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Productivity of Dewey and Emory soils for soybeans

Dewey Victor Simpson

To the Graduate Council:

I am submitting herewith a thesis written by Dewey Victor Simpson entitled "Productivity of Dewey and Emory soils for soybeans." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Plant, Soil and Environmental Sciences.

Frank F. Bell, Major Professor

We have read this thesis and recommend its acceptance:

George J. Buntley, Charles R. Graves

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Charles R. Graves

George J. Buntley

Accepted for the Council:

Hilton A. Smith

Vice Chancellor
Graduate Studies and Research

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PRODUCTIVITY OF DEWEY AND EMORY SOILS FOR SOYBEANS

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee

Dewey Victor Simpson

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ABSTRACT

The purpose of this study was to determine the productivity of Emory and Dewey soil mapping units for soybeans and to relate their yields to certain soil properties. The average yields as determined by this study may be used as a guide in updating the soybean yield estimates of Emory and Dewey soils in Tennessee. It must be realized that the results of this study are a collection of only one year's data; therefore, care must be taken when updating soybean yield estimates.

Yield data for soybeans were obtained from privately owned farms in Blount County, Tennessee. The plots were selected and soil samples were taken prior to planting. All producers cooperating in this study were interviewed to gather information on their production and management practices.

The soil samples from each plot were analyzed for pH, available phosphorus, exchangeable potassium, percent sand, percent silt, and percent clay. Variance that was due to fields and soils was determined and significance determined by an "F" test. It was found that there was a significant difference among the soil mapping units for yield, percent silt, and percent clay. Percent sand, available phosphorus, exchangeable potassium, pH, and plant population were not significant at the 0.01 level of probability among soil mapping units. There were significant differences among fields for all variables at the 0.01 level. Except for weed control, there appeared to be no obvious relationship between management practices and yield.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Several studies have been conducted to evaluate and estimate soil productivity. As agricultural technology advances, it becomes necessary to update these yield estimates. Updated yields can be used to estimate yields of similar soils within an area by comparison of soil properties and characteristics.

The purposes of this study were to determine the productivity of Emory and Dewey soils for soybeans and to relate these yields to certain soil properties.

CHAPTER II

LITERATURE REVIEW

As agricultural technology advances, it becomes necessary to update the productive potentials of soils. The productive potential of a soil is the maximum yield that a soil will produce under present technology. Modern equipment has reduced harvest losses, and soil fertility studies have greatly increased crop response to fertilization. These productivity potentials are useful in estimating crop yields of soils with similar properties and characteristics.

Several studies have been conducted on alternative ways of estimating soil productivity. All of these studies placed different priorities on the factors affecting yield. These factors were management, rainfall distribution, mean maximum daily temperature, slope gradient, degree of erosion, soil profile texture, cropping systems, and soil treatments.

Odell and Smith (9) recognized the management differences in their crop yield estimates by soil types. They divided management inputs into three clearly defined classes. The first class included land that was in a rotation with one-quarter in legume pasture or one-third of the land with a legume catch crop plowed under as green manure. The second class consisted of a rotation with one-sixth of the land in legume pasture, or one-fifth to one-quarter in a legume catch crop. The last class had a rotation of corn and oats, with no clover seeded in the oats.

Rust and Odell (11) later did a similar yield study with rainfall and mean maximum daily temperature as the independent variables. Management inputs were controlled. The results of the study were more satisfactory for determining the relative productivity of soils than were the results of predicting the net effect of individual management factors in the preceding study. It was found easier to measure and correlate rainfall and mean maximum daily temperature than management inputs.

The New Mexico Experiment Station (8) published a bulletin demonstrating a method for rating land. All production factors were assigned a rating. Factors which were included were slope gradient, degree of erosion, and such soil factors as pH, inherent fertility, stratification, rocks, and erodibility. Other special factors that were evaluated were moisture deficiency, flooding, salinity, alkalinity, water table influences, and stoniness. A "perfect" soil was given a rating of 100 percent, and a "fair" soil had a rating of about 70 percent. A rating of 70 percent may be fair, good, or poor for different crops. In other words, the soil may be fair for pasture production, but it may be poor for soybean production.

Moisture, which can be measured by drought days, could affect soybean yields. Van Bavel (15) defines a drought day as a "24-hour period (starting at the time of the day at which the precipitation of the previous day is recorded) in which the soil moisture stress (moisture tension plus osmotic pressure) exceeds a limit, which, on the basis of experimental evidence, may be taken as a point at which the productive processes of the crop are being appreciably decreased." Buntley (3) reports that the critical time for adequate water in soybeans is during flowering and early pod filling. Yields will be reduced if drought days occur during this critical time. It is pointed out that if flowering and pod filling could coincide with favorable rainfall distribution, yields could be significantly increased.

Buntley (2), in a report entitled "Soybean Production Potentials of Some Major Tennessee Soils," posed the question, "Could the average yield of soybeans in Tennessee be increased significantly through closer attention to the land selection factor and through the use of improved production practices?" Few of the sites selected yielded under 40 bushels. Well drained bottoms averaged 54 bushels, moderately well drained soils averaged 48.7 bushels/acre, somewhat poorly drained soils averaged 42.7 bushels, and those from somewhat poorly drained to poorly drained soils averaged 40.7 bushels. He also reports that soybean yields consistently decreased with an increased slope gradient. This yield sequence was found to be predictable, and probably reflects the higher runoff and lower water supplying capacity of the soils on steeper slopes.

