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Physical, Chemical and Mineralogical Characteristics of Important Mississippi Soils

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To realize the crop production potential of soils it is necessary to first have a knowledge of their chemical, physical and biological properties and reactions and then to so alter these properties and reactions to effect a medium optimum for plant growth. In the past, soils have been classified primarily on the basis of physical characteristics observable in the field. Although the soil survey reports resulting from field studies of observable soil physical characteristics provide valuable information, several physical and chemical measurements on soils provide information useful in the intelligent establishment of soil management practices such as irrigation, tillage, drainage, liming and fertilization. The measurements made on the soils discussed herein include mechanical composition, aggregate stability, bulk density, moisture content at 1/3 and 15 atmosphere tensions, pH, organic matter content, cation exchange capacity, exchangeable potassium, available phosphorus and mineralogical composition. The data obtained from these measurements may assist in resolving certain soil classification problems and in establishing suitable soil management practices.

Twenty of the more common Mississippi soils were investigated. Eleven soil series, representing 26 sites were investigated in somewhat more detail than the other series and include the following: Alligator, Atwood, Bladen, Ecru, Grenada, Houston, Lakeland, Norfolk, Ruston, Savannah, and Sharkey. The remaining nine soil series include the following: Bibb, Cuthbert, Dundee, Lexington, Memphis, Noxapater, Providence, Tippah, and Vaiden. All of the soils under investigation have been correlated by representatives of the Soil Survey Office, Soil Conservation Service, U. S. Department of Agriculture, and are considered representative of the designated soil series.

METHODS AND PROCEDURES

At each site pits were dug to the desired depth and the exposed profile was described as to color, texture, consistence and structure. Bulk samples of the principal layers or horizons were obtained from the pit wall. From the bulk samples clods were selected for the determination of clod density and the remainder of the samples was crushed to pass through a sieve with 2 mm. openings. In the case of the Bibb, Cuthbert, Dundee, Lexington, Memphis, Noxapater, Providence, Tippah, and Vaiden soils, undisturbed soil cores were also taken from the pit wall for bulk density determinations.

The aggregate stability index values, as recorded in the tables, are really values of intrinsic permeability multiplied by 10^6, in cm.^{2}, determined on a prepared sample of soil aggregates that pass through a sieve with 2 mm. openings and are caught on a sieve with 1 mm. openings. This method of measuring aggregate stability was suggested by Reeves (6)*. The permeability values were calculated from data obtained after water had passed through the sample for sufficient time at constant head to establish a constant flow rate.

The clod density values reported for the Alligator, Atwood, Bladen, Ecru, Grenada, Houston, Savannah and Sharkey soil series represent the density

*Numbers in parentheses refer to Literature cited, page 36.

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of oven-dry clods selected from the bulk samples (8). These clod density values do not reflect the bulk density of these soils under field conditions. Soils that do not significantly change their volume upon wetting and drying will under field conditions, have bulk density values approximating the clod density values. The bulk density of the Lakeland, Norfolk and Ruston soils was arbitrarily determined by taking a 100 gm. oven-dry subsample, passing a 2mm. sieve, from each of the bulk samples and pouring it into a 100 c.c. graduated cylinder. To obtain a more reproducible packing, sufficient water was added to bring the water level in the cylinder above the level of the soil. The volume of soil was then read from the graduated cylinder and the bulk density calculated.

The 15 atmosphere moisture percentage was determined with the pressure membrane apparatus (7). The one-third atmosphere moisture percentage was determined using a porous plate to replace the membrane in the pressure membrane apparatus. The 60 cm. of water moisture percentage was determined from samples equilibrated at this tension on a tension table (5). The one-third atmosphere and 15 atmosphere moisture percentage values were determined using soil passing a 2mm. sieve while the 60 cm. moisture percentage was determined from undisturbed core samples.

The mechanical composition of all soils excepting Sharkey was determined by a hydrometer procedure. The percent clay (less than 2 microns) was determined by the hydrometer reading in the suspension after two hours of settling, while the sand fraction (greater than 50 microns) was determined by sieving the dispersed soil material. The silt fraction (2-50 microns) was calculated by difference. In the case of the three Sharkey soils, the data for mechanical composition was determined by the pippette method (2).

The pH of a 2:1 water - soil suspension of each sample was measured with the glass electrode. The cation exchange capacity was determined by saturating the exchange complex with ammonia, then distilling the ammonia into 0.1 N HCl and titrating with NaOH to determine the amount of acid neutralized by the ammonia. The readily decomposable organic matter content was determined by a slightly modified wet combustion method originally proposed by Walkley (9). Instead of titrating as Walkley proposed, the reduced chromate was measured colorometrically.

The exchangeable potassium content was determined by the use of a flame photometer and an extracting solution containing an internal standard (3).

The available phosphorus was determined by the method used by the Soil Testing Laboratory at Mississippi State College (4).

The mineralogical composition of several of these soils has been investigated. The soils were fractionated by sedimentation, in the case of the coarse fractions and supercentrifuge in the case of the fine fractions. Then the soil fractions were saturated with calcium, glycerol solvated and oriented on slides. X-ray diffraction patterns were made from these samples.

INTERPRETATION OF DATA

The soils of Mississippi have been classified on the basis of geographical location, geological origin and nature of soil materials into several major land resource areas. The land area divisions are presented in Figure I. The soil series, under investigation, have been arranged in accordance with this classification and will be discussed individually and as a group of soils within a major land resource area.

Exchangeable potassium and available phosphorous data

In the tables of data to follow the data are expressed in two ways. For example, in Table 1, Column 2, 579H+ indicates not only the presence of 579 lbs. of exchangeable potassium (K) per acre furrow slice but also that it is a high plus level. In the same table and column 3.5L indicates the presence of 3.5 lbs. of available phosphorous (P) per acre furrow slice and that it is a

