

A DETAILED SOIL SURVEY OF THE SOILS OF THE
NORTH CENTRAL OKLAHOMA AGRONOMY RESEARCH
STATION, LAHOMA, OKLAHOMA

By

DON M. SCHIEBER

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1968

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
July, 1970

OKLAHOMA
STATE UNIVERSITY
LIBRARY
OCT 28 1970

A DETAILED SOIL SURVEY OF THE SOILS OF THE
NORTH CENTRAL OKLAHOMA AGRONOMY RESEARCH
STATION, LAHOMA, OKLAHOMA

Thesis Approved:

Henton Gray

Thesis Adviser

Lavoy J. Croy

W. Reed

N. Durbin

Dean of the Graduate College

763662

ACKNOWLEDGMENTS

The author is sincerely grateful to his major advisor, Dr. Fenton Gray, for his guidance and training throughout his graduate study and thesis work.

Sincere thanks is also expressed to the other members of his committee, Dr. Lester W. Reed and Dr. Lavoy I. Croy.

Gratitude is expressed to Glenn Williams for his valuable training during this study.

The author expresses thanks to the Agronomy Department of Oklahoma State University for the use of the facilities that made this study possible.

Special recognition and thanks go to the author's wife, Cecelia, for her encouragement during the course of this study.

TABLE OF CONTENTS

Chapter	Page
I. INTRODUCTION	1
II. SOIL FORMING FACTORS	3
Topography	3
Climate	3
Vegetation	4
Parent Material	4
Time	7
III. PREPARATION OF SOIL MAP	8
IV. MAPPING UNITS	11
V. METHODS AND TECHNIQUES	33
VI. CLASSIFICATION OF SOILS	35
VII. SUMMARY	36
BIBLIOGRAPHY	37

LIST OF TABLES

Table	Page
I. Estimated Yields of the Soils of the North Central Oklahoma Agronomy Research Station	5
II. Pond Creek Silt Loam, No. 1, 1 to 3 Percent Slopes	12
III. Pond Creek Silt Loam, No. 2, 1 to 3 Percent Slopes	16
IV. Grant Silt Loam, 1 to 3 Percent Slopes	19
V. Port Silt Loam, 0 to 1 Percent Slopes	23

LIST OF FIGURES

Figure	Page
1. Grant-Pond Creek-Nash Soil Association	2
2. Detailed Soil Map	9
3. Graph Analysis of Pond Creek Silt Loam, No. 1	13
4. Graph Analysis of Pond Creek Silt Loam, No. 2	17
5. Graph Analysis of Grant Silt Loam	20
6. Graph Analysis of Port Silt Loam	24

CHAPTER I

INTRODUCTION

The North Central Oklahoma Agronomy Research Station is located one mile west of Lahoma on U. S. Highway 60 in Major County. There is one river in the area, the Cimarron River, and it is about twelve miles southwest of the station. The Turkey Creek is located about one and three-fourths miles northeast of the station.

The area in which the Research Station is situated is characterized by reddish, rolling plains. The soils of the area include the Grant-Pond Creek-Nash Association (5) and some alluvial soils are in the vicinity. Soils similar to Grant, Pond Creek, Port, and Bethany are found on the Research Station. See Figure 1.

Within this study, information is presented which will be helpful in applying better management techniques on the soils mentioned and similar soils of North Central Oklahoma, and South Central Kansas.

The main objective of the Research Station is to study small grains as to management and technological advancement in detail. Also, since the station is in a moderate rainfall area, concentrated study is being applied to soil erosion by use of parallel terracing, soil management, and moisture conservation practices.

Agriculture is the mainstay of the area which the station represents. The main farming enterprises include small grains and livestock.

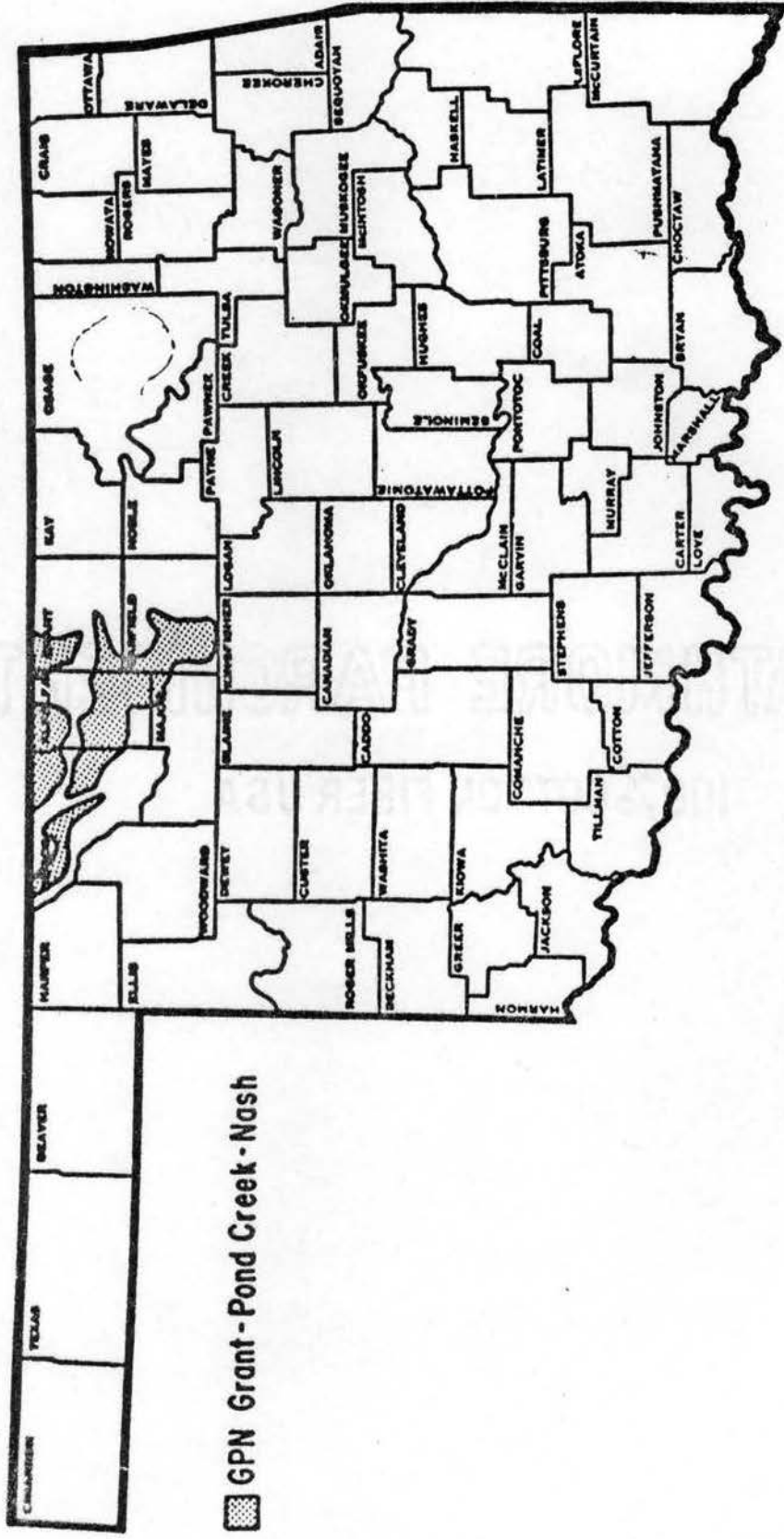


Figure 1. Grant-Pond Creek-Nash Soil Association

CHAPTER II

SOIL FORMING FACTORS

Topography

The topography of the station ranges from nearly level to moderately sloping. The area is characterized by several hills and rolling landscapes. The station is located on the lower north slope of a hill. The station has several intermittent streams throughout. One large intermittent stream is located on the western half of the station running north and south. Because of this drainage, many small intermittent streams have developed on the west side of the station causing erosion and developing the need for terracing.

Climate

The Research Station is in an area that has a warm, temperate, sub-humid climate. Normally, the seasons are variable. Available record from Fairview (4) shows an average annual temperature of 61.6°F. for the area. The monthly average temperatures range from 38.2°F. in January to 83.5°F. in July. Since 1940, the extreme temperatures have ranged from 113°F. on July 14, 1954, to -7°F. on January 4, 1959. The average annual rainfall is 29 inches for the area.