Bell and Springer (1) report that Tennessee soils vary greatly in their capacity to produce crops and in crop response to soil and crop management practices. By defining levels of management inputs, soil productivity could be evaluated on the basis of "key" soils. The yields of the "key" soils were related to soils of similar properties. Smith and Smith (12) used a similar approach. They indexed the soils on the basis of productivity. They point out that crop yields may be estimated if the soil type and system of management is known. Yields within a soil type vary little if the degree of management and climate do not vary. Soil properties within the same soil type are similar and variation in yield within a soil type may be insignificant.

Several studies have been conducted in Tennessee to evaluate and estimate soil productivity. Walker (16) found significant differences among soil groups for the productivity of corn when compared at the same level of management. In a study by Graves (6), Huntington, Waynesboro, and Dickson soils in Putnam County showed significant differences in yield and response to management inputs. Peace (10) revealed in his study that estimates of soil productivity were more accurate if the crops were grown under high levels of management, fertility, and adequate moisture. Homesley (7) grouped soils of similar characteristics and related yield to variations of these characteristics among soils. He established a base yield at 0 to 2 percent slope and none to slight erosion, and then adjusted the base yield by percentages as the slope and erosion increased.

Carpenter (4) conducted a study to determine the average and potential yields of certain crops on various soil mapping units in Tennessee. The yield data were compiled from yields obtained on University of Tennessee Agricultural Experiment Stations and from the Cotton Emphasis Program. Most of the data were obtained from variety trials, using the five highest yielding varieties to measure soil productivity. The yields were indexed, compared, and related to differences in each soil's characteristics. The yield differences were often explained by variation in depth, moisture supplying capacity, degree of erosion, slope gradient, or some combination of these factors. He also points out that the variability within one of his mapping units for soybean yields was reduced about 50 percent by irrigation.

CHAPTER III

METHODS AND PROCEDURES

This study was conducted in Blount County, Tennessee in 1973.

The soil series studied were Emory and Dewey. The mapping units within these series were: (1) Emory silt loam, 0 to 2 percent slope; (2) Emory silt, 0 to 2 percent slope; (3) Emory loam, 0 to 2 percent slope; (4) Emory silty clay loam, 0 to 2 percent slope; (5) Dewey silt loam, 2 to 5 percent slope, slight to moderate erosion; (6) Dewey loam, 2 to 5 percent slope, slight to moderate erosion; (7) Dewey silt, 2 to 5 percent slope, slight to moderate erosion; (8) Dewey clay loam, 2 to 5 percent slope, slight to moderate erosion; (9) Dewey silt loam, 5 to 12 percent slope, severely eroded; (11) Dewey clay loam, 5 to 12 percent slope, severely eroded; (12) Dewey silty clay loam, 5 to 12 percent slope, severely eroded; (13) Dewey clay, 5 to 12 percent slope, severely eroded. Representative soil descriptions are in Appendix A.

I. SELECTION OF THE EXPERIMENTAL PLOTS

Through the cooperation of the Soil Conservation Service, Blount County Co-op, and the Blount County Agricultural Extension Service, it was possible to obtain a list of the soybean producers in Blount County. The farms were screened for the appropriate soil series. From this list of about 20 producers, screening was again done to select farmers producing at a high management level. The farmers were then visited to discuss the research proposal with them. Each producer filled out a questionnaire concerning his past and present soybean production practices (sample questionnaire is in Appendix B).

There were three replications of each soil mapping unit within each field. The soil mapping unit plots were located, mapped and staked so that they could be relocated at harvest time. Soil samples were collected from the 6-inch surface horizon of each soil mapping unit plot. Eleven fields were used. (Two of the fields were lost due to early harvesting by the producer and poor weed control.)

II. ANALYSIS OF SOIL SAMPLES

Soil samples from the 6-inch surface horizon were analyzed for pH, available phosphorus, and exchangeable potassium by the University of Tennessee Soil Testing Laboratory. The same samples also were analyzed for the percentages of sand, silt, and clay. The percent sand was determined by sieving a 10-gram sample of the soil through a 300-mesh sieve, percent clay by the 10-gram hydrometer method, and silt by difference.

III. SOYBEAN SAMPLING AND SOYBEAN YIELD DETERMINATION

Three 20-foot soybean row samples were obtained from each soil mapping unit for yield determination. The row nearest the center of the plot and the third row on each side of the center row were sampled to determine yield. The aboveground plant was harvested, dried, and thrashed. Seed yield was calculated on the basis of 13 percent moisture content. Plant population was determined by counting the number of plants in each 20-foot row sample harvested.

IV. STATISTICAL ANALYSIS

The design was a split-split plot with fixed effects. Variance that was due to fields and soils was determined and significance determined by an "F" test (see Appendix C). Treatment means were subjected to Duncan's New Multiple Range Test.

CHAPTER IV

RESULTS AND DISCUSSION

The average and range of yields are given in Table I. There was a significant difference among all three soil mapping units" for yield at the 0.01 percent level. The greatest range in yield was on the Emory soils. This is attributed to the flooding of some of the Emory plots in the early part of the growing season. The other Emory soils were on slopes that allowed excess water to drain away before damaging the crop.