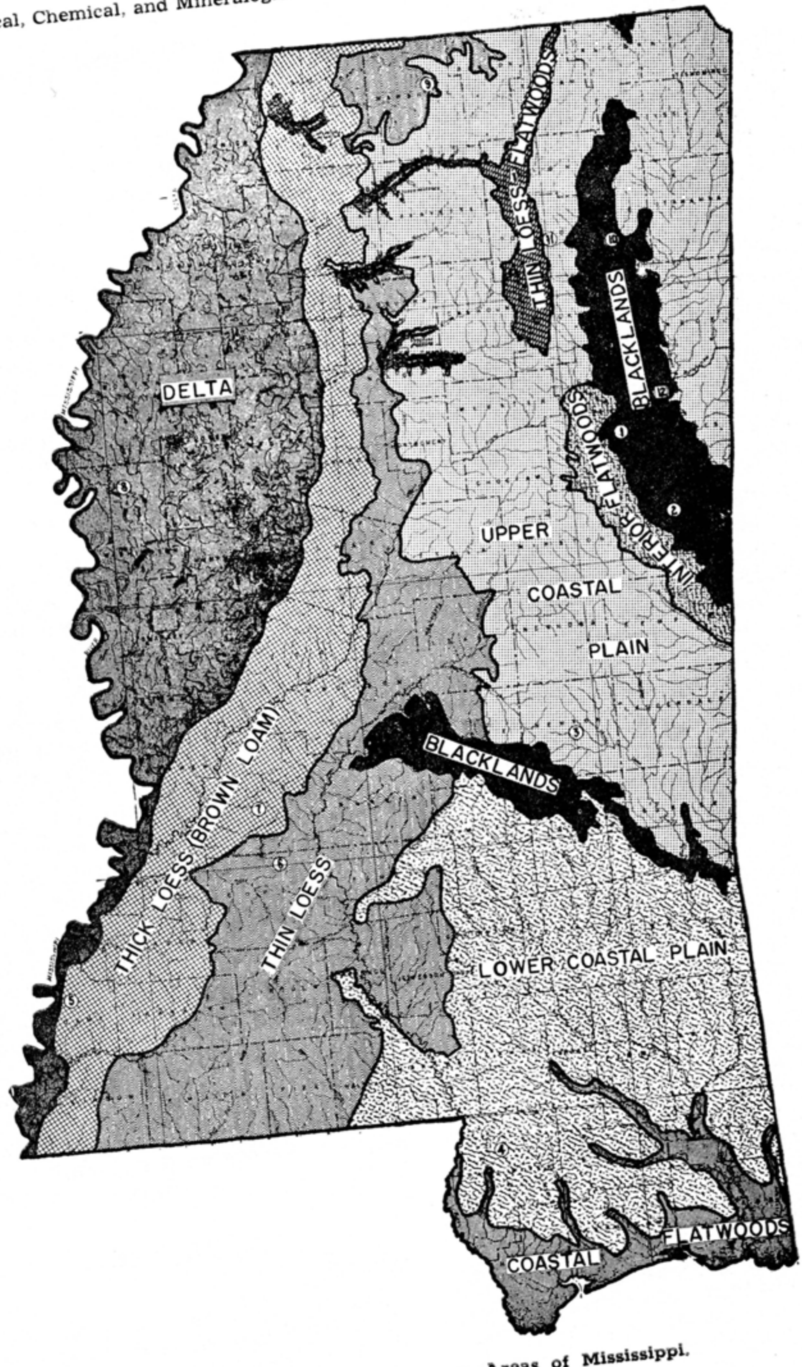

Figure 1. Land Resource Areas of Mississippi.

Available Phosphorous (P)		Exhangeable Potassium (K)	
Level	Lbs. per acre furrow slice	Level	Lbs. per acre furrow slice
Trace	Less than 2.5	L— (Low minus)	0 - 97.5
L (Low)	2.6 - 14.5	L (Low)	104.0 - 156.0
L+ (Low plus)	15.0 - 26.0	L+ (Low plus)	162.5 - 234.0
M— (Medium minus)	26.5 - 37.0	M— (Medium minus)	240.5 - 299.0
M (Medium)	37.5 - 47.5	M (Medium)	305.5 - 357.5
M+ (Medium plus)	48.0 - 58.0	M+ (Medium plus)	364.0 - 429.0
H (High)	58.5 or more	H (High)	435.5 - 533.0
		H+ (High plus)	539.5 or more

low level. A low level means that there is expected to be a large plant response to additions of available phosphorous fertilizers to this soil. In the case of high levels of either exchangeable potassium or available phosphorous the probability of plant response to additional amounts is low. The following key will assist in the interpretation of this data.

Soil moisture data

In making measurements of soil moisture it is always desirable to use methods that characterize the soil moisture in terms of its availability to the plant. In this regard, there are two very useful methods of expressing moisture availability. The first and most commonly used is the capacity factor or the available water capacity of a soil. The second may be called an intensity factor and states the work required to remove unit mass or volume of water from the soil at a given moisture content.

Data are presented in the following section which make it possible to estimate the available water capacity. To make laboratory measurments from which this quantity can be calculated it is necessary to know the soil moisture tension at the upper and lower limits of available moisture. The lower limit of available moisture is quite accurately determined by equilibrating the moisture in a soil sample with 15 atmospheres pressure. The moisture content of a soil at this pressure corresponds to the moisture content at the permanent wilting point of plants. The upper limit of available water commonly known as field capacity cannot be defined in terms of an assigned pressure. Commonly, the 1/3 atmosphere moisture percentage is used to represent field capacity moisture content. The 1/3 atmosphere moisture percentage represents the field capacity condition for medium textured soils only. It must, therefore, be emphasized that for coarse textured soils the 1/3 atmosphere moisture content is lower than the field capacity moisture content and for fine textured soils it is higher.

Mineralogical Data

In the soils under study several minerals have been identified in the clay and silt fractions. When present in significant amounts, each of these minerals exerts an influence on the soil behavior as a result of the specific physical and chemical properties of the minerals present. For a discussion of the characteristics of each of the minerals reported herein, it will be necessary to consult one of the many available text books on the subject.

The X-ray diffraction patterns for a number of the soil fractions were rather nondescript. Thus, only a very qualitative characterization of the mineralogy is given. Insufficient supporting information is available to adequately qualify the X-ray diffraction data. Due to the lack of additional information the existence of material giving a 14 Angstrom (A°) spacing is indicated in this bulletin by the mention of vermiculite. An effort has been made to discuss only the more certain aspects of the mineralogy of the fractions.

DELTA AREA

Alligator

Alligator soils have a level or almost level relief and are poorly drained. Two sites, both under hardwood forest were investigated (Tables 1 and 2). As these data indicate, this soil

Table 1. Alligator clay from near Merigold, Bolivar County, Mississippi

Soil property	Depth in inches 0-5	5-11	11-16	16-26	26-52	52+
Color	dark gray	grayish-brown	mottled grayish brown and reddish yellow	mottled grayish brown and reddish yellow	olive gray brownish-yellow mottles	olive gray brownish-yellow mottles
Texture	clay	clay	clay	clay	clay	clay
Consistence	firm	firm	firm	firm	firm	firm
Structure	moderate coarse subangular blocky	moderate medium subangular blocky	moderate medium subangular blocky	massive	massive	massive
pH	5.9	5.1	5.0	5.0	4.6	7.0
Cation exchange capacity m.e./100 gm.	51.45	49.63	51.85	48.90	——	46.95
Exchangeable potassium lb./ac.	579H+	481H	497H	465H	478H	403M+
Available phosphorous lb./ac.	3.5L	trace	trace	trace	trace	17.2L+
Aggregate stability index	149	23	4	5	15	4
Clod density gm./cm.³	1.83	1.91	1.94	1.92	2.07	2.04
			Percent by Weight			
Moisture content						
1/3 atmosphere	62	59	59	62	63	63
15 atmosphere	46	38	33	33	42	36
Available water capacity	16	21	26	29	21	27
Mechanical composition						
Sand	1	1	1	1	1	1
Silt	20	16	15	13	14	12
Clay	79	83	84	86	85	87
Organic matter	4.80	1.88	1.55	0.86	0.46	0.46

Table 2. Alligator clay from near Itta Bena, Leflore County, Mississippi

Soil property	Depth in inches 0-5	5-11	11-19	19-52	52+
Color	gray with yellowish brown mottles	gray with a few yellowish brown mottles	gray mottled with grayish brown	gray and brown	light grayish brown to grayish brown
Texture	clay	clay	clay	clay	clay
Consistence		slightly plastic		firm	tough
Structure	moderate to strong medium to coarse subangular blocky	weak to moderate coarse to medium subangular blocky	massive with evidence of weak coarse subangular blocky	massive	massive
pH	5.5	5.1	4.4	4.7	6.6
Cation exchange capacity m.e./100 gm.	41.80	43.70	47.13	49.98	45.08
Exchangeable potassium lb./ac.	536H	553H+	514H	514H	——
Available phosphorous lb./ac.	3.5L	trace	trace	trace	——
Aggregate stability index	426	30	9	3	4
Clod density gm./cm.3	1.96	1.97	1.99	2.14	2.07
			Percent by Weight		
Moisture content					
1/3 atmosphere	61	57	59	63.5	60
15 atmosphere	40	37	34	33.5	32
Available water capacity	21	20	25	30	28
Mechanical composition					
Sand	1	1	—	1	2
Silt	20	14	112	15	21
Clay	79	85	87	84	77
Organic matter	3.13	1.45	1.15	0.86	0.38

is rather uniform with depth. The clay content varies between 77 and 87 percent, with no apparent zones of accumulation in the profiles. As its higher aggregate stability indicates, the surface 5 inches has a decidedly better structure than the rest of the profile. The reasonably high organic matter content in the surface soil is probably responsible for the better structural condition.

This soil has a rather high available water capacity which appears to increase from about 18 percent in the surface horizon to about 27 percent at depths below 18 inches. These figures for available water capacity are based on the assumption that the 1/3 atmosphere percentage represents the upper limit of available water.

The pH of 5.5 to 5.9 in the surface soil decreases to about 4.4 - 5.0 at about 12 inches and increases again to 6.6 to 7.0 at about 52 inches. The supply of exchangeable potassium appears to be good but phosphorous is low. The cation exchange capacity is uniformly high, ranging between 42 and 52 m.e. per 100 gm.

