 in.	.0370
13	10.0	9.0	12.0	8.0	8.0	11.0	58.0	42 in.	.0360

^aData were not obtained for each sample harvest.

EXAMPLE OF THE CALCULATION OF YIELD PER ACRE FROM
THE HARVEST SAMPLES OF SOIL NUMBER 87

1. Total field weight of harvest samples 214.9 pounds.
 2. Conversion of pounds to grams - 12.2 pounds x 453.6 grams per
pound = 5,533.92 grams.
 3. Laboratory weight of the moisture sample = 4,336 grams.
 4. Moisture by Steinlite = 10.4 per cent.
 5. 6-75' rows 42 inches apart = $6 \times 75' \times \frac{42'}{12} \times \frac{1}{43560} = .036$ acre.
 6. (a) $\frac{214.9}{.036} = 5,969$ pounds per acre
(b) $\frac{5969 \text{ pounds}}{70 \text{ pounds per bushel}} = 85.3$ bushel per acre.
 7. To express 85.3 bushels per acre as bushels per acre at 15.5%
moisture the following calculations are made:
- | | | | | |
|-------------------|--|---------------|-----------------------------------|-------------|
| laboratory weight | $\frac{4336 \text{ grams}}{5533.92 \text{ grams}}$ | $\times 85.3$ | $\times \frac{1.00 - .104}{.896}$ | $= 70.8688$ |
| field weight | | | | |
- are 71 bushels per acre.

MEAN AMOUNTS OF NITROGEN, POTASH, AND PHOSPHOROUS
APPLIED TO THE SOIL GROUPS

(Manure applications were given five pounds
of nitrogen benefit per ton of manure)

	Applied N in <u>pounds/A</u>	Applied K ₂ O in <u>pounds/A</u>	Applied P ₂ O ₅ in <u>pounds/A</u>
Bottomland	70	61	63
Terrace	72	63	69
Fullerton	37	32	32
Dewey, Decatur, Cumberland	51	38	38

SURFACE SOIL TESTS, FERTILIZER APPLIED, PLANTS PER ACRE, AND
YIELD OF CORN ON SELECTED TRACTS 1956

Code No.	Soil Name	pH	Soil Test, lbs/A			Per Cent O.M.	Applied Fert. lbs/A			Previous Crop	Varieties of Corn	Date of Planting	Plants per Acre	1956 Corn Yields
			Ca	P	K		Manure	N	P ₂ O ₅					
Bottomland Soils														
97	Chewalca	5.90	2740	16.80	600	4.8	15T/A	97	56	56	Corn	D-29	22,289	181
34	Staser ^b	7.50	5000	4.16	336	3.1	43T/A	200	400	400	Oats (h)	D-33	16,238	147
33	Emory ^b	6.30	2530	29.76	344	3.5	0	70	20	20	Corn (g)	D-29	12,140	116
79	Staser	6.10	3000	40.00	492	3.0	8T/A	116	60	60	Corn (g)	D-22	15,378	113
121	Huntington	5.30	2720	20.80	214	3.5	0	65	57	49	None	FG-779W	11,389	108
51	Congaree	5.35	1400	28.80	124	2.0	0	12	24	24	Pasture	D-29	7,972	90
92	Congaree	5.80	2340	13.12	96	2.7	0	27	74	74	Oats (h)	FG-779W	9,889	86
61	Staser	6.15	3000	15.20	134	2.3	0	6	18	12	Corn	FG-711	7,645	82
45	Congaree ^a	5.50	1160	9.60	156	1.7	8T/A	18	36	36	Cover crop	FG-134	7,800	75
37	Staser ^b	5.70	1760	17.76	300	1.9	0	12	24	24	No crop	FG-134	8,389	72
111	Lindside ^b	6.20	2260	16.80	380	1.9	0	14	28	28	Soybeans (g)	D-33	8,417	64
15	Huntington	5.35	1520	28.80	160	2.4	0	40	44	44	Oats and	FG-711	9,056	63
											Crimson cl. (p.h)	D-29		
57	Hamblen	6.15	2800	7.20	212	1.9	1T/A	33	66	66	Corn & Beans	FG-711	7,750	62
113	Huntington ^b	6.15	3920	18.56	600	2.5	0	9	36	18	Corn (g)	FG-34	7,083	55
												FG-711		
93	Emory ^b	6.10	2200	20.80	424	2.1	0	59	32	32	Corn	D-22	8,140	53
63	Prater	6.30	2840	4.24	222	1.7	1T/A	33	66	66	Corn & Beans(g)	FG-711	8,250	49
23	Emory	6.45	2640	14.40	400	2.8	8T/A	16	48	48	Oats & Crim-	FG-711	7,222	47
											son cl. (h)			
118	Huntington	5.90	3060	11.76	110	1.9	0	18	36	36	Oats (h)	FG-711	7,000	34
Terrace and Old Colluvial Soils ^c														
123	Etowah ^b	6.30	3580	29.76	344	3.5	0	58	18	18	Corn (g)	D-22	15,015	123
100	Etowah ^b	6.15	1600	6.98	286	1.7	10T/A	102	32	32	Oats	D-29	8,000	108
71	Harstelle ^c	5.10	1280	30.00	500	2.2	0	25	50	50	Crimson cl. & Rye grass	D-33	9,593	106
43	Sequatchie ^a	6.70	1920	28.00	148	2.1	8T/A	68	36	36	Lespedeza (h)	FG-134	7,600	93
7	Sequatchie	6.80	2160	19.20	182	3.8	0	137	274	274	Rye grass	FG-134	14,128	90
85	Hayter	5.70	2640	6.24	386	6.6	7T/A	117	106	106	Timothy & Red clover (p)	FG-134	22,651	83
29	Wolftever	5.50	3480	9.52	148	2.3	0	17	34	34	Sudan (h)	FG-711	6,833	79
77	Sequatchie ^b	5.30	2320	20.40	212	2.2	0	68	96	96	Corn (g)	FG-134	8,167	77
109	Sequatchie ^b	5.60	1520	32.00	166	2.3	0	20	60	60	Corn (g)	FG-711	7,083	50
31	Wolftever	5.80	3320	8.40	160	2.2	0	20	60	60	Corn (g)	FG-711	5,611	47