The three soil mapping units did not yield in the same decreasing order in every field. As shown in Table II, Fields 7 and 8 had lower yields for the Emory soils than the Dewey B1 soils, and in Field 7 the Emory soils had the lowest average yield of the three soil mapping units. This is also attributed to flooding of these Emory soil mapping units in the early part of the growing season. The yield remained high for the Emory soils, because some of the Emory soils were located on convex midslopes rather than concave slopes. The concave slopes did

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*From this point on all Emory soil mapping units will be referred to as Emory soils; the Dewey silt loam or loam, 2 to 5 percent slope, slight to moderate erosion will be referred to as Dewey B1; the Dewey loam, silt loam, silty clay loam, or silty clay, 5 to 12 percent slope, severely eroded will be referred to as Dewey C3. All of the above will remain so unless otherwise stated.

TABLE I

AVERAGE AND RANGE OF SOYBEAN YIELDS OF THE THREE SOIL MAPPING UNITS ACROSS ALL FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Soil Mapping Unit	Number of Observations	Average Yield*	Range of Plot Yields
		------------bu/A------------	
Emory soils	81	28.3 a	52.9-9.1
Dewey B1	81	25.0 b	42.0-10.9
Dewey C3	81	19.6 c	37.5-6.3

*Means for any given treatment followed by any letters in common are not significantly different at the 5 percent level according to Duncan's New Multiple Range Test.

TABLE II

AVERAGE SOYBEAN YIELDS OF THE THREE SOIL MAPPING UNITS BY FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Field Number	Number of Observations Per Soil	Soil Mapping Unit: Emory Soil	Dewey B1	Dewey C3
		bu/A		
1	9	42.0	34.0	28.3
2	9	31.3	20.6	12.1
3	9	32.6	24.6	20.4
4	9	15.2	17.0	13.7
5	9	22.5	22.0	15.0
6	9	32.2	28.8	18.3
7	9	22.6	26.1	23.0
8	9	23.6	25.6	22.0
9	9	33.0	26.9	23.8

not allow the excess water to drain away as readily as the convex midslopes. Data in Table III indicates that the yields among the Emory soils differed because of the relative location of the soil within the field. The concave positions yielded lower than the convex midslope positions, because the concave slopes received more runoff and drained more slowly than the convex midslope positions. The Emory soils in other fields were located on convex slopes or concave slopes that allowed drainage during periods of heavy rainfall.

The Dewey B1 soils across all fields averaged 25.0 bushels per acre, which is 3.3 bushels per acre less than the Emory soils. The Dewey B1 soils were located on slopes great enough to allow runoff of excess water, thus avoiding damage to the crop. The 6-inch silt loam or loam surface of the Dewey B1 may have also provided enough available water to supply the soybeans with available water during the short drought periods of August, September, and October. The Dewey C3 soils did not have this extra available water during these periods of moisture stress, possibly because they were severely eroded.

The lowest average yields across all soil mapping units were obtained in Fields 4 and 5 as shown in Table IV. These reduced yields may be attributable to low fertility in Field 5 and the lack of weed control in both fields. By excluding Fields 4 and 5, the average yield on the Emory soils is increased by 2.8 bushels, the Dewey B1 soils by 1.6 bushels, and on the Dewey C3 soils by 1.5 bushels (see Table V).

TABLE IV

AVERAGE SOYBEAN YIELD OF ALL SOILS BY FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Field Number	Number of Observations	Average Yield* bu/A
1	27	34.7 a
2	27	21.3 c
3	27	25.9 b
4	27	15.3 d
5	27	19.8 c
6	27	24.6 b
7	27	23.9 bc
8	27	23.6 bc
9	27	27.9 b

*Means for any given treatment followed by any letters in common are not significantly different at the 5 percent level according to Duncan's New Multiple Range Test.

TABLE V

AVERAGE SOYBEAN YIELD OF THE THREE SOIL MAPPING UNITS MINUS SOYBEAN YIELDS OF FIELDS 4 AND 5 - BLOUNT COUNTY, TENNESSEE - 1973

Soil Mapping Unit	Number of Observations	Average Yield* bu/A
Emory soils	63	31.1 a
Dewey B1	63	26.6 b
Dewey C3	63	21.1 c

*Means for any given treatment followed by any letters in common are not significantly different at the 5 percent level according to Duncan's New Multiple Range Test.

I. SOIL FERTILITY

There were significant differences among fields, which included all mapping units at the 0.05 percent level for pH, available phosphorus, and exchangeable potassium as shown in Table VI. Field 1 had the highest pH, level of available phosphorus, and average yield of soybeans. The exchangeable potassium in Field 1 was the third highest level of all fields. This indicates that the high yield of Field 1 may be attributable to its high soil fertility.

Field 4 had the lowest average yield across all mapping units but not the lowest fertility. Field 5, the second lowest yielding field, had the lowest available phosphorus and exchangeable potassium, and these levels were significantly different from Field 4. The pH and average yields of Fields 4 and 5 were not significantly different. Field 6 had very similar fertility conditions and the same variety of soybean as Field 4, yet Field 6 yielded 11.1 bushels per acre more than Field 4. This supports the earlier indication that weeds may have contributed heavily to reduced soybean yields in Field 4.