In the silt fraction illite type clay minerals are dominant. In the 0.2 to 2-micron clay fraction illite type clays are probably present in greatest amounts although kaolinite is sometimes found in equal amounts and montmorillonite type clays are usually present in significant amounts. The fine clay fraction (less than 2 microns) is composed principally of montmorillonite clays. Illite is often present, particularly in the upper 30 inches. The high clay content of these soils and the presence of large amounts of montmorillonitic clays are reflected by the high cation exchange capacities.

The above data indicate that Alligator clay soils have a high potential productivity. Experience indicates that this potential has not been used due to the lack of a satisfactory management system.

Sharkey

This soil, like Alligator clay, is found in the slack-water areas of the Mississippi River flood plain. Sharkey clay has an almost level relief and is poorly drained. Three sites were sampled, all of which were under hardwood forest (Tables 3, 4, 5). The clay content ranged from a low of 74 percent in the surface horizon to a high of 85 percent at about 12 inches. From 45 to 55 percent of the soil particles were less than 2 microns in diameter.

The relatively high organic matter content throughout the profile gives Sharkey clay a slightly darker color than the Alligator soils. The higher aggregate stability index of the Sharkey soils may also be a reflection of its organic matter content. The clod density data indicate that except for the surface 2 inches the Sharkey soils are equally as dense as the Alligator soils.

Because of the high clay content, much of the soil moisture is unavailable to plants. This is indicated by the fact that 15-atmosphere moisture percentage ranges from 32 to 42. The available water capacity as determined from the 1/3 and 15 atmosphere percentages is relatively high. It increases from about 15 percent in the surface layer to about 25 percent at depths greater than 18 inches.

The pH of the surface horizons ranges from 4.8 to 6.0 with an average of 5.4. The pH appears to increase with depth and reaches a value between 5.7 and 6.2 at 28 or 30 inches. The cation exchange capacity is consistently high and ranges between 43 and 51 m.e. per 100 gm. The supply of exchangeable potassium is large throughout the profile. The available phosphorous supply is low although slightly greater than in the Alligator soils.

The dominant clay mineral in the silt fraction is illite-like. In the 0.2 to 2 micron diameter fraction illite-type clays are present in significant amounts but montmorillonitic clays predominate. Clay less than 0.2 micron in diameter is unmistakably dominant in montmorillonite type clay.

Table 3. Sharkey clay from near Cleveland, Bolivar County, Mississippi.

Soil property	Depth in inches 0-2	2-8	8-12	12-21	21-28	28-36
Color	dark gray with splotches of yellow brown	very dark gray with brown mottles	dark gray mottled with yellowish brown	dark gray mottled with dark yellowish brown	dark gray splotched with dark yellowish brown	very dark gray splotched with dark grayish brown and yellowish brown
Texture	clay	clay	clay	clay	clay	clay
Consistence	loose	firm	firm	plastic	plastic	firm
Structure	weak subangular blocky	weak angular blocky	moderately weak angular blocky	coarse subangular blocky	weak subangular blocky to massive	massive and weak subangular blocky to massive
pH	5.3	5.3	5.6	5.4	5.7	6.2
Cation exchange capacity m.e./100 gm.	51.4	43.6	44.1	43.4	43.1	44.1
Exchangeable potassium lb./ac.	488H	517H	471H	442H	419M+	416M+
Available phosphorous lb./ac.	15.4L+	4.7L	3.5L	3.6L	3.5L	3.1L
Aggregate stability index	913	612	271	116	13	8
Clod density gm./cm.³	1.74	1.92	1.96	2.01	2.06	2.11
			Percent by Weight			
Moisture content						
1/3 atmosphere	61	57	56	53	53	56
15 atmosphere	41	40	39	33	33	29
Available water capacity	20	17	17	20	20	27
Mechanical composition						
Sand (greater than 50M)	1	1	1	1	1	1
Silt (2-50M)	24	21	21	20	20	19
Coarse clay (.2-2M)	29	32	30	28	25	25
Fine clay (less than .2M)	46	46	48	51	54	55
Organic matter	5.56	3.13	1.88	1.65	1.45	1.33

Table 4. Sharkey clay from Stoneville, Washington County, Mississippi.

Soil property	Depth in inches 0-2	2-8	8-16	16-26	26-36
Color	very dark gray	very dark gray mottled with dark yellowish brown	dark gray mottled with brown and dark yellowish brown	dark gray with dark yellowish brown to brown mottles	very dark gray splotched with dark yellowish brown
Texture	clay	clay	clay	clay	clay
Consistence	loose	firm	firm	plastic	
Structure	weak blocky	coarse subanglar blocky	weak angular blocky	very weak subangular to massive	massive
pH	6.0	5.7	5.5	5.6	5.7
Cation exchange capacity m.e./100 gm.	46.3	44.7	46.3	46.5	46.3
Exchangeable potassium lb./ac.	644H+	650H+	566H+	494H	455H
Available phosphorous lb./ac.	15.8L+	5.7L	3.1L	4.0L	3.1L
Aggregate stability index	1855	604	154	19	15
Clod density gm./cm.³	1.76	1.97	2.03	1.98	1.98
			Percent by weight		
Moisture content					
1/3 atmosphere	47	57	61	60	58
15 atmosphere	34	40	36	35	32
Available water capacity	13	17	25	25	26
Mechanical composition					
Sand	1	1	1	1	1
Silt (2-50M)	25	24	16	19	19
Coarse clay (.2-2M)	29	28	31	31	31
Fine clay (less than .2M)	45	47	52	49	49
Organic matter	5.56	2.35	1.77	1.55	1.15

Table 5. Sharkey clay from Cary, Sharkey County, Mississippi.

Soil property	Depth in inches 0-2	2-8	8-14	14-20	20-36
Color	very dark gray	very dark gray with dark yellowish brown mottles	dark gray with medium brown and dark yellowish brown mottles	dark gray with dark yellowish brown to brown mottles	very dark gray with brown, dark yellowish brown and dark brown mottles
Texture	clay	clay	clay	clay	clay
Consistence	loose	firm	firm	plastic	plastic
Structure	weak blocky	coarse subangular blocky	weak angular blocky	very weak subangular to massive	massive
pH	4.8	5.6	5.8	6.4	6.0
Cation exchange capacity m.e./100 gm.	47.8	50.1	48.8	48.0	48.0
Exchangeable potassium lb./ac.	520H	618H+	546H+	546H+	546H+
Available phosphorous lb./ac.	5.7L	3.5L	3.5L	trace	15.0L+
Aggregate stability index	1277	108	37	16	16
Clod density gm./cm.^{3}	1.77	1.97	1.98	1.99	2.03
			Percent by weight		
Moisture content					
1/3 atmosphere	54	61	58	62	60
15 atmosphere	41	35	42	38	36
Available water capacity	13	26	16	24	24
Mechanical composition					
Sand	1	1	0	0	0
Silt (2-50M)	25	20	15	19	19
Coarse clay (.2-2M)	29	29	34	32	32
Fine clay (less than .2M)	45	50	51	49	49
Organic matter	3.62	3.13	1.83	1.65	1.33

Dundee

Unlike the Sharkey and Alligator soils, Dundee silty clay loam is located on old natural levees and is fairly well drained (Table 6). This particular site was in pasture.

The surface 12 inches is reasonably uniform in texture. The increase in bulk density from 1.3 in the 0-6 inch layer to 1.5 in the 6-12 inch layer indicates a relatively dense layer below normal plow depth which retards the movement of air and water.

The moisture content of samples in equilibrum with 60 cm. of water tension has been determined for this soil. This moisture tension is too low for the field capacity moisture tension. However, the difference between the moisture content at 60 cm. of water and 15 atmospheres tension provides an estimate of the available water capacity.

Table 6. Dundee silty clay loam from near Clarksdale, Coahoma County, Mississippi.