Vegetation

The Research Station is located in the Reddish Prairie resource area (4). Tall bunchgrasses occupied the loamy soils and middle height grasses occupied the clay beds at the time of settlement.

Wheat is the main crop in the area and cash grain farming is practiced. On many soils of the area, grain sorghum is grown for cattle feed and some is grown for grain. The more rolling areas are used mostly for small grain-cattle farming.

Mixed native grasses and alfalfa are made into hay and much land is devoted to pasture. Many farmers in the vicinity of the station realize a great deal of winter pasture from winter wheat and other small grains. Some cattle are brought into the area for commercial grazing.

Corn and cotton were once grown widely in the area, but now corn is grown only on bottom soils, while cotton is grown on both bottomlands and smoother uplands.

Since wheat is well adapted to the area and economical to grow, it has become the dominant crop. With the release of better varieties, use of grain sorghums has increased. Some farmers are beginning to follow wheat with early maturing grain sorghum varieties to take advantage of the double-cropping opportunity. See Table I for estimated yields.

Parent Material

The soils of the area formed largely in materials deposited during the Permian and post-Permian geologic periods. In the Permian period, about 200 million years ago, sediments that formed the redbeds were deposited. The Permian redbeds can be distinguished by the reddish color of iron oxides that formed in the prevailing arid climate.

TABLE I
ESTIMATED YIELDS OF THE SOILS OF THE NORTH CENTRAL
OKLAHOMA AGRONOMY RESEARCH STATION

Soil	Wheat (bu.)	Oats (bu.)	Barley (bu.)	Grain Sorghum (bu.)	Alfalfa Tons
Bethany	25	42	40	36	2.0
Grant	19	30	27	30	1.7
Pond Creek	23	38	34	35	2.1
Port	25	46	37	43	3.1

The soils of this area formed in residuum deposits of Flowerpot shale. Exposures of Flowerpot shale were studied by Mankin and Wu (6). The upper Flowerpot shale in the area is primarily a redbed sequence with isolated layers of dolomite and gypsum. The red shales are mottled with greenish-gray spots, and intercalations of greenish-gray silty shale and siltstone are common. Ferric iron oxides reduced to the ferrous state by the oxidation of organic matter caused the greenish-gray color. The permeability of the siltstone and silty shale allows more circulation of solutions and is believed to be responsible for the reduction of the total iron content of the area.

Illite swelling chlorite, and regular chlorite are the main clay minerals present in the Flowerpot formation. The swelling chlorite is present only in the uppermost portion of the Flowerpot shale and is concentrated in the shale bed beneath the uppermost dolomite bed. There is no kaolinite present.

The sediments seem to have been derived from the south or southeast and deposited in a shallow, low energy environment under semi-arid to arid conditions.

Loess mantles, both old and young, occur in the area and have textures of silt loam, loam, fine sandy loam, very fine sandy loam, and clay loam. The older, silty mantles, which indicate mature development of soils in place, are in areas of Flowerpot shale and the Cedar Hills member of Hennessey shale. These mantles are 1 to 20 feet thick. Pond Creek and Grant soils developed in these materials.

Most of the alluvium of the area occurs in strips, one to two miles wide, along the river valleys. Other areas of alluvium occur near smaller streams in the vicinity of the station. One such area is

found on the research station and the Port soils developed in this location. More research is needed to determine if there is a loess mantle.

Time

Time plays an important factor in soil development. Soil development is a very slow and time-consuming process. The age of a soil can be estimated by studying the profile. The deeper the solum, the older it is, if it has developed in place.

Soils of different ages occur on the Station. The young soils occur on changing land forms such as slopes and flood plains, and the older soils occur on the most stable land forms, the upland flats.

CHAPTER II

PREPARATION OF SOIL MAP

The soil map of the North Central Oklahoma Agronomy Research Station was made by probing the station area on a grid system, locating the different boundaries, and plotting these boundaries on the map.

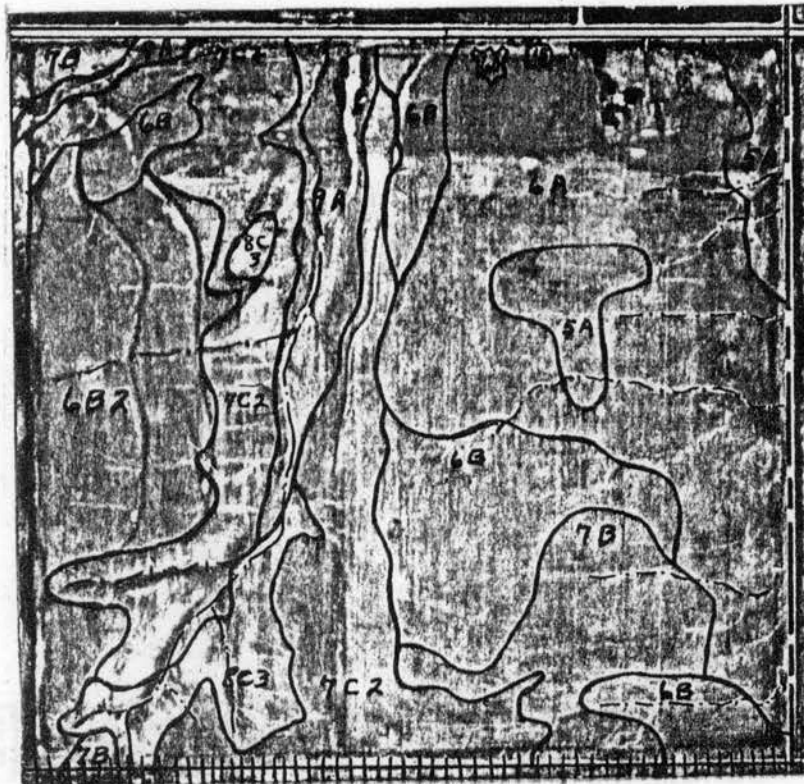
The grid lines were marked and flagged by agricultural engineers for the purpose of preparing a contour map. They located the center of the station and marked and staked a square 100 feet by 100 feet. Flags were placed every 200 feet in length and width across the field.

When mapping the station, it was very easy to locate a certain spot on an aerial photograph of the station. An advance party made a hasty survey of the station and set up a temporary legend to go by using the grid flags.

By using the grid flags as guides, field probing was done easily and systematically. At least one probe was taken every 200 feet. In some areas, additional probings were made to determine more accurately a soil boundary. Additional probings were made on eroded areas, also. Field notes were taken on each probe.

Four different sampling sites were selected by studying the field notes and probings. Pits were dug at these sites and samples were collected. See Figure 2.

The sampling technique employed was to start with a clean profile



Legend

<u>Symbol</u>	<u>Soil Type</u>
5A	Bethany silt loam, 0 to 1 percent slopes
6A	Pond Creek silt loam, 0 to 1 percent slopes
6B	Bond Creek silt loam, 1 to 3 percent slopes
6B2	Pond Creek silt loam, 1 to 3 percent slopes, eroded
7B	Grant silt loam, 1 to 3 percent slopes
7C2	Grant silt loam, 3 to 5 percent slopes, eroded
8C3	Grant silt loam, 3 to 5 percent slopes, severely eroded
9A	Port silt loam, 0 to 1 percent slopes




County Line	-----	Good Motor Road	=====
Railroad		U. S. Highway	
Intermittent Streams (Crossable)	-.-.-.-	State Highway	
		Buildings	

Figure 2. Detailed Soil Map

and determine the horizon boundaries. After this was completed, sampling was made starting at the bottom of the profile and sampling each horizon, placing each sample in a plastic bag and then in a paper bag for transport. Care was taken not to contaminate any sample. If this was done, the sample was discarded and another one was collected. These samples were brought to the laboratory and analyzed. Physical and chemical analyses of these four profiles are presented with the respective mapping unit description.

Soils sampled at these sites are similar to Pond Creek, Grant, and Port soils. Two of the profiles sampled were similar to Pond Creek. Two sites of Pond Creek soils were sampled to study the variation on the station.

CHAPTER IV

MAPPING UNITS

Pond Creek Silt Loam, No. 1, 0 to 1 Percent Slopes (6A)

This mapping unit is comprised of deep, nearly level, well drained soils. The surface horizons are brown (16), strongly acid silt loam that grades to dark brown, neutral, blocky clay loam subsoils in the upper portion and reddish brown, moderately alkaline, coarse prismatic lower subsurface horizons to 80 inches of depth.