It is interesting to note that Field 8 had the lowest pH, which was 5.0, yet Field 8 had the highest exchangeable potassium and the fourth highest available phosphorus. The reduced yield of Field 8 probably can be attributed to this low pH and flooding of some parts of the field in the early part of the growing season.

The average pH, available phosphorus, and exchangeable potassium by soil mapping units across all fields are shown in Table VII. There was

TABLE VI

AVERAGE pH, AVAILABLE PHOSPHORUS, AND EXCHANGEABLE POTASSIUM BY FIELDS ACROSS ALL MAPPING UNITS IN BLOUNT COUNTY, TENNESSEE - 1973

Field Number	pH*	P*	K*
1	6.4 a	31.2 a	267.8 ab
2	5.3 cd	7.1 d	177.8 cd
3	6.3 a	10.8 cd	212.2 bc
4	6.1 ab	26.6 a	241.1 abc
5	6.1 ab	7.1 d	126.7 d
6	6.1 ab	27.8 a	238.9 abc
7	5.8 abc	17.0 bc	205.6 bc
8	5.0 d	22.9 ab	304.4 a
9	5.6 bc	17.7 bc	273.3 ab

*Means for any given treatment followed by any letters in common are not significantly different at the 5 percent level according to Duncan's New Multiple Range Test.

TABLE VII

AVERAGE pH, AVAILABLE PHOSPHORUS, AND EXCHANGEABLE POTASSIUM BY SOIL MAPPING UNITS ACROSS ALL FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Soil Mapping Unit	Number of Observations	pH*	P*	K*
Emory soils	27	5.8 a	19.5 a	213.0 a
Dewey B1	27	5.9 a	19.9 a	233.7 a
Dewey C3	27	5.8 a	16.7 a	235.9 a

*Means for any given treatment followed by any letters in common are not significantly different at the 5 percent level according to Duncan's New Multiple Range Test.

no significant differences among the soil mapping units for pH, available phosphorus, or exchangeable potassium at the 0.05 level of probability.

II. PERCENTAGES OF SAND, SILT, AND CLAY OF THE 6-INCH SURFACE HORIZON OF THE THREE SOIL MAPPING UNITS

The 6-inch surface horizon analyzed for pH, available phosphorus, and exchangeable potassium was also analyzed for percentages of sand, silt, and clay. The Emory soils in Field 1 were silt loams and loams and were the highest yielding soils in this study. The Emory silt loam soils of Field 1 yielded higher than the loams as shown in Table VIII. However, notice in Field 7 that the loam soils of the Emory plots yielded higher than the silt loams. The silt loam Emory soils of Field 7 were flooded with water occasionally in the early part of the growing season, whereas the Emory loam received little runoff and remained drained.

Also note that in Field 6, one of the Emory soils had a texture of silty clay loam. This Emory soil was located at the base of a Dewey clay, 5 to 12 percent slope, severely eroded, and the Emory soil was beginning to develop an inverted profile as a result of the erosion from Dewey C3 above it.

One Emory soil of Field 3 had a silt texture. No reason can be given for the occurrence of this texture.

The average yield of the different textures of the Emory soils are given in Table IX. The silt loam textures yielded 8.7 bushels per acre

TABLE VIII

TEXTURE OF THE 6-INCH SURFACE HORIZON AND AVERAGE YIELD OF THE EMORY SOIL MAPPING UNITS BY FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Field Number	Texture	Average Yield bu/A	Number of Observations
1	Silt loam	44.1	3
	Loam	40.9	6
2	Silt loam	33.6	6
	Silt	26.8	3
3	Silt	31.9	6
	Silt loam	34.1	3
4	Silt loam	15.2	9
5	Silt loam	22.5	9
6	Silt loam	33.2	6
	Silty clay loam	30.3	3
7	Silt loam	21.4	6
	Loam	25.0	3
8	Silt loam	23.6	9
9	Silt loam	33.0	9

TABLE IX

AVERAGE YIELD BY TEXTURES OF THE 6-INCH SURFACE HORIZON OF THE EMORY SOILS ACROSS ALL FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Texture 6-Inch Surface Horizon	Average Yield bu/A	Number of Observations
Silt loam	26.9	60
Silt	30.2	9
Loam	35.6	9
Silty clay loam	30.3	3

less than the loam textures, but it is important to note that the occurrence of the silt loam soils was seven times more than the loam soils.

The Dewey B1 soils had textures of loam, silt loam, silt, and clay loam as shown in Table X. The Dewey B1 soils in Field 1 were all loams and were the highest yielding Dewey B1 soils. Field 4 contained one Dewey B1 soil with a silt texture. This Dewey B1 soil was located close to the edge of a Dunmore silt loam mapping unit, and the silt texture was probably the result of a transition influence. The Dewey B1 loam soils yielded 8.8 bushels per acre higher than the silt loam mapping units (Table XI). Again notice that there are four times the number of observations on the silt loam mapping units. However, it was observed that the Dewey B1 soils all remained well drained throughout the growing season, and the difference in yield between the two mapping units might be explained through further substrata investigations.