Soil property	Depth in Inches 0-6	6-12
Color	grayish brown	brown to light yellowish brown mottled with gray and yellow
Texture	silty clay loam	silty clay loam
Consistence	firm	firm
Structure	———	coarse blocky
Bulk density	1.31	1.52
	Percent by weight	
Moisture content		
60 cm. of water	29.8	26.0
15 atmosphere	13.3	14.8
Mechanical composition		
Sand	17	12
Silt	54	51
Clay	29	37

Summary of data on Delta Soils

The Alligator and Sharkey clay soils show great similarity in most respects. Each has a clay content of about 80 percent, a cation exchange capacity of about 47 m.e. per 100 gm., dominantly montmorillonite in the fine clay fraction and illite in the coarse clay and silt fraction. The organic matter content is significantly higher throughout the Sharkey profile than in the Alligator; hence Sharkey is slightly darker in color and more stable in structure. These soils have a very high productive potential which has not yet been taxed.

Although only a limited amount of data are presented for the Dundee silty clay loam soil, this soil has a high available water capacity. The presence of a compacted zone between 6 and 12 inches restricts plant root development and air and water movement but can be remedied by deep tillage.

BLACKLANDS (NORTHEAST)

Houston

These are upland soils derived from the weathering of chalk or soft limestone. As a result of the dark grayish brown color of the surface soil and the native grass vegetation they are called "black prairie" soils. Three sites, all under cultivation, were investigated (Tables 7, 8 and 9). The great variation in depth of Houston soils has been emphasized many times. It appears that the sites described in Tables 7 and 8 have unusually deep profiles since the average depth to chalk is usually 40-48 inches.

The surface soil texture at these three sites varies from a clay to a silty clay loam. The clay content increases slightly with depth, to a maximum of 51 to 58 percent at 4 to 5 feet. Thereafter it decreases or remains constant.

The aggregate stability appears to be greatest at the 4-16 inch depth; pre-

Table 7. Houston clay from 5 miles east of West Point, Clay County, Mississippi.

Soil property	Soil depth in inches 0-4	4-15	15-23	23-38	38-59	59-75
Color	dark grayish brown	dark olive gray mottled with yellowish brown	olive gray	olive gray with faint yellowish brown mottles	olive gray with faint yellowish brown mottles	olive gray mottled with reddish yellow
Texture	clay	clay	clay	clay	clay	clay
Consistence	very firm	very firm	very firm	very firm	firm	plastic
Structure	strong medium subangular blocky	strong medium subangular blocky	moderate, fine to medium subangular blocky	moderate, fine to medium subangular blocky	moderate, fine to medium subangular blocky	weak, medium subangular blocky
pH	7.5	7.7	6.9	7.8	7.5	7.6
Cation exchange capacity m.e./100 gm.	24.50	28.03	35.25	35.03	——	33.55
Exchangeable potassium lb./ac.	205L+	205L+	189L+	192L+	202L+	202L+
Available phosphorous lb./ac.	3.5L	3.5L	4.0L	4.8L	2.6L	4.0L
Aggregrate stability index	146	254	166	120	69	45
Clod density gm./cm.^{3}	2.08	2.00	2.01	1.95	2.00	2.13
			Percent by weight			
Moisture content						
1/3 atmosphere	35	44	43	43	43.5	40
15 atmosphere	20	29.5	26	28	25.5	23.5
Available water capacity	15	14.5	17	15	18	16.5
Mechanical composition						
Sand	6	4	4	4	4	11
Silt	38	40	38	39	38	39
Clay	56	56	58	57	58	50
Organic matter	2.87	1.88	1.65	1.45	1.15	0.70

Table 8. Houston silty clay from 5 miles northeast of West Point, Clay County, Mississippi.

Soil property	Soil depth in inches 0-4	4-17	17-33	33-48	48-56	56-64
Color	very dark gray	very dark gray	dark grayish brown faint brownish yellow mottles	very dark grayish brown with faint yellowish brown mottles	olive gray mottled with yellowish brown	light olive gray mottled with yellowish brown
Texture	silty clay	silty clay	silty clay	clay	silty clay	clay
Consistence	very firm	very firm	very firm	very firm	very firm	very firm
Structure	strong medium to large subangular blocky	strong medium to large subangular blocky	moderate fine medium subangular blocky	weak subangular blocky	weak medium subangular blocky	weak medium platy
pH	7.6	7.4	6.8	7.0	7.4	7.5
Cation exchange capacity m.e./100 gm.	—	34.00	34.55	34.18	22.93	17.88
Exchangeable potassium lbs./ac.	156L	150L	150L	169L+	172L+	182L+
Available phosphorous lbs./ac.	trace	trace	trace	trace	trace	trace
Aggregate stability index	397	913	333	113	70	10
Clod density gm./cm.^{3}	1.96	1.98	1.98	2.01	2.07	1.83
			Percent by weight			
Moisture content						
1/3 atmosphere	38	39	40	43	41	43.5
15 atmosphere	22	25	29	25.5	23.5	23.5
Available water capacity	16	14	11	17.5	17.5	20
Mechanical composition						
Sand	6	6	6	9	9	9
Silt	47	46	44	40	51	39
Clay	47	48	50	51	40	52
Organic matter	3.41	2.35	1.65	0.95	0.85	0.70

vious cultivation has probably lowered the aggregate stability of the surface layer. The surface 2 to 2½ feet seems moderately stable in structure. The clod density values for all depths are very high and indicates a low pore space volume.

The available water capacity of the surface 12 inches is about 15 percent. Using the bulk density of 1.4, reported in Table 9, calculation shows the surface 12 inches to have an available water capacity of 2.5 inches. It will be noted that the 15-atmosphere percentages reported in Table 9 are lower than those in Table 7 and 8. Also, the 60 cm. of water moisture content in Table 9 is lower than the 1/3 atmosphere percentages reported in Tables 7 and 8. These differences are attributed to the differences in mechanical composition.

The pH of Houston soils is usually above 7.0 in all horizons. The highest acidity is encountered between 15 and 33 inches, where a pH of 6.8 was recorded. The organic matter content is moderately high dropping below 1 percent only at depths of more than 3 feet.

Table 9. Houston silty clay loam from Okolona, Chickasaw County, Mississippi.

Soil property	Soil depth in inches 0-6	6-12
Color	dark grayish brown	grayish brown
Texture	silty clay loam	silty clay loam
Consistence	friable, sticky when wet	firm, sticky when wet
Structure	strong, medium granular	medium to coarse blocky
Bulk density gm./cm.^{3}	1.42	1.40
	Percent by weight	
Moisture content		
60 cm. of water	27 8	30.6
15 atmosphere	12.2	15.4
Mechanical composition		
Sand	14	13
Silt	57	57
Clay	29	30

These soils are low in exchangeable potassium and still lower in available phosphorous. The high cation exchange capacity, ranging from 25 to 35 m.e. per 100 gm., reflects the presence of large amounts of clay minerals with high cation exchange capacities.

The mineralogy of each soil horizon of the two soils described in Tables 7 and 8 was investigated. in the silt fraction (2-50 microns) quartz was always noted in significant amounts and was often dominant. Kaolinite was also found in large amounts and sometimes was the dominant mineral. In the surface 48 inches of one profile, material giving spacings between 14 and 18 A° was present in considerable quantity and appeared to be dominant in the surface 4 inches. This material was probably an interstratification of montmorillonite and vermiculite. Illite was usually present throughout the soil profile.

In the coarse clay fraction (0.2-2 microns) kaolinite was present throughout the profile in large amounts and often was the dominant mineral. Halloysite is also suggested at several points in the horizon. A montmorillonite: vermiculite interstratification was often the dominant mineral. Illite was often present in amounts equal to the other 2:1 clay minerals. Quartz was present in trace amounts.

In the fine clay fraction (less than 0.2 micron) montmorillonite: vermiculite interstratifications were dominant in nearly all soil horizons. In a few horizons excellent peaks at 17.6 A° occurred and these horizons were indicated as dominantly montmorillonite. Illite, Kaolinite, and halloysite were commonly present in all soil horizons in trace amounts. At the 56 to 64 inch depth in one profile a peak at 3.05 A° was shown in both the silt and coarse clay fraction. This mineral is probably calcite.

Vaiden

These grayish-brown upland soils are derived from soft limestone or chalk, and have been called "yellow prairie" soils. The native vegetation is post oak (Quercus stellata). Two sites were sampled. Site I was under herbaceous cover while site II was bare (Table 10).