This profile of Pond Creek silt loam was sampled 525 feet south and 1050 feet west of the northeast corner of the research station. This profile is typical of the mapping unit. Also included is the laboratory data in Table II and graph analysis in Figure 3.

Horizon and Description

<u>Horizon</u>	<u>Description</u>
Ap	0-8": Dark brown (7.5 YR 4/3); silt loam; dark brown (7.5 YR 3/3) moist; weak fine granular structure; hard, friable; many fine roots; abrupt smooth boundary.
B1	8-16": Dark brown (7.5 YR 3/3) heavy silt loam; dark brown (7.5 YR 3/3) moist; moderate fine granular structure; hard, friable; many fine roots; few patchy clay films on ped faces; gradual smooth boundary.
B2lt	16-26": Dark brown (7.5 YR 4/3) silty clay loam; dark brown (7.5 YR 3/2) moist; moderate fine and medium sub-angular blocky structure; extremely hard, firm; few fine roots; nearly continuous clay films on ped faces; diffuse boundary.

TABLE II

POND CREEK SILT LOAM, NO. 1, 1 TO 3 PERCENT SLOPES

Physical Analysis

Horizon	% Sand	% Silt	% Clay	% VFS	% FS	% MS	% CS	% VCS	% 2MM
AP	19.5	64.2	16.30	13.4	3.6	2.2	.3	.3	0
B1	15.3	55.9	28.80	11.0	3.4	1.3	0	0	0
B21t	18.1	45.0	36.90	9.0	5.6	3.5	0	0	0
B22t	22.4	45.1	32.50	10.5	7.3	4.6	0	0	0
B23t	32.5	41.3	26.20	14.2	10.9	6.8	.8	0	0
B24t	33.9	42.4	23.70	20.6	9.1	4.2	0	0	0
B3	25.0	53.8	21.20	18.3	5.3	1.5	0	0	0
C1	20.1	61.7	18.20	17.7	1.4	.4	.3	.5	0

Chemical Analysis

Horizon	pH		Extractable Cations (meq/100gms)						P (ppm)	CEC	% Base Saturation		% Organic Matter
	H ₂ O	KC	Ca	Mg	Na	K	H	Al			Sum of Cations	Na Acetate	
AP	5.5	4.6	5.7	9.8	.07	.70	1.13	0	275	10.6	99.3	156.5	1.97
B1	6.7	5.5	10.4	6.7	.09	.64	.64	0	275	21.3	96.1	69.5	2.05
B21t	7.1	6.0	13.0	8.9	.14	.66	1.6	0	275	18.2	97.1	124.8	1.49
B22t	7.4	6.2	16.2	8.4	.17	.60	1.7	0	250	26.7	91.9	72.5	1.18
B23t	7.3	6.2	9.0	6.0	.21	.50	0.0	0	225	16.5	100	95.5	1.02
B24t	7.5	6.3	7.8	5.8	.29	.50	0.0	0	200	15.8	100	91.1	1.01
B3	7.6	6.5	10.6	2.4	.47	.49	0.0	0	200	13.0	100	107.7	.21
C1	8.2	7.0	11.4	7.2	.79	.46	0.0	0	275	13.4	100	148.5	.42

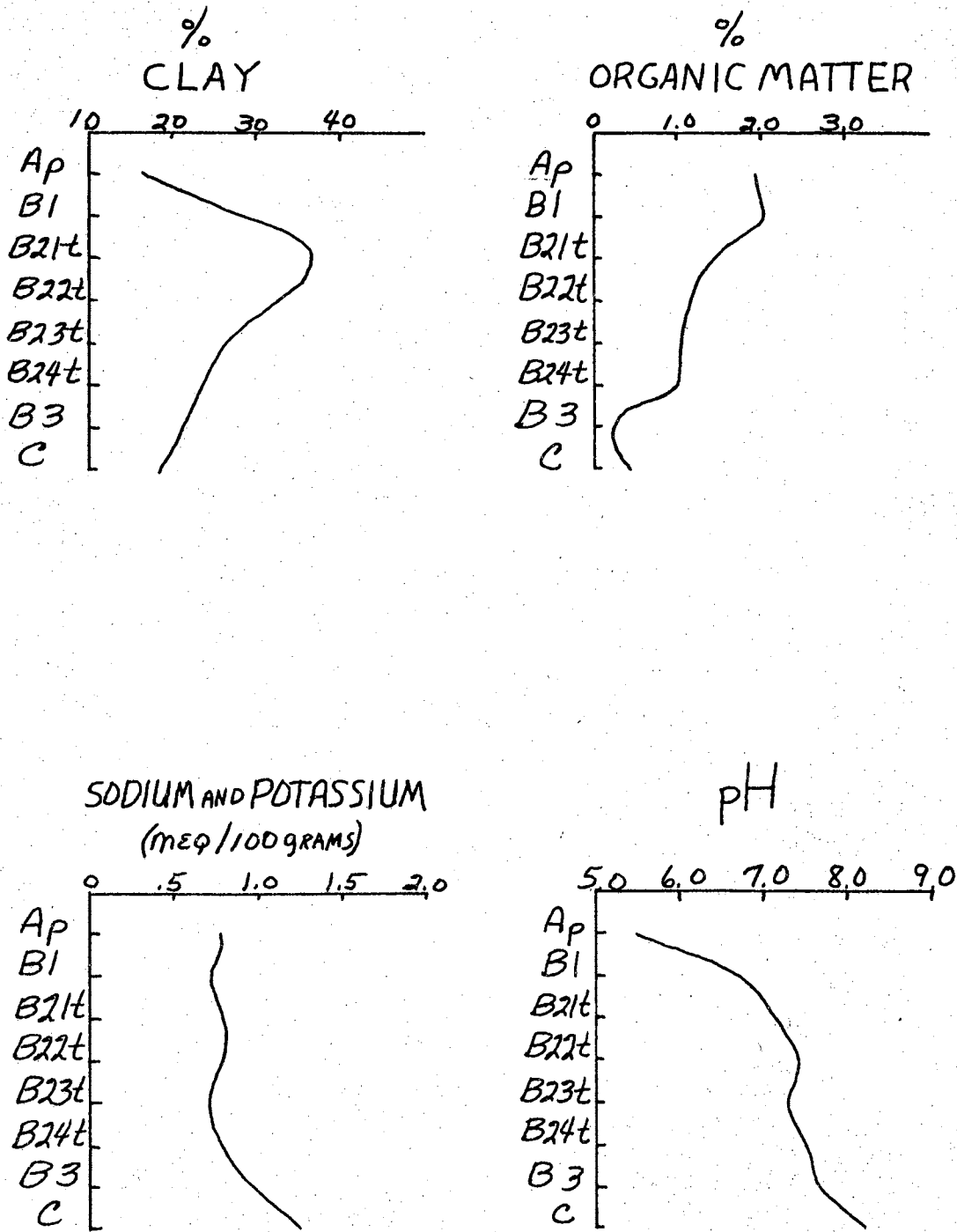


Figure 3. Graph Analysis of Pond Creek Silt Loam, No. 1

- B22t 26-36": Very dark brown (7.5 YR 3/2) silty clay loam; dark brown (7.5 YR 3/2) moist; moderate fine and medium subangular blocky structure; extremely hard, firm; few fine roots; nearly continuous clay films on ped faces; gradual boundary.
- B23t 36-48": Reddish brown (5 YR 4/4) silty clay loam; reddish brown (5 YR 3/4) moist; weak coarse prismatic structure; extremely hard, firm; few fine roots; nearly continuous clay films on ped faces; few dark colored krotovina; few dark colored clay balls; gradual smooth boundary.
- B24t 48-56": Red (2.5 YR 4/6) silty clay loam; dark red (2.5 YR 3/6) moist; weak coarse prismatic structure; very hard, firm; few fine roots; nearly continuous clay films on ped faces; gradual smooth boundary.
- B3 58-67": Yellowish red (5 YR 4/8) light silty clay loam; yellowish red (5 YR 3/8) moist; weak coarse prismatic structure; extremely hard, friable; few fine roots; few patchy clay films on ped faces; many films of soft powdery secondary carbonates and a few soft cemented concretions occur at a depth of 60 inches and increase in amount with increasing depth; calcareous; clear boundary.
- C1 67-86": Yellowish red (5 YR 5/6) silty clay loam; yellowish red (5 YR 4/6) moist; massive structure; very hard, friable; calcareous.