The Dewey C3 soils had textures of silt loam, loam, clay loam, silty clay loam, and clay as shown in Table XII. Two of the Dewey C3 soils in Field 1, the highest yielding of the Dewey C3 soils, were loams. The third Dewey C3 mapping unit was a clay loam and yielded 11 bushels per acre less than the loam mapping units. This reduced yield is probably attributable to the lower infiltration rate of the clay loam mapping unit, which would result in a lower water supplying capacity than the loam. The occurrence of a silt loam mapping unit in Field 6 was probably the result of sampling too close to the Dewey silt

TABLE X

TEXTURE OF THE 6-INCH SURFACE HORIZON AND AVERAGE YIELD OF THE DEWEY B1 SOIL MAPPING UNITS BY FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Field Number	Texture 6-Inch Surface Horizon	Average Yield bu/A	Number of Observations
1	Loam	34.0	9
2	Silt loam	20.6	9
3	Silt loam	24.6	9
4	Silt loam	18.0	6
	Silt	15.0	3
5	Silt loam	22.0	9
6	Loam	30.0	6
	Clay loam	26.2	3
7	Silt loam	26.1	9
8	Silt loam	25.2	9
9	Silt loam	26.9	9

TABLE XI

AVERAGE YIELD BY TEXTURES OF THE 6-INCH SURFACE HORIZON OF THE DEWEY B1 SOILS ACROSS ALL FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Texture 6-Inch Surface Horizon	Average Yield bu/A	Number of Observations
Silt loam	23.6	60
Loam	32.4	15
Silt	14.9	3
Clay loam	26.2	3

TABLE XII

TEXTURE OF THE 6-INCH SURFACE HORIZON AND AVERAGE YIELD OF THE DEWEY C3 SOIL MAPPING UNITS BY FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Field Number	Texture 6-Inch Surface Horizon	Average Yield bu/A	Number of Observations
1	Loam	31.9	6
	Clay loam	21.0	4
2	Silt loam	14.2	3
	Silty clay loam	9.2	6
3	Silt loam	23.0	6
	Silty clay loam	15.6	3
4	Silt loam	13.7	9
5	Silt loam	15.0	9
6	Silt loam	19.0	3
	Clay	18.1	6
7	Clay loam	23.0	9
8	Silt loam	20.5	3
	Silty clay loam	23.0	6
9	Silt loam	22.0	3
	Silty clay loam	25.0	6

loam B1 mapping unit above the C3. Also this C3 mapping unit did not have as steep a slope or degree of erosion as the other two C3 mapping units in the field.

With the exception of the Dewey loam C3, the clay loam yielded higher than the other C3 textures (Table XIII). The lowest yielding Dewey C3 texture was a silt loam with 17.4 bushels per acre. This can be explained in part by the Dewey silt loam C3 textures of Fields 4 and 5, which were the two lowest yielding fields. If these Dewey C3 yields were not averaged in with the other silt loam yields, the average yield of the silt loam C3 soils would be 20.1 bushels per acre. This is a three bushel per acre increase, but still less than the clay loam texture. Also, the clay loam textures were located in the first and fourth highest yielding fields.

The average percent sand, silt, and clay of the 6-inch surface horizon by soil mapping units is shown in Table XIV. There were no significant differences among the mapping units for sand. For silt, significant differences were found between the Dewey C3 and the other two mapping units. This is expected, because the Dewey C3 soils have only slight amounts of the A horizon remaining. Likewise, the significant differences between the Dewey C3 and the other two mapping units for percent clay is also expected, because the soil samples for the Emory and Dewey B1 soils were taken from the top 6-inch A_p horizon, where only slight to moderate amounts of the original A horizon had been eroded.

TABLE XIII

AVERAGE YIELD BY TEXTURES OF THE 6-INCH SURFACE HORIZON OF THE DEWEY C3 SOILS ACROSS ALL FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Texture 6-Inch Surface Horizon	Average Yield bu/A	Number of Observations
Silt loam	17.2	36
Loam	31.9	6
Clay loam	22.5	12
Silty clay loam	18.5	21
Clay	18.1	6

TABLE XIV

AVERAGE PERCENT SAND, SILT, AND CLAY BY SOIL MAPPING UNITS ACROSS ALL FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Soil Mapping Unit	Percent Sand*	Percent Silt*	Percent Clay*
Emory soils	21 a	65 a	14 a
Dewey B1	23 a	62 a	15 a
Dewey C3	23 a	51 b	26 b

*Means for any given treatment followed by any letters in common are not significantly different at the 5 percent level according to Duncan's New Multiple Range Test.

III. PLANT POPULATION

The average plant population per 20-foot row by fields is shown in Table XV. Fields 2 and 4, which were two of the three lowest yielding fields, had a significantly higher average population than the other fields.

The average plant population per 20-foot row by soil mapping units is given in Table XVI. There were no significant differences in plant population among the soil mapping units.

Table XVII shows the average plant population per 20-foot row by soil mapping units by fields. There were reductions in plant population on the Emory soils in Fields 4 and 7. This probably is due to flooding in the early part of the growing season on the Emory soils.

IV. SUMMARY OF THE QUESTIONNAIRE

Each producer was asked to complete a questionnaire in an attempt to find out his past and present farming practices. The form used in this survey is in Appendix A.

The average number of years growing soybeans for the producers in this study was four years. Experience ranged from two to ten years. The producers indicated that the reasons they failed to obtain a good stand of soybeans in the past were because of planter problems, excessive rainfall during pre- and postemergence herbicide applications, dry weather, failure to cover the seed properly, soil crusting, and drilling made it difficult to regulate depth.