The surface 6 inches is a plastic clay loam with a bulk density of 1.35 to 1.47. The 6- to 12-inch depth is a very plastic clay with a bulk density of 1.39 to 1.50. The organic matter content and 15-atmosphere moisture percentage are lower than in the Houston soils.

Summary of data on Blackland soils

Although the Houston soils are low in exchangeable potassium and available phosphorous, they are neutral to slightly alkaline in reaction. Both Houston and Vaiden series have a moderately high bulk density and a high clay content. A physical condition favorable for seed germination and

Table 10. Vaiden clay loam from State College, Oktibbeha County, Mississippi.

Soil property	Site I 0-6	Site I 6-12	Site II 0-6	Site II 6-12
Color	grayish brown	pale yellow mottled with gray, brown and red	grayish brown	pale yellow mottled with gray, brown and red
Texture	clay loam	clay	clay loam	clay
Consistence	plastic	very plastic	plastic	very plastic
Structure	weak, medium to coarse blocky	weak, medium to coarse blocky	weak, medium to coarse blocky	weak, medium to coarse blocky
Bulk density gm./cm.^{3}	1.35	1.39	1.47	1.50
	Percent by weight			
Moisture content				
60 cm. of water	36	37	34	35
15 atmosphere	17	16	14	13
Mechanical composition				
Sand	42	36	42	36
Silt	25	24	25	24
Clay	33	40	33	40
Organic matter	3.24	1.77	2.75	0.82

crop growth is difficult to obtain by conventional tillage practices. These soils appear to have a high potential productivity when depth to chalk or soft limestone is not limiting. Much has yet to be learned about their management.

THICK LOESS (BROWN LOAM)

In the relatively large area of land situated east of the Delta the depth of loess deposit is of great importance. The greatest depth of loess occurs along the margin of the Delta area and the depth decreases with distance from the Delta. For example, along the eastern border of the Loess belt, where the loess may be only a few inches deep, the underlying coastal plain material may strongly influence soil properties and productivity. In this study, soils from both the Thick Loess (Brown Loam) and the Thin Loess-Rolling areas have been included. The soils in the Thick Loess (Brown Loam) area have developed in more than 4 feet of loess.

Memphis

The Memphis soil series is derived from loess deposits from 10 to 50 feet in depth. It occurs as bluffs and within a few miles east of the Delta area. The surface 12 inches at two sites were sampled (Table 11). The Vicksburg site was on gently sloping upland under cultivation while the Port Gibson location was on an upland slope under mature pine and hardwood forest cover.

The surface 6 inches is characteristically a friable to very friable silt loam with a weak, fine to medium granular structure. The silt content of the surface 6 inches ranges between 75 and 80 percent. Within the surface 12 to 14 inches a Memphis silt loam which has not undergone accelerated erosion has a uniform mechanical composition. This is evident from Table I in Bulletin 521 (1), which presents data for a near-virgin Memphis soil. Below 12 to 14 inches the silt content decreases to about 60 percent and clay content increases to about 35 percent. The sand content may decrease from about 10 percent in the surface 12 inches to 5 percent at about 20 inches. From the finer texture in the 6- to 12-inch layer it appears that the Port Gibson site may have undergone some erosion or developed under slightly different conditions from the other two sites.

Comparison of the near-virgin condition (Table 1, Bulletin 521) with the cultivated soil in Table 11 shows the change in bulk density and organic matter content that can be expected.

Grenada

The Grenada soil series has been derived from loess material varying from 4 to 10 feet deep. Coastal Plain material is usually encountered in Gre-

Table 11. Memphis silt loam from two different sites.

Location	Vicksburg, Warren County Depth in inches		Port Gibson, Claiborne County Depth in inches	
Soil property	0-6	6-12	0-6	6-12
Color	dark yellowish brown	strong brown	brown to grayish brown	yellowish red to brownish-yellow
Texture	silt loam	silt loam	silt loam	silty clay loam
Consistence	friable	friable	very friable	friable
Structure	weak, fine granular	weak, fine blocky	weak, fine granular to weak, medium platy	weak, fine blocky
Bulk density gm./cm.^{3}	1.36	1.48	1.26	1.46
		Percent by weight		
Moisture content				
60 cm. of water	28.9	25.9	31.9	26.1
15 atmosphere	6.2	8.4	6.8	13.3
Mechanical composition				
Sand	11	9	12	11
Silt	75	71	77	56
Clay	14	20	11	33
Organic matter	0.86	0.46	1.45	.38

nada soils at 5 to 8 feet. Often loose Coastal Plain sand underlies this mantle of loess and under mismanagement erosion proceeds at a rapid rate. Characteristically the Grenada soils have a pan layer at a depth of 24 to 30 inches. This pan layer, called a fragipan, is very hard when dry but friable when moist.

The surface soil texture of the Grenada soils investigated varies between a silt and silt loam (Table 12-15). These soils appear to be lighter in color than the Memphis soil. Although the profiles vary considerably in the depth of designated horizons and in the mechanical composition, the surface horizon has the highest silt content varying between 65 and 88 percent. Below the surface horizon there is usually a decrease in the silt fraction and an increase in the clay fraction. Between 21 and 34 inches, however the silt fraction again increases and approaches the composition of the surface horizon. Between the 30 and 48 inch depth the clay content was 21 percent while the silt content ranged between 66 and 74 percent, the smallest silt content encountered in the profile.

The aggregate stability decreases with depth but a reasonable degree of stability is indicated in the surface 2 feet. The bulk density increases rather uniformly to a depth of 24 inches at which point a significantly greater increase appears. This large increase in bulk density reflects the presence of the fragipan layer.

The available water capacity of these soils is quite high. From simple calculations, it appears that the average available water capacity of the surface 30 inches is about 7 inches.

The pH at the surface is between 5.1 and 5.5. The lowest pH measured was 4.7 in the 5- to 22-inch layer. Grenada soils are low in both exchangeable potassium and available phosphorous. The cation exchange capacity ranges between 4.5 and 8.7 m.e. per 100 gm. at the surface and from 4.5 to 14.1 m.e. throughout the profile.

In the silt fraction (2-50 microns) quartz is the dominant mineral throughout the profile. Traces of illite type

Table 12. Grenada silt loam from North Mississippi Branch Station at Holly Springs, Marshall County, Mississippi.

Soil property	Soil depth in inches 0-7	7-21	21-27	27-34	34-48
Soil Horizon	Ap	B_1	B_{21}	Pan	C
Color	yellowish brown to yellow	dark yellowish brown to yellowish brown	mottled brown to dark brown	light gray to pinkish gray mottled	dark brown streaked with light gray
Texture	silt loam	silty clay loam	silt loam	silt loam	silt loam
Consistence	firm	friable	firm	very firm	firm
Structure	weak medium crumb to weak platy	weak fine subangular blocky	moderate medium blocky	weak, medium subangular blocky	weak, medium subangular blocky
pH	5 1	5.1	5.3	5.3	5 5
Cation exchange capacity m.e../100 gm.	4.50	10.55	8.90	9.13	9.95
Exchangeable potassium lbs./ac.	91L —	127L	127L	114L	91L —
Available phosphorous lbs./ac.	2.6L	3.1L	4.0L	3.1L	3.5L
Aggregate stability index	1460	448	319	236	163
Clod density gm./cm.^{3}	1.11	1.30	1.50	1.80	1.60
			Percent by weight		
Moisture content					
1/3 atmosphere	19.0	21.5	20.5	16.0	18.0
15 atmosphere	4.5	7.0	6.0	4.5	5.5
Available water capacity	14.5	14.5	14.5	11.5	12.5
Mechanical composition					
Sand	5	2	2	4	9
Silt	83	70	75	74	70
Clay	12	28	23	22	21
Organic matter	1.25	0.62	0.38	0.38	0.36

Table 13. Grenada silt loam from Holly Springs, Marshall County, Mississippi.