Range in Characteristics

The depth of the surface or A1 horizons vary from 8 to 14 inches of brown to dark grayish brown silt loam. The depth to the B2t horizon ranges from 14 to 20 inches. The color is dark brown in the upper portion and grades to reddish brown or yellowish red in the B3 horizons. The texture of the upper 20 inches of the B horizons is clay loam or silty clay loam that ranges from 28 to 35 percent clay.

The texture of the B3 horizons varies from silt loam to clay loam. The depth to soft powdery lime ranges from 35 to 70 inches.

Pond Creek Silt Loam, No. 2

This profile of Pond Creek silt loam was sampled 210 feet south and 1040 feet west of the northeast corner of the research station. This profile is included in the 6A mapping unit description. This profile will be referred to as Pond Creek number 2 in this paper. See Table III and Figure 4 for laboratory analysis and graph analysis.

Horizon and Description

<u>Horizon</u>	<u>Description</u>
Ap	0-8": Brown (10 YR 5/3) silt loam, dark brown (10 YR 3/3) moist; weak fine granular structure; hard, friable; abrupt smooth boundary.
A12	8-14": Brown (7.5 YR 5/3) silt loam, dark brown (7.5 YR 3/2) moist; weak fine granular structure; hard, friable; gradual boundary.
B1	14-20': Brown (7.5 YR 4/3) light silty clay loam, dark brown (7.5 YR 3/2) moist; weak moderate blocky structure; very hard, firm; gradual boundary.
B21t	20-30": Brown (7.5 YR 4/3) silty clay loam, brown (7.5 YR 3/2) moist; moderate medium blocky structure; extremely hard, firm; diffuse boundary.
B22t	30-40": Brown (7.5 YR 4/3) silty clay loam, brown (7.5 YR 3/3) moist; moderate medium blocky structure; diffuse boundary.
B23t	40-50": Brown (7.5 YR 4/3) silty clay loam, brown (7.5 YR 3/3) moist; weak coarse blocky structure; extremely hard, firm; gradual boundary.
B3	50-62": Reddish brown (5 YR 4/4) silty clay loam, dark reddish brown (5 YR 3/4) moist; weak coarse blocky structure; very hard, friable; gradual boundary.
B3&C1	62-80": Reddish yellow (5 YR 6/6) silty clay loam, yellowish red (5 YR 5/6) moist; weak coarse prismatic structure; very hard, friable; gradual boundary.
C1	over 80": Reddish yellow (5 YR 6/6) silty clay loam, yellowish red (5 YR 5/6) moist; massive structure; very hard, friable.

TABLE III

POND CREEK SILT LOAM, NO. 2, 1 TO 3 PERCENT SLOPES

Physical Analysis

Horizon	% Sand	% Silt	% Clay	% VFS	% FS	% MS	% CS	% VCS	% 2MM
AP	22.2	60.3	17.5	14.8	4.7	2.3	.4	0	0
A12	18.9	56.7	24.4	11.6	4.2	2.9	.3	0	0
B1	17.8	54.0	28.2	10.2	4.5	2.9	.3	0	0
B21t	17.2	49.0	33.8	8.2	5.3	3.2	.5	0	0
B22t	20.5	44.4	35.1	8.8	6.4	4.4	.9	0	0
B23t	23.1	45.0	31.9	9.4	7.7	5.7	.3	0	0
B3	38.2	36.1	25.7	15.2	12.5	8.7	1.8	0	0
B3&C	33.1	43.1	23.8	14.4	10.9	6.5	1.3	0	0
C1	31.4	46.1	22.5	18.6	9.8	2.7	.3	0	0

Chemical Analysis

Horizon	pH		Extractable Cations (meq/100gms)						P (ppm)	CEC	% Base Saturation		% Organic Matter
	H ₂ O	KCl	Ca	Mg	Na	K	H	Al			Sum of Cations	Na Acetate	
AP	5.2	4.5	5.4	2.4	.98	.91	8.0	0	363	12.6	57.3	76.2	2.50
A12	6.2	5.2	8.0	4.0	.76	.78	6.5	0	275	16.6	67.7	81.5	2.16
B1	6.6	5.5	10.0	6.2	1.06	.63	6.25	0	275	18.3	74.1	97.7	1.75
B21t	6.7	5.6	12.2	7.4	1.16	.68	6.5	0	363	19.7	76.7	108.8	1.61
B22t	6.9	5.7	12.2	7.8	1.39	.67	7.25	0	388	24.6	75.2	89.6	1.41
B23t	7.0	5.9	11.6	7.8	1.69	.66	5.25	0	388	23.7	80.6	91.7	1.16
B3	7.2	6.1	9.2	6.6	1.15	.59	4.0	0	250	21.6	81.4	81.2	.90
B3&C	7.6	6.7	13.2	6.0	1.51	.51	3.0	0	175	18.3	87.6	115.9	.69
C1	7.8	6.9	13.4	6.1	1.70	.49	2.75	0	144	18.2	88.7	94.6	.50

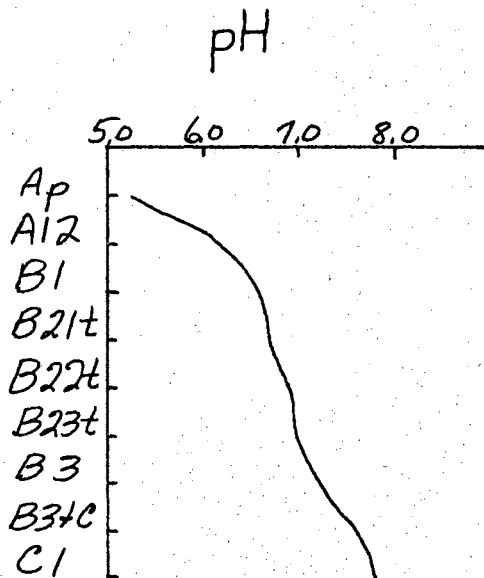
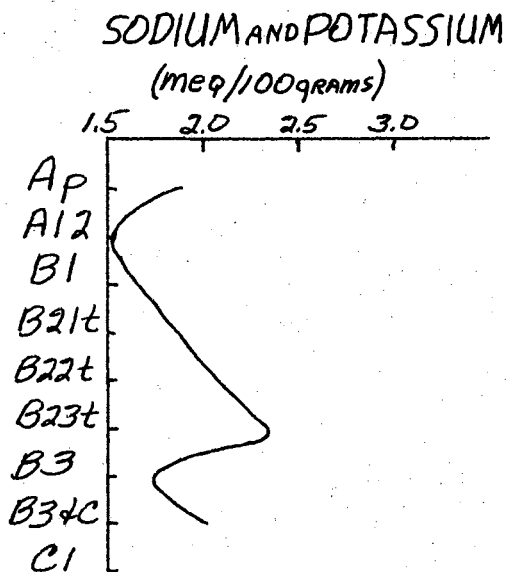
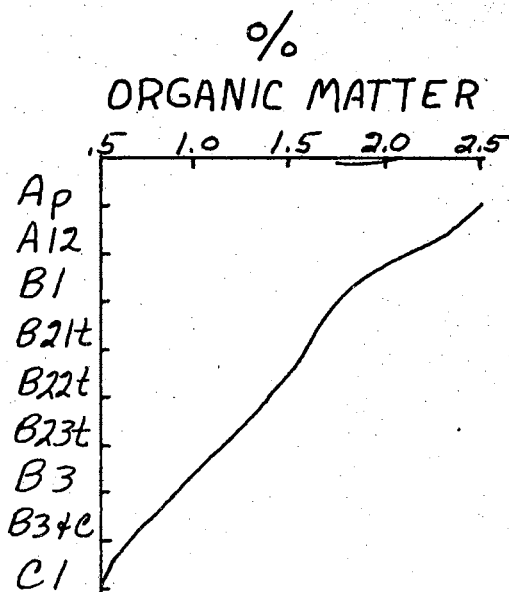
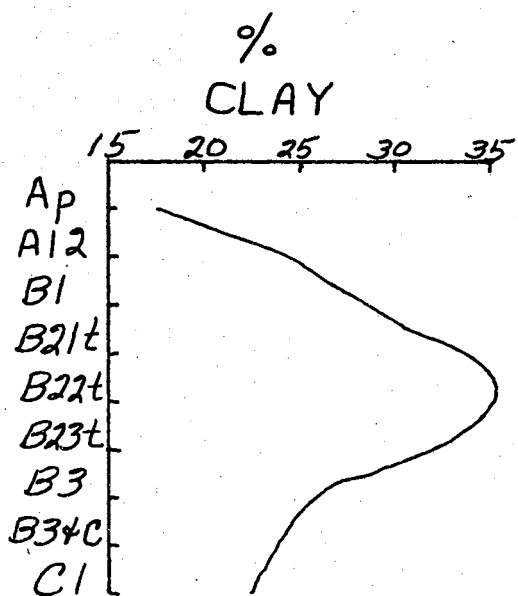


Figure 4. Graph Analysis of Pond Creek Silt Loam, No. 2

The B21t, B22t, and B23t horizons all have distinct continuous clay films. The B3 has free lime in the form of films and calcium carbonate concretions. The B3 & C1 has soft carbonates in all pores and on all peds.