TABLE XV

AVERAGE SOYBEAN PLANT POPULATION PER 20-FOOT ROW SAMPLE BY FIELDS ACROSS ALL SOIL MAPPING UNITS IN BLOUNT COUNTY, TENNESSEE - 1973

Field Number	Number of Observations	Plant Population* Per 20-Foot Row
1	27	71.1 c
2	27	156.6 a
3	27	No data gathered
4	27	168.1 a
5	27	No data gathered
6	27	80.0 c
7	27	74.9 c
8	27	108.0 b
9	27	75.3 c

*Means for any given treatment followed by any letters in common are not significantly different at the 5 percent level according to Duncan's New Multiple Range Test.

TABLE XVI

AVERAGE SOYBEAN PLANT POPULATION PER 20-FOOT ROW SAMPLE BY SOIL MAPPING UNITS ACROSS ALL FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Soil Mapping Unit	Number of Observations	Plant Population* Per 20-Foot Row
Emory soils	81	102.0 a
Dewey B1	81	111.2 a
Dewey C3	81	101.4 a

*Means for any given treatment followed by any letters in common are not significantly different at the 5 percent level according to Duncan's New Multiple Range Test.

TABLE XVII

AVERAGE SOYBEAN PLANT POPULATION PER 20-FOOT ROW SAMPLE BY SOIL MAPPING UNITS BY FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Field Number	Number of Observations Per SMU/Field	Emory Soils	Dewey B1	Dewey C3
1	9	75.1	71.9	66.2
2	9	157.2	157.3	156.0
3	9	---	---	---
4	9	133.7	197.0	173.7
5	9	---	---	---
6	9	83.0	82.7	74.0
7	9	71.0	78.3	75.3
8	9	116.3	111.3	96.3
9	9	77.9	80.0	68.0

The producers used different cropping systems with soybeans. The most used system was a rotation of corn for grain, sometimes followed by small grain for pasture, and then followed by soybeans for grain. Other producers used soybeans followed by small grain for pasture. Only one producer in this study used a continuous soybean cropping system with no winter cover.

Land preparation was fairly consistent with all producers. They usually plowed once, disced twice, and cultimulched twice.

Four of the six producers indicated that they always tested the soil before planting. All of these four producers also indicated that they followed the recommendations of their soil tests.

Two of the producers indicated that they followed no consistent liming practice. One producer indicated that he limed every five years, and the other three producers said that they followed recommendations.

Not all farmers treated their seed with innoculant. Four of the six producers innoculated their seed. One producer said that he did not innoculate because the innoculant clogged his planter. Another producer said that he did not use innoculant if the field had been in soybeans within the last three years.

Also the same two producers that did not innoculate their seed, did not treat their seed with molybdenum. Again one producer indicated that molybdenum clogged up his planter. The other producer said that if the pH of the soil was above 6, molybdenum was not used.

Different varieties of soybeans were grown by the producers. As shown in Table XVIII, four of the producers grew Dare, three grew Hill, and two producers grew Lee-68.

Three of the six producers indicated that they cultivated their soybeans during the growing season to control weeds.

The earliest soybeans were planted on May 10 while the latest soybeans were planted on June 20 as shown in Table XVIII. This 41-day difference in planting dates did not show any obvious relationship to yield.

Fertilization rates are shown in Table XIX. There appears to be no obvious relationship of fertilization rate to yield.

TABLE XVIII

VARIETY OF SOYBEAN AND PLANTING DATE BY FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Field Number	Planting Date	Variety
1	6/20	Dare
2	6/12	Lee-68
3	5/16	Hill
4	5/10	Dare
5	5/21	Hill
6	6/20	Dare
7	6/20	Dare
8	5/18	Hill
9	5/18	Lee-68

TABLE XIX

FERTILIZER ANALYSIS AND FERTILIZATION RATES BY FIELDS IN BLOUNT COUNTY, TENNESSEE - 1973

Field Number	Fertilizer Analysis	Fertilization Rate lb/A
1	60% KCl	300
2	0-20-20	200
3	0-26-26	250
4	6-12-12	250
5	0-26-26	400
6	40% P_2O_5	70
7	0-26-26	150
8	0-26-26	250
9	0-26-26	250

CHAPTER V

SUMMARY AND CONCLUSIONS

The productive capacity of Emory and Dewey soil mapping units for soybeans was measured on selected farms in Blount County, Tennessee. Yields ranged from 53 to 9 bushels per acre on Emory soils, 42 to 11 bushels per acre on Dewey B1, and 38 to 6 bushels per acre on Dewey C3. The average yields per acre obtained on these three mapping units across all fields were: Emory A1, 28.3 bushels; Dewey B1, 25.0 bushels; and Dewey C3, 19.6 bushels. There was a significant different between all three mapping units at the 0.01 percent level of probability.

Soil samples were taken from the 6-inch surface horizon of all plots. These samples were analyzed for pH, available phosphorus, exchangeable potassium, percent sand, percent silt, and percent clay. There were no significant differences between the soil mapping units for the average pH, available phosphorus, exchangeable potassium, or percent sand. There were significant differences among the soil mapping units for percent silt and clay. These differences were expected, because the Dewey C3 has only slight amounts of the original silt loam surface remaining.