Soil property	Soil depth in inches 0-5	5-18	18-24	24-30	30-48
Soil Horizon	Ap	B_2	B_3	pan	C
Color	yellow	yellow to brownish yellow	mottled yellow to brownish yellow and dark grayish-brown	mottled white and yellowish brown	brownish-yellow highly mottled with grayish brown
Texture	silt loam	silt loam	silt	silt loam	silt loam
Consistence	slightly hard	hard	hard	very hard	very hard
Structure	weak fine crumb	weak medium subangular blocky	moderate medium subangular blocky	weak medium subangular blocky	moderate medium subangular blocky
pH	5.5	4.9	5.7	5.2	5.7
Cation exchange capacity m.e./100 gm.	5.15	13.40	7.25	14.08	10.52
Exchangeable potassium lb./ac.	162L+	172L+	166L+	159L	124L
Available phosphorous lb./ac.	3.5L	2.6L	3.1L	2.6L	2.6L
Aggregate stability index	1330	372	191	62	46
Clod density gm./cm.³	1.51	1.51	1.53	1.62	1.70
			Percent by weight		
Moisture content					
1/3 atmosphere	20	27.5	25.5	27.5	29.0
15 atmosphere	6.5	10.5	9.0	8.5	10.5
Available water capacity	13.5	17.0	16.5	19.0	18.5
Mechanical composition					
Sand	23	2	2	3	5
Silt	65	76	86	82	74
Clay	12	22	12	15	21
Organic matter	0.78	0.38	0.25	0.22	0.18

Table 14. Grenada silt from Hernando, DeSoto County, Mississippi.

Soil property	Soil depth in inches 0-3	3-10	10-22	22-30	30-42
Soil Horizon	Ap	A_2	B_{21}	B_{22}	pan
Color	dark brown to brown	light yellowish brown	yellowish brown	brown to yellowish brown mottled with gray, rust brown, black	light gray mottled with brown, yellow
Texture	silt	silt loam	silt loam	silt loam	silt loam
Consistence	friable	friable	slightly plastic	firm	weakly cemented
Structure	weak medium crumb	weak medium crumb	moderate medium blocky	moderate medium and coarse blocky to prismatic	weak fine subangular blocky
pH	5.2	5.1	4.7	5.1	5.1
Cation exchange capacity m.e./100 gm.	8.75	6.85	9.80	10.93	13.08
Exchangeable potassium lb./ac.	221L+	127L	159L	150L	195L+
Available phosphorous lb./ac.	11.9L	11.9L	5.7L	3.5L	3.5L
Aggregate stability index	1521	1239	635	149	37
Clod density gm./cm.³	1.42	1.46	1.54	1.56	1.74
			Percent by weight		
Moisture content					
1/3 atmosphere	27.5	21.0	24.0	22.5	28.0
15 atmosphere	7.0	4.5	8.5	8.5	8.5
Available water capacity	20.5	16.5	15.5	14.0	19.5
Mechanical composition					
Sand	2	15	3	6	13
Silt	88	69	74	77	66
Clay	10	16	23	17	21
Organic matter	3.54	0.95	0.62	0.32	0.18

Table 15. Summary of Measurements Made on Profile Samples of Grenada silt loam from National Military Park at Vicksburg* and from a 10-Year Old Pine Forest at Holly Springs.

Soil property	Depth in inches 0-5	5-22	22-40+
Color	light yellowish brown	yellowish-brown to brown	light gray, mottled with shades of brown and yellow
Texture	silt loam	silt loam to silty clay loam	silt loam to silty clay loam
Consistence	friable	friable	very firm (compact)
Structure	weak, fine to medium granular	moderate, medium angular blocky	very weak medium blocky to massive
Bulk density gm./cm.^{3}	1.17 - 1.18	1.36 - 1.46	1.54 - 1.57
		Percent by weight	
Moisture content			
60 cm. of water	29	34	34
1/3 atmosphere	22	27	27
15 atmosphere	6-12	9.5 - 16	9 - 13
Available water capacity	10-16	11 - 17.5	14 - 18

*Mississippi Agricultural Experiment Station Bulletin 521, Table 4.

minerals are common throughout the profile. In one profile kaolinite was suggested in two horizons.

In the coarse clay fraction (0.2-2 micron) illite is the predominant mineral throughout the profile. Kaolin and vermiculite are also usually present in sizeable amounts. Frequent interstratifications of illite and vermiculite are suggested. Montmorillonite is frequently indicated in trace amounts in all horizons but larger quantities are indicated in the C horizon. In the C horizon montmorillonite: vermiculite interstratification is suggested.

The X-ray patterns for the fine clay fractions (less than 0.2 micron) were rather nondescript. Perhaps poor orientation was responsible. There appeared to be much interstratification of vermiculite and illite and vermiculite: montmorillonite. Montmorillonite seemed to be present in increasing amounts with depth. Kaolin minerals are undoubtedly present but in smaller amounts than the 2:1 type minerals. Both halloysite and kaolinite occur.

THIN LOESS—ROLLING

The soils in this area have developed in less than 4 feet of loess.

Lexington

Lexington soils occupy upland positions and are developed from shallow loess over sandy Coastal Plain material. The loess may be from a few inches to 4 feet deep. Five sites were sampled all of which were under forest except the McComb site, which had a mixed herbaceous cover and scattered oak trees (Tables 16 and 17).

The clay content increases from about 13 percent in the 0- to 6-inch layer to 24 to 29 percent in the 6- to 12-inch layer. The silt content decreases from 67 to 71 percent in the surface 6 inches to 56 to 62 percent in the 6- to 12-inch layer. The sand content also decreases some what with soil depth.

The bulk density is about 1.25 gm./cm.^{3} at the surface and 1.5 at 6 to 12 inches; it may increase to 1.6 at depths greater than 36 inches. The moisture data on these soils is rather difficult to evaluate since the 1/3 atmosphere percentages for only one site are reported. The 15-atmosphere percentage varies between 3.5 and 7 percent for the surface 6 inches and for the 6- to 12-inch layer between 7.4 and 10.8 percent. The available water capacity of the surface 12 inches is estimated at 3 to 4 inches. For the most part only the upper layers of these soils have been investigated. The depth of loess over the sandy Coastal Plain material largely determines the natural productivity. When the loess is deep enough these soils have very desirable physical characteristics and respond well to managment. Erosion is always a great hazard.

Providence

The Providence soil series, like the Lexington, is derived from shallow loess over sandy Coastal Plain material. It has a pan (fragipan) at 24 to

Table 16. Lexington silt loam from three sites in Lafayette County, Mississippi.

Soil property	Tallahatchie Experimental Forest				Oxford
	Site I		Site II		Site III
	0-3 inches	3-8 inches	0-6 inches	6-12 inches	soil depth of 0-6 inches
Color	brownish gray	light gray	brownish gray to light gray	strong brown to reddish yellow	brownish gray
Texture	silt loam	silt loam	silt loam	silty clay loam	silt loam
Consistence	friable	friable	friable	———	friable
Structure	weak medium crumb	weak medium crumb	weak medium crumb	weak medium blocky	weak medium crumb
Bulk density gm./cm.^{3}	1.00	1.33	1.40	1.49	1.21
			Percent by weight		
Moisture content					
60 cm. of water	—	—	28.0	25.6	23.6
1/3 atmosphere	38.5	28.7	—	—	—
15 atmosphere	9.0	5.0	3.5	10.8	7.0
Available water capacity	29.5	23.7	—	—	—
Available water capacity in inches	0.89	1.58	—	—	—
Mechanical composition					
Sand	—	—	16	9	—
Silt	—	—	71	62	—
Clay	—	—	13	29	—
Organic matter	5.0	1.0	—	—	—

Table 17. Lexington silt loam from two sites.

Soil property	McComb, Pike County Soil depth in inches		Holly Springs, Marshall County Soil depth in inches		
	0-6	6-12	0-8	8-36	36+
Color	dark grayish brown	yellowish brown	brownish gray	reddish yellow	strong brown to reddish yellow
Texture	silt loam	silt loam	silt loam	silt loam	sandy clay loam
Consistence	very friable	friable	friable	friable to slightly firm	very friable
Structure	granular to weak, medium blocky	moderate, medium blocky	weak, medium crumb	weak, medium blocky	———
Bulk density gm./cm.^{3}	1.28	1.50	1.21	1.56	1.58
			Percent by weight		
Moisture content					
60 cm. of water	27.0	24.2	21.1	21.8	14.6
15 atmosphere	4.1	7.4	6.0	10.3	7.0
Mechanical composition					
Sand	20	20	—	—	—
Silt	67	56	—	—	—
Clay	13	24	—	—	—

30 inches and is less well drained than the Lexington soils.