Grant Silt Loam, 1 to 3 Percent Slopes (7B)

This mapping unit is very typical of the surrounding area. It is a somewhat smaller unit than what was expected from initial study of the area. These soils are somewhat shallower than other soils of the area, ranging in depth from 43 to 70 inches. The Grant soils are lighter colored soils than the Pond Creek soils. This lighter color occurs mainly in the subsurface horizons.

This sampling site is located 500 feet west and 630 feet north of the southeast corner of the Research Station. See Table IV and Figure 5 for laboratory analysis and graph analysis.

Horizon and Description

<u>Horizon</u>	<u>Description</u>
Ap	0-7": Brown (7.5 YR 5/3) silt loam; dark brown (7.5 YR 3/3) moist; weak fine granular structure; slightly hard, friable; many fine roots; clear boundary.
A12	7-12": Dark brown (7.5 YR 4/3) silt loam, dark brown (7.5 YR 3/3) moist; moderate fine granular structure; hard, very friable; many fine roots; neutral; gradual smooth boundary.
B1	12-18": Reddish brown (5 YR 4/3) heavy silt loam, dark reddish brown (5 YR 3/3) moist; moderate coarse prismatic structure; parting to weak fine subangular blocky; hard, friable; many fine roots; few patchy clay films on ped faces; neutral; gradual smooth boundary.
B21t	18-27": Reddish brown (5 YR 4/4) silty clay loam, dark reddish brown (5 YR 3/4) moist; moderate coarse pris-

TABLE IV

GRANT SILT LOAM, 1 TO 3 PERCENT SLOPES

Physical Analysis

Horizon	% Sand	% Silt	% Clay	% VFS	% FS	% MS	% CS	% VCS	% 2MM
AP	12.7	70.1	17.2	10.0	1.6	.8	.3	0	0
A12	16.4	62.4	21.1	14.6	1.2	.6	0	0	0
B1	17.2	59.6	23.2	15.6	.9	.7	0	0	0
B21t	18.2	59.6	22.2	16.0	1.4	.8	0	0	0
B22t	19.2	65.6	15.2	18.4	.5	.3	0	0	0
B3	19.3	65.5	15.2	18.4	.5	.4	0	0	0
R	25.5	67.8	6.7	25.2	.3	0	0	0	0

Chemical Analysis

Horizon	pH		Extractable Cations (meq/100gms)						P (ppm)	CEC	% Base Saturation		% Organic Matter
	H ₂ O	KCl	Ca	Mg	Na	K	H	Al			Sum of Cations	Na Acetate	
Ap	5.3	4.5	5.70	3.50	.00	.41	2.05	0	300	12.2	82.4	78.8	1.30
A12	6.0	5.2	8.80	4.30	.05	.42	2.78	0	287	16.6	83.0	81.7	1.19
B1	6.4	5.7	10.00	4.30	.05	.42	1.33	0	330	18.8	91.7	78.5	1.06
B21t	6.7	6.0	8.00	6.60	.10	.38	2.66	0	350	18.8	85.0	80.2	.86
B22t	6.9	6.1	6.20	5.00	.10	.29	.00	0	389	12.9	100.0	89.8	.52
B3	7.0	6.0	5.90	5.70	.10	.31	.00	0	405	13.5	100.0	89.9	.54
R	7.4	6.4	3.60	3.20	.09	.20	.00	0	475	6.4	100.0	109.4	.10

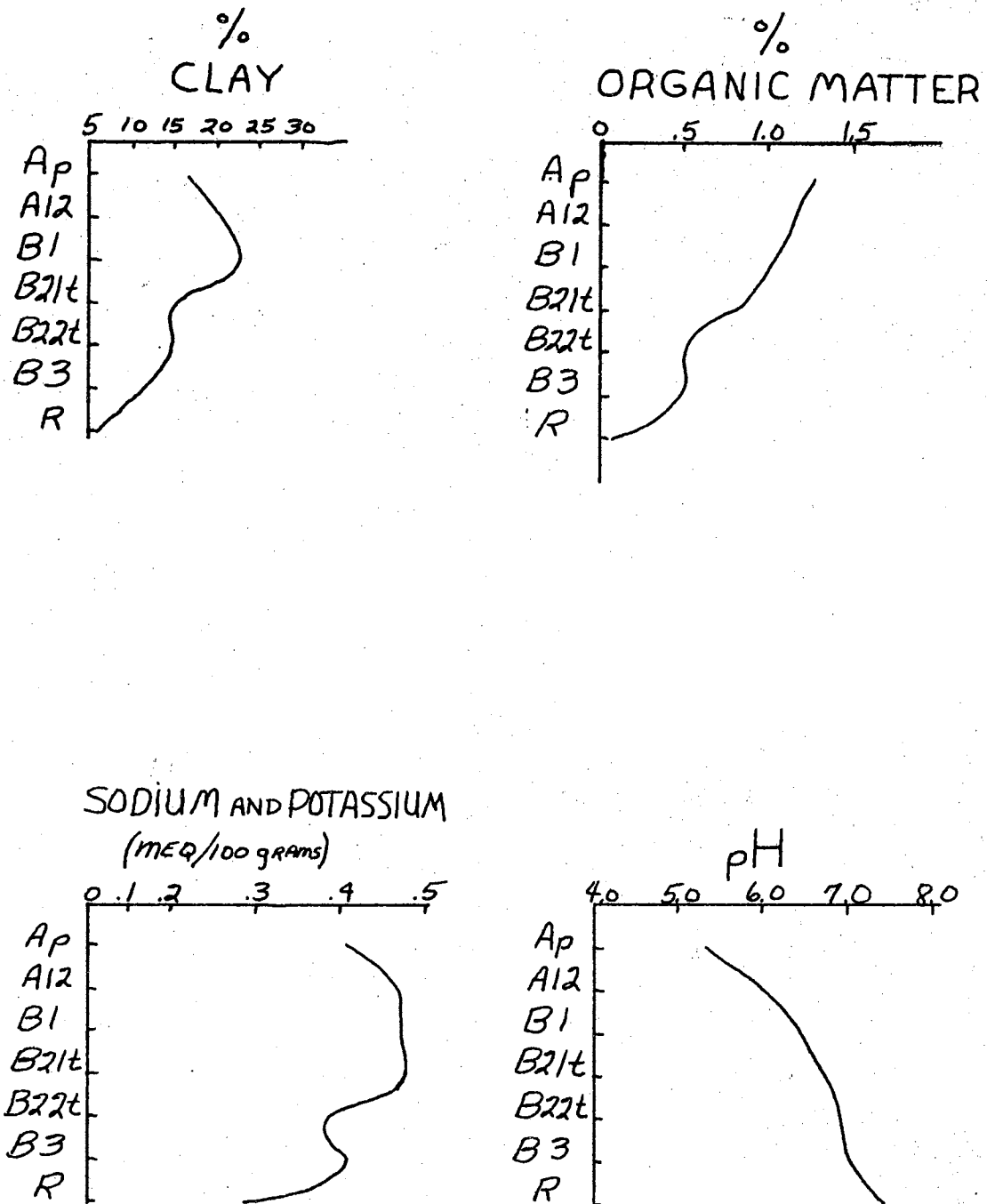


Figure 5. Graph Analysis of Grant Silt Loam.

matic structure parting to weak fine subangular blocky; hard, friable; few fine roots; nearly continuous clay films on ped faces; neutral; gradual smooth boundary.