SURFACE SOIL TESTS, FERTILIZER APPLIED, PLANTS PER ACRE, AND
YIELD OF CORN ON SELECTED TRACTS 1956 (CONTINUED)

Code No.	Soil Name	pH	Soil Test, lbs/A			Per Cent O.M.	Applied Fert. lbs/A				Previous Crop	Varieties of Corn	Date of Planting	Plants per Acre	1956 Corn Yields
			Ca	P	K		Manure	N	P ₂ O ₅	K ₂ O					
1	Jefferson D2	6.80	2000	61.00	370	4.7	0	123	80	80	Corn	FG-134	May 1,2,5	10,242	43
105	Waynesboro	5.90	1240	7.04	118	1.3	0	6	18	12	Corn	Thompson's Prolific	May 20	5,656	38
25	Face	5.50	1400	34.56	228	2.0	0	74	42	42	Fescue & landino cl.	D-22	May 18	4,528	26
Upland and Terrace Soils Predominately on C and D Slopes															
75	Dewey C2	7.35	2900	VL	330	2.7	0	82	84	84	Grass (p)	D-29	April 10	14,694	132
55	Sequoia C2	6.90	2520	12.96	182	2.3	0	40	80	80	Alf. & Fescue	D-33	May 1	9,244	85
41	Dunmore C2, D2	5.85	1440	8.00	174	1.5	0	45	68	100	Lespedeza (h)	FG-134	May 9	9,506	82
87	Cumberland C2	5.20	1080	8.00	414	2.8	0	40	28	28	Pasture (h)	FG-711	April -	10,944	71
3	Dunmore C2	6.05	1720	19.80	362	1.7	0	45	180	180	Or. & Landino	FG-512W	April 17	7,722	65
53	Cumberland D1	6.00	1640	21.44	360	2.4	0	7	14	14	No crop	T-10	May 5	12,530	54
21	Fullerton C2	5.40	1520	32.00	340	2.1	3T/A	21	42	42	Corn	FG-711	April 24	7,139	52
65	Dewey C2	5.85	2000	3.60	344	2.5	0	95	30	30	Lespedeza	Neal's Paymaster	June 5	7,389	51
19	Fullerton C2	6.10	1520	9.28	156	2.4	2.5T/A	15	30	30	Or. & Landino	D-29	April 24	6,779	51
39	Dunmore D-2	5.90	1400	35.20	264	2.8	1T/A	324	145	145	Lesp. & Or. gr.	FG-711	May 15	8,777	50
38	Sequoia C2	5.40	1920	22.70	254	2.0	0	12	24	24	Corn	Neal's Paymaster	April 20	6,000	49
35	Montevallo E3	6.00	2100	17.76	480	2.3	0	50	46	46	Alfalfa (h,gr)	D-22	April 25	7,878	43
115	Deweyb C2	5.50	1680	15.52	600	2.1	0	10	12	12	Oats & Lesp. (h)	FG-711	Apr. 27,28	7,381	38
17	Decatur B2	5.70	1760	16.00	550	1.9	0	45	24	24	Or. & Landino	D-29	June 1	7,722	32
89	Fullerton B2	5.65	1320	17.60	100	2.0	0	45	90	90	Lespedeza (h)	FG-711	May 4	5,917	32
69	Talbottb C3	4.95	1880	3.92	500	1.2	0	21	42	42	Sage	D-29	June 11	9,486	29
73	Fullerton Cherty C2	5.70	1480	68.00	140	2.5	7T/A	0	0	0	Clover & Gr.	Shoepeg	May 15	7,837	23
13	Fullerton D2	5.30	960	4.64	218	2.9	0	40	0	0	Idle	Thompson's Prolific	May 29	4,916	14

^aNot harvested by randomized row method.

^bNo moisture determination was made and field weight was considered as being at 15½ per cent moisture with the exception of bottom plots. For bottom plots a factor of .7239 was used to convert field weight to 15½ per cent moisture. This factor was obtained by averaging all of the factors that were obtained from moisture samples on bottom plots.

^cUpland soil placed in this group because of similarity in profile properties to terrace soils in this group.