The surface 12 inches of the site described in Table 18 has a rather uniform mechanical composition and contains more clay and less silt than the Lexington soils. The bulk density values are rather similar to the Lexington soils. The moisture contents both at 15-atmosphere and 60 cm. of water tension are higher than for the Lexington soils.

The physical characteristics of the surface 12 inches of the Providence and Lexington soils appear to be equally desirable.

Tippah

The Tippah soil series are upland soils derived from shallow loess over heavy acid clays. Measurements on the surface 12 inches at one site are presented in Table 18. The mechanical composition and the moisture con-

Table 18. Providence silty clay loam and a Tippah silt loam from Lafayette County, Mississippi.

Soil property	Providence silty clay loam Oxford, Lafayette County Depth in inches		Tippah silt loam Oxford, Lafayette County Depth in inches	
	0-6	6-12	0-6	6-12
Color	yellowish gray to brownish yellow	yellowish red	light yellowish gray	brown to brownish yellow to yellowish red
Texture	silty clay loam	silty clay loam	silt loam	silt loam
Consistence	friable	friable	———	friable
Structure	weak fine to medium subangular blocky	moderate to coarse subangular blocky	———	moderate, medium to coarse subangular blocky
Bulk density gm./cm.^{3}	1.26	1.45	1.38	1.59
	Percent by weight			
Moisture content				
60 cm. of water	33.7	30.4	27.6	23.0
15 atmosphere	14.1	15.1	5.4	8.4
Mechanical composition				
Sand	10	6	18	17
Silt	60	60	66	58
Clay	30	34	16	25

tents at 15-atmosphere and 60 cm. of water tension are similar to those of the Lexington soils, but the Tippah has a higher bulk density, at least in the surface 12 inches.

UPPER COASTAL PLAIN

Atwood

The Atwood soils occupy upland positions and are derived from deep sandy clay Coastal Plain materials with rather high silt contents. These soils are recognized as being among the most productive in the hill section of Mississippi. The native vegetation was chiefly shortleaf pine (Pinus echinata). One profile near Iuka, under cultivation for cotton, was investigated (Table 19).

The surface 0 to 5 inches has very desirable physical characteristics. It is a friable, yellowish-brown loam with a loose crumb structure showing a high degree of aggregate stability. Below 5 inches, the clay content is fairly constant and comprises 26 to 29 percent of the soil by weight. The silt content decreases with depth while the sand increases.

The sudden increase in clod density between the 0- to 5-inch horizon and the 5- to 17-inch horizon partly reflects a real decrease in pore volume. However, because the clay content in the second horizon is about 1.5 times greater than in the surface horizon, the clods from the second horizon shrink more than those from the surface horizon when over dried. The difference in shrinkage makes it impractical to compare clods in terms of their real density. It appears, however, that the clod density and total pore space is reasonably constant at depths below 5 inches. The aggregate stability of the B_2 horizon is only one-third that of the A horizon and reflects the marked difference in physical properties of the two horizons. Values for available water capacity are rather low and appear to decrease with depth below the soil surface

The pH was 5.4 in the surface 17 inches, 5.5 or 5.6 in the 17- to 38-inch zone and 5.1 to 5.3 at depths below 38 inches. Exchangeable potassium is present in low to medium amounts while available phosphorous is present in only trace amounts.

In the silt fraction (2-50 microns) quartz dominates. Illite is present in significant amounts in all soil horizons with an apparent minimum at the 17- to 38-inch depth.

In the coarse clay (0.2-2 microns) fraction kaolin and vermiculite clay minerals are present in about equal amounts. The kaolin minerals are

Table 19. Atwood loam from Iuka, Tishomingo County, Mississippi.

Soil property	Depth in inches 0-5	5-17	17-28	28-38	38-48	48+
Soil horizon	Ap	B_{21}	B_{22}	B_3	C_1	C_2
Color	yellowish brown	reddish brown to yellowish red	dark red to red	dark red to red	dark reddish brown to red	dark reddish brown to red
Texture	loam	sandy clay loam	clay loam	sandy clay loam	sandy clay loam	sandy clay loam
Consistence	friable	friable	firm	friable	friable	firm
Structure	loose crumb	weak blocky	medium blocky	very weak subangular blocky	weak subangular blocky	weak subangular blocky
pH	5.4	5.4	5.6	5.5	5.1	5.3
Cation exchange capacity m.e./100 gms.	4.80	6.55	6.53	6.28	5.85	7.5
Exchangeable potassium lbs./ac.	156L	234L+	280M—	270M—	231L+	254M—
Available phosphorous lbs./ac.	trace	trace	trace	trace	trace	trace
Aggregate stability index	1350	460	490	520	560	810
Clod density gm./cm.^{3}	1.42	1.76	1.83	1.88	1.79	1.74
			Percent by weight			
Moisture content						
1/3 atmosphere	14	17.5	18	16.5	15.5	15.5
15 atmosphere	5	8.5	9.5	8.5	8.5	9.5
Available water capacity	9	9.0	8.5	8.0	7.0	6.0
Mechanical composition						
Sand	34	48	44	48	56	60
Silt	47	24	27	25	18	11
Clay	19	28	29	27	26	29
Organic matter	1.05	0.32	0.25	0.25	0.25	0.25

kaolinite and halloysite and occur in varying proportions. Illite is present in significant amounts in all horizons. In addition, frequent interstratifications of illite and vermiculite occur. Other 2:1 type clay minerals and interstratifications of these may also be present but the available X ray patterns do not allow a more detailed analysis. Quartz is present in varying amounts.

The fine clay (less than 0.2 microns) fraction in every soil horizon is dominant in kaolin (kaolinite and halloysite). Illite is present in large amounts in all horizons and is often found in quantities equal to kaolin. Vermiculite and vermiculite-illite interstratifications are usually present in significant amounts. There may be traces of montmorillonite clay, particularily in the surface 17 inches. Only traces of quartz are indicated.

Although this soil is classified as medium textured, considerable quantities of illite and vermiculite give it a cation exchange capacity of 5.8 to 7.5 m.e. per 100 gm.

Cuthbert

Cuthbert soils have developed from stratified sandy clay or shale and clay. In Table 20 are data characterizing the surface 12 inches of a Cuthbert loam. The surface 6 inches has a rather desirable physical condition similar to the Atwood loam. The clay content of the Cuthbert soil is approximately 1.5 times greater in the 6- to 12-inch depth than in the surface 6 inches while the sand and silt content decreases with depth. In the 6- to 12-inch layer the bulk density significantly increases and it is expected that the available moisture capacity decreases.

Although data are not presented for depths greater than 12 inches, descriptions commonly emphasize the presence of a fine textured sub-soil with low permeability which limits response to good farming practices.

Bibb

Unlike the Cuthbert and Atwood, the Bibb series is comprised of poorly drained bottom-land soils developed from Coastal Plain sand and clay. The surface 12 inches of a Bibb loam is described in Table 20. The mechanical composition is very uniform. The surface 6 inches has a bulk density of 1.22, an indication of adequate pore space. Although the bulk density increases to 1.37 in the 6- to 12-inch layer, this does not suggest a serious reduction in pore space.

It appears that inadequate drainage is the factor limiting crop production on these soils.

Ecru

The Ecru series are upland soils derived from deep orange red to red sandy clay Coastal Plain materials with a high silt content. They are among the best upland soils in Mississippi and are adapted to many crops. The natural vegetation consists chiefly of black and red oak and hickory. In this investigation only one site, under grass cover, near Pontotoc was studied. (Table 21).

Table 20. Bibb and Cuthbert loam from Burnsville, Tishomingo County, Mississippi.