- B22t 27-37": Reddish brown (2.5 YR 4/4) silty clay loam, dark reddish brown (2.5 YR 3/4) moist; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; few fine roots; nearly continuous clay films on ped faces; mildly alkaline; gradual wavy boundary.
- B3 37-43": Red (2.5 YR 4/6) silt loam; dark red (2.5 YR 3/6) moist; weak coarse prismatic structure; hard, friable; few fine roots; patchy clay films on ped faces; moderately alkaline and noncalcareous; gradual wavy boundary.
- R 43-60": Red (2.5 YR 4/6) weakly cemented sandstone that contains many fine and medium light greenish gray (5 GY 7/1) spots; massive; few fine roots in the upper few inches between the bedding plains; bedding plains are weak; moderately alkaline and noncalcareous.

Range in Characteristics

The surface horizon varies from 6 to 7 inches in thickness and from brown to dark brown in color. The texture of all the soils of the unit is silt loam in the surface horizons becoming heavy silt loam and silty clay loam with depth. The texture of the B3 is silt loam.

The color of the B horizon becomes lighter from dark reddish brown to yellowish red with depth.

The reaction varies from medium acid to slightly acid in the surface horizons and mildly alkaline to moderately alkaline in the subsurface horizons. The lower portion of the B horizon and the C horizons are calcareous.

The C horizon is 5 to 10 percent weathered sandstone with light greenish gray circles up to 7 mm in diameter.

Port Silt Loam, 0 to 1 Percent Slopes (9A)

This mapping unit is located in the western half of the Station and is a narrow unit extending nearly the length of the Station from north to south. It is characterized by deep, well-drained, very fertile soils.

The surface soils are dark brown silt loam grading to reddish brown silt loam in the B horizons.

The buried A horizons are dark brown and very dark brown silt loams. The buried B horizons are reddish brown heavy silt loams.

This profile of Port silt loam was sampled 1500 feet west and 600 feet south of the northeast corner of the Station. Laboratory and graph analyses are included in Table V and Figure 6.

Horizon and Description

<u>Horizon</u>	<u>Description</u>
Ap	0-8": Dark brown (7.5 YR 4/3) silt loam, dark brown (7.5 YR 3/3) moist; weak fine granular structure; hard, friable; abrupt smooth boundary.
A12	8-18": Dark brown (7.5 YR 4/3) silt loam, dark brown (7.5 YR 3/3) moist; weak fine granular structure; hard, friable; abrupt smooth boundary.
B2	18-20": Reddish brown (5 YR 4/3) silt loam, dark reddish brown (5 YR 3/3) moist; weak fine granular and weak coarse prismatic structure; hard, friable; gradual smooth boundary.
A11b	29-36": Dark brown (10 YR 4/2) silt loam, very dark brown (10 YR 2/2) moist; weak fine granular structure; hard, friable; diffuse smooth boundary.
A12b	36-44": Dark brown (10 YR 4/2) silt loam, very dark brown (10 YR 2/2) moist; weak fine granular structure; hard, friable; diffuse smooth boundary.

TABLE V

PORT SILT LOAM, 0 TO 1 PERCENT SLOPES
Physical Analysis

Horizon	% Sand	% Silt	% Clay	% VFS	% FS	% MS	% CS	% VCS	% 2MM
AP	32.0	52.0	16.0	10.6	11.4	9.2	.4	0	0
A12	20.4	63.6	16.0	14.0	4.2	2.4	.2	0	0
B2	18.8	67.2	14.0	16.0	2.4	.4	0	0	0
A11b	10.4	73.6	16.0	8.0	1.6	.8	0	0	0
A12b	9.4	72.6	18.0	7.8	1.0	.6	0	0	0
A13b	12.4	67.6	20.0	10.2	1.4	.6	0	0	0
B21b	15.2	64.8	20.0	12.2	2.0	.8	0	0	0
B22b	14.4	65.6	20.0	12.0	1.6	.8	0	0	0

Chemical Analysis

Horizon	pH		Extractable Cations (meq/100gms)						P (ppm)	CEC	% Base Saturation		% Organic Matter
	H ₂ O	KCl	Ca	Mg	Na	K	H	Al			Sum of Cations	Na Acetate	
Ap	7.6	6.7	13.3	4.5	.08	.61	1.7	0	275	10.6	92.0	174.5	2.20
A12	6.8	5.9	6.8	3.9	.08	.65	2.1	0	419	11.2	84.4	101.7	2.58
B2	7.0	5.8	5.9	4.5	.12	.34	1.7	0	363	10.3	86.4	104.8	1.38
A11b	7.2	6.1	8.8	5.6	.11	.35	1.5	0	275	14.5	90.7	102.0	2.80
A12b	7.3	6.1	9.9	6.6	.11	.39	1.3	0	275	16.3	94.8	104.2	3.83
A13b	7.4	6.5	9.7	6.1	.13	.44	1.3	0	263	17.2	92.6	94.7	2.78
B21b	7.7	6.7	9.3	6.1	.11	.52	1.0	0	388	16.8	90.3	95.2	1.78
B22b	7.7	6.9	9.9	6.4	.23	.37	.8	0	4.9	22.2	95.4	76.1	1.18

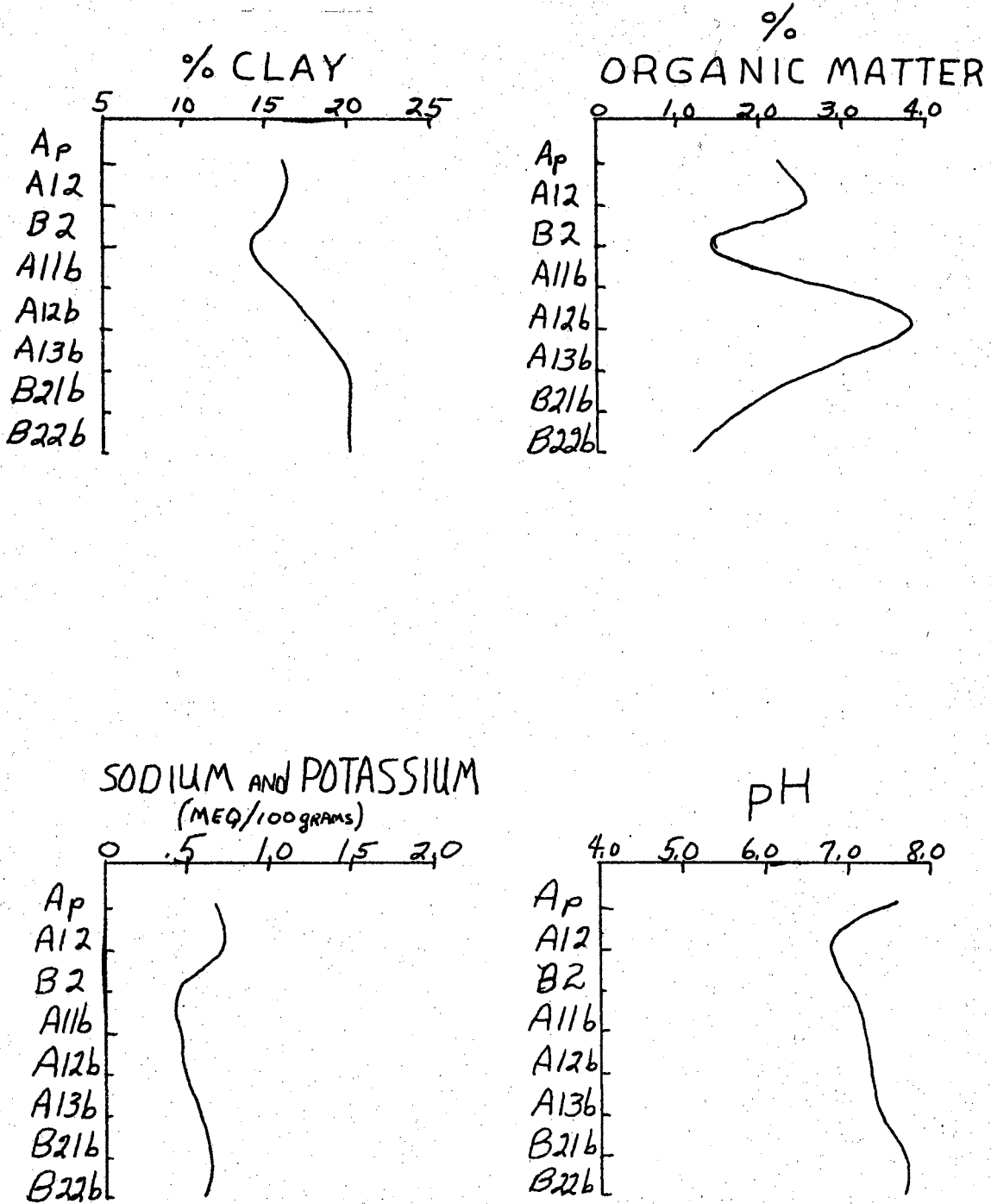


Figure 6. Graph analysis of Port Silt Loam

- A13b 44-51": Dark brown (10 YR 4/2) silt loam, very dark brown (10 YR 2/2) moist; weak fine granular structure; hard, friable; gradual smooth boundary.
- B21b 51-60": Yellowish red (5 YR 4/4) heavy silt loam, dark reddish brown (5 YR 3/4) moist; weak coarse prismatic structure; hard, friable; diffuse smooth boundary.
- B22b 60-70+": Reddish brown (5 YR 5/4) heavy silt loam, yellowish red (5 YR 4/6) moist; weak coarse prismatic structure; hard, friable.