Yields obtained in this study will be useful in estimating yields of these three soil mapping units. Also these yields can be useful in estimating productivity of soils with similar physical and chemical properties in the same general region of Dewey and Emory. It is also important to note that the rainfall during this study was higher than normal.

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LITERATURE CITED

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APPENDIX A

SOIL DESCRIPTIONS

The following soil descriptions are taken from the Blount County Soil Survey and are representative of the three soil mapping units in this study. These descriptions do not refer to any particular soil mapping unit in this study.

Emory Silt Loam, 0 to 2 Percent Slope*

This is a well drained soil that is developing in local alluvium. The alluvium was washed from associated Dewey soils. The Dewey soils were derived from high grade limestone. This soil occupies narrow strips along intermittent drainageways and small areas in sinks. Most of the areas along the drainageways have very gentle slopes. They are not likely to be flooded except under very heavy precipitation. The areas in the sinks are nearly level or saucerlike. Much of their acreage is subject to temporary ponding because most of the water that flows onto them from surrounding slopes is carried away only through subterranean outlets. Even though the individual areas of this soil are small, the soil is important to farming because it is highly productive.

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*Elder, Joe A., et al. Soil Survey. Blount County, Tennessee, 1959.

Profile description:

0 to 18 inches, dark reddish-brown or dark-brown friable silt loam; moderate medium granular structure.

18 to 40 inches +, reddish-brown, dark reddish-brown, or dark-brown friable silt loam; moderate medium granular structure.

5 to 12 feet, limestone bedrock generally occurs.

The soil is highly fertile, moderately high in organic matter, medium acid, permeable, high in water supplying capacity, and tilth is very good.

Dewey Silt Loam, 2 to 5 Percent Slope*

This is an upland soil that is deep and well drained. It is the result of weathered products of high grade dolomitic limestone. This soil contains a moderate amount of organic matter, reaction is medium acid to strongly acid, natural fertility is relatively high, is permeable to roots, has a moderately high water supplying capacity, and often contains large quantities of clay in the subsoil.

Profile description:

0 to 7 inches, brown to dark-brown friable silt loam; moderate medium granular structure.

7 to 11 inches, yellowish-red friable silty clay loam; moderate and strong fine subangular blocky structure.

11 to 17 inches, red firm silty clay; moderate to strong medium subangular blocky structure.

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*Elder, Joe A., et al. Soil Survey. Blount County, Tennessee, 1959.

17 to 44 inches, red firm silty clay or clay; strong medium subangular blocky structure.

44 to 60 inches, red or yellowish-red firm clay or silty clay; structure less distinct than in layer above and individual aggregates are larger; few yellowish-brown variegations that are more numerous in lower portion; few finely divided chert fragments.

7 to 20 feet, limestone bedrock generally occurs.

Dewey Silty Clay, 5 to 12 Percent Slope*

This is a well drained soil that is scattered to small areas on the uplands. This soil is developed from high grade dolomitic limestone. The plow layer is red or yellowish-red firm silty clay or clay loam. The underlying material contains some chert fragments and grades with depth to a lighter red. There are a few shallow gullies which can be crossed with heavy farm machinery. This soil is low in fertility and contains little organic matter. It is medium to strongly acid, low in moisture supplying capacity, fairly permeable to roots, and very poor in tilth.

Profile description:

0 to 4 inches, yellowish-red friable silty clay; moderate and strong fine subangular blocky structure.

4 to 10 inches, red firm silty clay; moderate to strong medium subangular blocky structure.

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*Elder, Joe A., et al. Soil Survey. Blount County, Tennessee, 1959.

10 to 37 inches, red firm silty clay or clay; strong medium subangular block structure.

37 to 53 inches, red or yellowish-red firm clay or silty clay; structure less distinct than in layer above and individual aggregates are larger; few yellowish-brown variegations that are more numerous in lower portion; few finely divided chert fragments.

7 to 20 feet, limestone bedrock generally occurs.

APPENDIX B

QUESTIONNAIRE FORM

Community____

Owner____

Address____ Phone No.__________

Operator____

Address____ Phone No.__________

Photo No.______________ General location of farm______________________

____

Number of acres in soybeans______________________

Amount and analysis of fertilizer used__________________________________

Planting date____________________________________

Variety planted__________________________________

% germination of seed____________________________

Was Molybdenum used______________________________

Were the seed innoculated________________________

Type of herbicide(s) used________________________

Rate of herbicide application____________________

Calibration______________________________________

Any planned practices for the summer?___________________________________

____

Are the beans going to be custom harvested?_____________________________

____

1. How long have you been growing soybeans? ______yrs.

2. How many times have you failed to obtain a good stand?___________

3. What do you think caused these failures?____________________

____

4. What cropping system have you usually followed prior to planting soybeans?

____

5. What has been your usual method of land preparation?___________

____

6. Have you usually had a soil test before planting soybeans?

   Yes______ No______

   If so, did you follow the recommendations? Yes______ No______

7. What is your usual liming practice?_______________________

____

8. Do you always innoculate?_____________________________

   If not, why?____

____

9. Do you always use molybdenum on seed?____________________

   If not, why?____

____

APPENDIX C

TABLE XX

ANALYSIS OF VARIANCE OF SOYBEAN YIELDS IN BUSHELS PER ACRE FOR ALL THREE SOIL MAPPING UNITS IN BLOUNT COUNTY, TENNESSEE - 1973

Source	D.F.	S.S.	Variance	F
Field	8	6470.47	808.81	15.81**
Soil	2	3144.34	1572.17	30.73**
Field * Soil	16	1900.34	118.77	2.32N.S.
Error A	54	2762.54	51.16	4.18**
Error B	162	2136.91	13.19	

** Significant at the .01 level of probability.

N.S. Not significant at the .05 level of probability.