Range in Characteristics

The solum thickness varies from 70 to 80 inches plus. The thickness of the A horizons varies from 15 to 53 inches. The B horizon varies from 11 to 18 inches in thickness. The buried A horizons are very dark brown silt loams. All sites sampled in this unit are noncalcareous. A spot located 250 feet south and 1600 feet west of the northeast corner of the station has indistinctly stratified layers of silt loam from 1/16 inch thick to 1 1/2 inches thick between 9 and 19 inches deep.

Pond Creek Silt Loam, 1 to 3 Percent Slopes (6B)

The soils of this mapping unit are deep, gently sloping, and well drained.

The surface horizons are dark brown, slightly acid to medium acid silt loam that grades to dark brown, mildly alkaline, silty clay loam subsoils. In the subsurface horizons, the color changes from dark brown to brown to yellowish red from 16 to over 80 inches.

This typical profile of this mapping unit was taken 1575 feet south and 1250 feet west of the northeast corner of the Station. The slope at this site is 1.6 percent.

Horizon and Description

<u>Horizon</u>	<u>Description</u>
Ap	0-6": Dark brown (7.5 YR 3/3) silt loam; weak fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.
A12	6-10": Dark brown (7.5 YR 3/2) silty loam; moderate fine granular structure; friable; neutral; clear smooth boundary.
B1	10-14": Dark reddish brown (5 YR 3/3) silty clay loam; weak coarse blocky structure; firm; neutral; gradual boundary.
B2t	14-40": Dark reddish brown (5 YR 3/3) silty clay loam; weak coarse blocky structure; firm; moderately alkaline; gradual boundary.
B3	40-64": Yellowish red (5 YR 4/6) silt loam; weak coarse prismatic structure; friable; moderately alkaline; calcareous; clear boundary.
C	64-80+": Weathered sandstone; yellowish red (5 YR 4/3); common fine to 10 mm light gray (5 G 7/1) spots.

The colors mentioned in the above profile are the moist color readings.

At the time the profile was sampled, it was too moist to obtain a dry color reading. The same is true for the consistency.

Range in Characteristics

The depth of the surface or A1 horizon varies from 6 to 8 inches of dark brown silt loam. The depth to the B2t horizon varies from 13 to 16 inches. The texture of the B horizon varies from silty clay loam in the upper portion to silt loam in the lower portion.

In the B3 horizon, there are numerous spots of calcium carbonate ranging in size from 1 to 2 mm. In some areas, it is difficult to determine between the B3 and C horizons because of the weathered sandstone that occurs as high as 30 percent in some places. This weathered

sandstone has a few fine light gray spots.

Pond Creek Silt Loam, 1 to 3 Percent Slopes, Eroded (6B2)

This unit has deep, well drained, gently sloping, eroded soils. The surface horizons are dark brown, nearly neutral, silt loam and light silty clay loam. The subsurface horizons vary from dark brown to reddish brown in color and are mostly coarse subangular blocky in structure. In the lower areas of the subsurface horizons, the structure grades to coarse prismatic. In some areas of this unit, there are a few fine threads of carbonates in the B2t horizon. The lower level of the B2t horizon extends to about 50 to 62 inches deep.

This profile was taken 770 feet south and 230 feet east of the northwest corner of the Research Station. It is very typical of this mapping unit.

Horizon and Description

<u>Horizon</u>	<u>Description</u>
ABp	0-5": Brown (7.5 YR 4/3) light silty clay loam; dark brown (7.5 YR 3/3) moist; weak fine granular structure; very hard, friable; about 30% of this horizon is B1; clear smooth boundary.
B1	5-9": Reddish brown (5 YR 4/3) silty clay loam, dark reddish brown (5 YR 3/3) moist; weak, fine blocky structure; extremely hard, firm; many worm casts; clear boundary.
B2t	9-36": Reddish brown (5 YR 4/3) silty clay loam, dark reddish brown (5 YR 3/3) moist; weak, moderate subangular blocky structure; distinct continuous clay films on ped faces; few fine hard calcium carbonate concretions from 30 to 36 inches; diffuse boundary.
B3	36-49": Reddish brown (5 YR 4/4) silty clay loam, reddish brown (5 YR 4/3) moist; weak coarse prismatic structure; extremely hard, firm; common medium hard calcium carbonate concretions from 36 to 45 inches;

diffuse boundary.

- B3&C 49-62": Red (2.5 YR 5/6 silty clay loam, red (2.5 YR 4/6) moist; weak, coarse prismatic structure; very hard, firm; 30% soft weathered siltstone; diffuse boundary.
- C 62-75+": Red (2.5 YR 5/6), red (2.5 YR 4/6) moist; layers of weathered siltstone; about 10% fine light greenish gray spots.

Bethany Silt Loam, 0 to 1 Percent Slopes (5A)

This unit of Bethany silt loam consists of nearly level, deep, dark colored soils. The surface horizons are dark brown, slightly acid silt loam that grades to very dark brown silt loam. The subsurface horizons are dark brown silty clay loam that have moderate medium subangular blocky structure. These soils range in depth from 72 to 75 inches. They are characterized by slow permeability.

This profile, which is typical of the Bethany unit, was sampled 770 feet south and 970 feet west of the northeast corner of the Research Station.

Horizon and Description

<u>Horizon</u>	<u>Description</u>
Ap	0-7": Brown (10 YR 4/3) silt loam, dark brown (10 YR 3/3) moist; weak fine granular structure; hard, friable; slightly acid; abrupt smooth boundary.
A12	7-12": Very dark grayish brown (10 YR 3/2) silt loam, very dark brown (10 YR 2/2) moist; weak fine granular structure; hard, friable; slightly acid; gradual boundary.
B1	12-16": Very dark grayish brown (10 YR 3/2) silty clay loam, very dark brown (10 YR 2/2) moist; moderate medium granular structure; hard, friable; neutral; clear boundary.

- B2t 16-42": Dark brown (7.5 YR 4/2) silty clay loam, very dark brown (7.5 YR 3/2) moist; weak coarse blocky structure; extremely hard, firm; moderately alkaline; diffuse boundary.
- B31 42-50": Brown (7.5 YR 4/4) silty clay loam, dark brown (7.5 YR 3/3) moist; weak coarse prismatic structure; very hard, firm; moderately alkaline; diffuse boundary. (Few medium hard calcium carbonate concretions.)
- B32 50-75+": Yellowish red (5 YR 5/6) light silty clay loam, yellowish red (5 YR 4/6) moist; weak coarse prismatic structure; very hard, friable; soft powdery lime in seams; moderately alkaline.

Range in Characteristics

The A horizon varies in depth from 12 to 17 inches. The depth to the B2t horizon varies from 16 to 22 inches. The color of the B horizon varies from dark brown in the upper limits to yellowish red in the B3 horizon. The upper portion of the B horizon contains the heaviest clay content grading lighter to the lower limits of the B horizons.

The texture of the B3 horizon varies from silt loam to silty clay loam.

In some areas of the unit there are a few very fine black shotlike concretions in the B2t horizon. In the B3 horizon there is soft powdery lime in the seams occurring mostly below 43 inches. There are some areas in which the B3 is non-calcareous.

Grant Silt Loam, 3 to 5 Percent Slopes, Eroded (7C2)

This mapping unit is moderately sloping, eroded soil. Some areas in the unit are less than 40 inches to parent material but are very small areas.

The surface horizon overlays the B2t in most cases, but the B1 is

present in some areas. The Ap horizon is dark brown silt loam, but grades to dark reddish brown silt loam and silty clay loam in the B horizons.

This profile, sampled 1700 feet west and 1400 feet south of the northeast corner of the Station, is very typical of the mapping unit.

Horizon and Description

<u>Horizon</u>	<u>Description</u>
Ap	0-7": Dark brown (7.5 YR 4/3) silt loam, dark brown (7.5 YR 3/3) moist; weak, fine granular structure; friable, slightly acid; clear boundary.
B1	7-11": Dark brown (7.5 YR 4/3) silt loam, dark brown (7.5 YR 3/3) moist; moderate medium granular structure; friable; neutral; gradual boundary.
B2t	11-28": Reddish brown (5 YR 4/3) light clay loam, dark reddish brown (5 YR 3/3) moist; moderate coarse blocky structure; friable; moderately alkaline; non-calcareous; gradual boundary.
B3	28-41": Reddish brown (5 YR 4/4) silt loam, dark reddish brown (5 YR 3/4) moist; weak coarse prismatic structure; friable; moderately alkaline; calcareous; clear boundary.
C	41-50+": Yellowish red (5 YR 4/6) weathered sandstone, yellowish red (5 YR 3/6) moist; many very fine light gray (5 G 7/1) spots; moderately alkaline; calcareous; no soft powdery calcium carbonate.

Range in Characteristics

the Ap horizon is uniform in depth, ranging from 6 to 7 inches. In some areas, there is no B1 horizon. The depth to the B2t ranges from 6 to 11 inches. The thickness of the B2t ranges from 12 to 20 inches. The thickness of the C horizon varies from 5 to 9 inches. Only slight color variation appears in the B horizons. The depth to sandstone varies throughout the mapping unit from 36 to 50 inches.

Grant Silt Loam, 3 to 5 Percent Slopes, Severely Eroded (8C3)

This mapping unit is characterized by moderate slopes, severe erosion, and shallow solums. The thickness of the solums is very shallow in some places and deep in others. The surface horizons are composed of AB horizon mixtures and B2t horizons. The composition depends on the slope and amount of erosion.

This unit is unsuited for farming because of the slope and the severity of erosion.

This profile was sampled 1980 feet south and 2990 feet west of the northeast corner of the Station and is representative of the mapping unit.

Horizon and Description

<u>Horizon</u>	<u>Description</u>
ABp	0-5": Dark brown (7.5 YR 4/3) silt loam, dark brown (7.5 YR 3/3) moist; weak medium granular structure; friable; slightly acid; clear boundary.
B2t	5-27": Brown (7.5 YR 5/4) silt loam, brown (7.5 YR 4/4) moist; weak coarse prismatic structure; friable; mildly alkaline; clear boundary.
C	27-50+": Strong brown (7.5 YR 5/6) weathered sandstone, yellowish red (5 YR 4/6) moist; moderately alkaline; calcareous below 39 inches.

Range in Characteristics

The surface horizon varies from 4 to 6 inches in depth. In some places, the surface horizon is composed of AB mixtures and other places it is composed of the B2t horizon. This is caused by the severe erosion. The depth to the B2t varies from 0 to 5 inches. The thickness of the B2t varies from 6 to 22 inches. The unit has areas that have 10

to 15 percent light greenish gray spots.

In some spots, the soil is calcareous below 14 inches. A few fine hard calcium carbonates are found in the B3 & C horizon.

CHAPTER V

METHODS AND TECHNIQUES

Upon completion of the soil map and mapping units, the field samples were collected at four sites on the Station. Samples were taken from each soil horizon of each site. These samples were air-dried in the laboratory and stored. Smaller samples were taken from these samples and used in lab work.

All samples were oven-dried at 105°C overnight prior to analysis work.

Physical analysis including % sand, % silt and % clay were made using the method outlined by Day (2). Also, the sand fraction was separated into very coarse sand, coarse sand, medium sand, fine sand, and very fine sand.

Chemical analysis of the samples was delayed until completion of physical analysis. Soil reaction was measured by mixing a 1:1 paste with water and again by mixing a 1:1 paste using potassium chloride. The percent organic matter was measured after the sample was ground to approximately 60 mesh (10).

Total phosphorous was measured by perchloric acid digestion (13) using a colorimeter, and the results are reported in ppm. The extractable cations were determined using atomic absorption and plotting the results against a standard curve (8). These are reported in milliequivalents per 100 grams.

The exchangeable aluminum was determined by leaching the soil with 100 milliliters of potassium chloride, then the leachate was titrated with sodium hydroxide. After the first titration was finished, one drop of hydrochloric acid was added to bring back the colorless condition. Ten milliliters of sodium fluoride were added and the sample was titrated with hydrochloric acid (1).

Cation Exchange Capacity was measured by washing with sodium acetate, ethanol, and ammonium acetate, then reading on an atomic absorption machine (9).

The percent base saturation as sum of cations was determined by adding calcium, magnesium, potassium and sodium together and dividing that total by the sum of calcium, magnesium, potassium, sodium, hydrogen and aluminum. That answer is multiplied by 100 to give sum of cations (2). The percent base saturation by sodium acetate was determined by dividing the sum of calcium, magnesium, potassium and sodium by the cation exchange capacity and multiplying by 100 (2).

CHAPTER VI

CLASSIFICATION OF SOILS

The soils of the Research Station have not had the final correlation by the Soil Conservation Service. The names of the soils that appear in this study are only tentative. They are subject to change at the discretion of the Soil Conservation Service.

With correlation incomplete, it is improper to classify the soils at this time. However, the family designation is on the border line among four family groups.

Until the correlation is completed no further attempts will be made to classify the soils of the Research Station.

CHAPTER VII

SUMMARY

A detailed soil map was made of the North Central Oklahoma Agronomy Research Station, at Lahoma, Oklahoma. It was prepared through detailed field work on the Station. Mapping units were set up and the boundaries were drawn on the map.

Sampling sites were selected and samples were collected and laboratory analysis was made on all the samples collected.

Included in this study are the soil map, mapping unit descriptions, and laboratory analyses.

BIBLIOGRAPHY

1. Black, C. A. (ed.), Methods of Soil Analysis, Part II, American Society of Agronomy, 1965, p. 988-994.
2. Day, Paul, Soil Science Society of America Proceedings, 1956.
3. Gray, Fenton and H. M. Galloway, Soils of Oklahoma, MP-56, p. 36.
4. Gray, Fenton, Productivity of Key Soils in Oklahoma, Bulletin B-650 October 1966, p. 24.
5. Mankin, Charles J. and Dah Cheng Wu, Oklahoma Geology Notes, Vol. 30, No. 3, June 1970, p. 63.
6. Munsell Soil Color Chart, Munsell Color Co., Inc., 1954.
7. Saline and Alkali Soils, Agriculture Handbook No. 60, p. 94.
8. Saline and Alkali Soils, Agriculture Handbook No. 60, p. 101.
9. Saline and Alkali Soils, Agriculture Handbook, No. 60, p. 105.
10. Soil Classification System (7th Approximation), Soil Survey Staff, USDA Soil Conservation Service, March, 1967.
11. Soil Classification System (7th Approximation) Supplement, Soil Survey Staff, USDA Soil Conservation Service, March, 1967.
12. Soil Science Society of America Proceedings, 1965, pp. 677-678.
13. Soil Survey, Major County, Oklahoma, USDA Soil Conservation Service, October 32, 1968.
14. Soil Survey, Garfield County, Oklahoma, USDA Soil Conservation Service, October 31, 1967.
15. Soil Survey Manual, USDA Soil Conservation Service, May, 1962.

VITA

Don M. Schieber

Candidate for the Degree of
Master of Science

Thesis: A DETAILED SOIL SURVEY OF THE SOILS OF THE NORTH CENTRAL OKLAHOMA AGRONOMY RESEARCH STATION, LAHOMA, OKLAHOMA

Major Field: Agronomy

Biographical:

Personal Data: Born April 27, 1946, at Ponca City, Oklahoma, son of Frank and Frances Schieber.

Education: Graduated from Ponca City High School, Ponca City, Oklahoma, in May 1964; undergraduate work at Oklahoma State University, 1964-1968; graduate study at Oklahoma State University, 1968-1970.

Experience: Reared on a farm; worked part-time during school terms from 1964-1968; graduate research assistant at Oklahoma State University, 1969-1970.