TABLE XXI

ANALYSIS OF VARIANCE OF pH FOR ALL THREE SOIL MAPPING UNITS IN BLOUNT COUNTY, TENNESSEE - 1973

Source	D.F.	S.S.	Variance	F
Field	8	47.97	5.60	5.35**
Soil	2	1.10	0.55	0.49N.S.
Field *Soil	16	4.92	0.31	0.27N.S.
Error	54	16.82	1.12	

** Significant at the .01 level of probability.

N.S. Not significant at the .05 level of probability.

TABLE XXII

ANALYSIS OF VARIANCE OF AVAILABLE PHOSPHORUS IN POUNDS PER ACRE FOR ALL THREE SOIL MAPPING UNITS IN BLOUNT COUNTY, TENNESSEE - 1973

Source	D.F.	S.S.	Variance	F
Field	8	17652.30	2206.54	10.52**
Soil	2	498.74	249.37	1.19N.S.
Field * Soil	16	4591.93	287.00	1.37N.S.
Error	54	11324.00	209.70	

** Significant at the .01 level of probability.

N.S. Not significant at the .05 level of probability.

TABLE XXIII

ANALYSIS OF VARIANCE OF EXCHANGEABLE POTASSIUM IN POUNDS PER ACRE FOR ALL THREE SOIL MAPPING UNITS IN BLOUNT COUNTY, TENNESSEE - 1973

Source	D.F.	S.S.	Variance	F
Field	8	629451.85	78681.48	5.89**
Soil	2	25985.19	12992.59	0.97N.S.
Field * Soil	16	175081.48	10942.59	0.82N.S.
Error	54	722000.00	13370.37	

** Significant at the .01 level of probability.

N.S. Not significant at the .05 level of probability.

TABLE XXIV

ANALYSIS OF VARIANCE OF PERCENT SAND FOR ALL THREE SOIL MAPPING UNITS IN BLOUNT COUNTY, TENNESSEE - 1973

Source	D.F.	S.S.	Variance	F
Field	8	24109.19	3013.65	33.76**
Soil	2	194.30	97.15	1.09N.S.
Field * Soil	16	3059.70	191.23	2.14*
Error	54	4820.00	89.26	

* Significant at the .05 level of probability.

** Significant at the .01 level of probability.

N.S. Not significant at the .05 level of probability.

TABLE XXV

ANALYSIS OF VARIANCE OF PERCENT SILT FOR ALL THREE SOIL MAPPING UNITS IN BLOUNT COUNTY, TENNESSEE - 1973

Source	D.F.	S.S.	Variance	F
Field	8	21105.85	2638.23	16.07**
Soil	2	7630.52	3815.26	23.24**
Field * Soil	16	2026.15	126.63	0.77N.S.
Error	54	8866.00	164.19	

** Significant at the .01 level of probability.

N.S. Not significant at the .05 level of probability.

TABLE XXVI

ANALYSIS OF VARIANCE OF PERCENT CLAY FOR ALL THREE SOIL MAPPING UNITS IN BLOUNT COUNTY, TENNESSEE - 1973

Source	D.F.	S.S.	Variance	F
Field	8	9694.00	1211.75	6.14**
Soil	2	8877.56	4438.78	22.48**
Field * Soil	16	2555.11	159.69	0.80N.S.
Error	54	10664.00	197.48	

** Significant at the .01 level of probability.

N.S. Not significant at the .05 level of probability.

TABLE XXVII

ANALYSIS OF VARIANCE OF PLANT POPULATION PER 20-FOOT ROW FOR ALL THREE SOIL MAPPING UNITS IN BLOUNT COUNTY, TENNESSEE - 1973

Source	D.F.	S.S.	Variance	F
Field	6	276628.44	46104.74	34.12**
Soil	2	3802.57	1901.29	1.41N.S.
Field * Soil	12	18405.87	1533.82	1.14N.S.
Error	42	56753.11	1351.27	

** Significant at the .01 level of probability.

N.S. Not significant at the .05 level of probability.

VITA

Dewey Victor Simpson was born in Garmisch, Germany on September 8, 1947. He attended elementary school in Centerville, Tennessee. His family later moved to Maryville, Tennessee. He completed grammar school in the Blount County school system and was graduated from Alcoa High School in 1965. The following summer he entered the University of Tennessee in Knoxville, and in August 1969, he received his Bachelor of Science degree in Agriculture. He then taught vocational agriculture for two years on Oneida, Tennessee and one year in Evans, Georgia.

In the summer of 1972, he returned to the University of Tennessee campus and began study toward a Master's degree with a major in Plant and Soil Science. Later in his studies, he accepted a departmental teaching assistantship. He received this degree in June, 1974. He is a member of Gamma Sigma Delta.

He is married to the former Jane Ella Cook of Alcoa, Tennessee.