Soil property	Cuthbert loam Soil depth in inches 0-6	6-12	Bibb loam Soil depth 0-6	6-12
Color	grayish-brown	mottled grayish-brown	grayish-brown to yellow	yellow to reddish yellow
Texture	loam	loam	loam	loam
Consistence	friable	————	loose	friable
Structure	fine granular	————	weak granular	weak medium blocky
Bulk density gm./cm.³	1.22	1.37	1.31	1.54
		Percent by weight		
Moisture content				
60 cm. of water	32.2	29.2	29.0	21.4
15 atmosphere	8.0	8.6	3.9	8.5
Mechanical composition				
Sand	43	44	39	35
Silt	37	38	47	42
Clay	20	18	14	23

Table 21. Ecru silt loam from near Pontotoc, Pontotoc County, Mississippi.

Soil property	0-5	5-9	Depth in inches 9-37	37-57	57-72	72+
Color	dark brown to brown	yellowish red	dark reddish brown to red	dark red to dark reddish brown	dark red	dark red to red
Texture	silt loam	silt loam	silty clay loam	clay loam	clay loam	clay loam
Consistence	friable	slightly plastic	plastic	firm	firm to hard	firm
Structure	loose crumb	crumb to weak subangular blocky	medium blocky	weak subangular blocky	crumb to weak subangular blocky	crumb
pH	6.1	6.2	5.2	5.3	5.0	5.0
Cation exchange capacity m.e./100 gms.	—	7.63	10.38	8.23	8.35	7.88
Exchangeable potassium lbs./ac.	195L+	208L+	254M—	169L+	182L+	111L
Available phosphorous lbs./ac.	trace	trace	trace	trace	trace	3.08
Aggregate stability index	1665	1130	290	1295	1315	482
Clod density gm./cm.³	1.44	1.60	1.77	1.84	1.83	1.66
			Percent by weight			
Moisture contennt						
1/3 atmosphere	22	21	27	22	24	21
15 atmosphere	7	9	13	12	13	12
Available water capacity	15	12	14	10	11	9
Mechanical composition						
Sand	12	12	12	22	20	36
Silt	70	63	53	44	41	30
Clay	18	25	35	34	39	34
Organic matter	1.98	1.65	0.78	0.46	0.32	0.25

The mechanical composition of this soil changes significantly with depth. The silt content is 70 percent in the surface horizon, decreases to 30 percent in the 9- to 37-inch horizon and then remains reasonably constant to 72 inches. The sand content is about 12 percent in the surface 37 inches and increases to 36 percent at 72 inches. The texture, therefore, ranges from a silt loam in the surface 9 inches to a clay loam below 37 inches.

The clod density increases with depth to a maximum in the 37- to 72-inch layers. However, with the exception of the 9- to 37-inch horizon, this soil appears to have very stable structural units even to a depth of 72 inches. The available water capacity is between 12 and 15 percent by weight in the surface 37 inches. This might be rated as a medium capacity for available water. The increased 15-atmosphere percentage at depths below 9 inches reflects the higher clay content of these layers. The available water capacity remains above 10 percent by weight to a depth of 72 inches.

In the silt fraction (2-50 microns) quartz is the dominant mineral and illite is present in significant amounts in all horizons. In the surface 57 inches vermiculite occurs in considerable amounts and is frequently interstratified with illite.

The coarse clay (0.2-2 microns), from the surface 9 inches, is composed of large quantities of illite, vermiculite and illite-vermiculite interstratifications. Kaolinite, halloysite and quartz are present in significant amounts in these surface layers. In the 9- to 37-inch layers illite, vermiculite, kaolinite, and halloysite are present in about equal amounts. In the 37- to 72-inch zone kaolinite or halloysite is dominant while illite, vermiculite and illite-vermiculite interstratifications occur in lesser amounts.

In the fine clay (less than 0.2 microns) fraction kaolinite or halloysite is the dominant mineral in all soil horizons investigated. Illite, vermiculite and interstratifications of these minerals are present in considerable amounts in the surface 9 inches but the amounts decrease with depth. Montmorillonite is present in significant amounts in the 5- to 9-inch layer and decreases with depth. In the 0- to 5-inch layer small amounts of quartz and goethite were indicated.

The pH is about 6.1 in the surface layer and between 5.0 and 5.3 at lower depths. Obviously the pH of the surface 9 inches has been affected by additions of lime. The presence of considerable quantities of illite and vermiculite clay minerals has resulted in a relatively high cation exchange capacity ranging between 7.9 and 10.4 m.e. per 100 gm. The exchangeable potassium content is low to medium. Only traces of available phosphorous are present. The surface 9 inches of this Ecru soil appears to have very desirable physical condition and the subsoil shows high structural stability. With lime, fertilizer and adequate moisture high productivity can be expected.

LOWER COASTAL PLAIN

The soils in this region are developed from widely varying materials—sand, gravel, sandy clay, clay and some shale. The deposits from which these soils were developed have been exposed to weathering processes for a longer period of time in the northern part of this region than those in the south. The dominant native vegetation in the southern part of this area is longleaf pine (Pinus palustris) while in the north shortleaf pine (Pinus echinata) and loblolly pine (Pinus taeda) are common. Hardwood trees and some cypress occur on the bottomland throughout the area.

Ruston

The Ruston soil series are upland soils derived from sandy and sandy clay Coastal Plain materials. The topography is almost level to rolling and the natural drainage is good. From the standpoint of parent materials the Ruston and Savannah soils are closely associated. These soils are mapped in the upper as well as the lower Coastal Plain areas. In this investigation five sites were investigated. Tables 22, 23, 24 and 25). There were two sites in Newton County investigated, one near Chunky under longleaf pine (Pinus palustris) and one near Decatur under cotton cultivation. Two sites in the lower Coastal Plain, one near Saucier under longleaf pine and one near Columbia under herbaceous cover were investigated. In addition, a Ruston loam under herbaceous cover near Oxford in the upper Coastal Plain was studied.

The surface layers varied from very pale brown to grayish-brown to yellowish brown. Reds and yellowish-

Table 22. Ruston sandy loam from near Decatur, Newton County, Mississippi.

Soil property	0-6	6-10	10-18	18-24	24-36
	Depth in inches				
Soil horizon	A_1	A_2	B_{21}	B_{22}	B_3
Color	yellowish brown	light yellowish brown	dark reddish brown	red	yellowish red
Texture	sandy loam	loamy sand	loamy sand	sandy loam	sandy loam
Consistence	friable	loose	firm	friable	friable
Structure	single grain	single grain	weak medium subangular blocky	very weak fine subangular blocky	very weak fine subangular blocky
pH	5.8	5.8	4.8	4.8	5.0
Cation exchange capacity m.e./100 gm.	2.00	1.28	7.55	3.75	3.85
Exchangeable potassium lbs./ac.	117L	88L—	182L+	153L	143L
Available phosphorous lbs./ac.	3.52L	trace	trace	trace	trace
Aggregate stability index	1654	1544	653	857	1041
Bulk density gm./cm.³	1.47	1.53	1.81	1.90	1.78
	Percent by weight				
Moisture content					
1/3 atmosphere	10.0	7.0	20.0	11.5	10.5
15 atmosphere	2.5	2.0	10.0	5.0	5.0
Available water capacity	7.5	5.0	10.0	6.5	5.5
Mechanical composition					
Sand	69	85	80	66	74
Silt	27	11	16	18	11
Clay	4	4	4	16	15
Organic matter	1.05	0.46	0.38	0.25	0.12

Table 23. Ruston sandy loam from near Chunky, Newton County, Mississippi.

Soil property	0-6	6-14	14-18	18-32	32-38	38-48
	Depth in inches					
Soil horizon	A_1	A_2	B_1	B_2	B_3	C
Color	grayish brown	light yellowish brown	yellowish red	red to yellowish red	yellowish red	yellowish red
Texture	sandy loam	loamy sand	loam friable	silt loam	sandy loam	sandy loam
Consistence	friable	loose	weak	friable	friable	friable
Structure	single grain	single grain	medium blocky	weak medium blocky	weak coarse blocky	weak massive
pH	5.4	5.0	4.9	4.9	4.8	4.8
Cation exchange capacity m.e./100 gm.	2.35	0.58	4.73	6.70	3.90	3.20
Exchangeable potassium lbs./ac.	52L—	39L—	182L+	211L+	156L	127L
Available phosphorous lbs./ac.	3.1L	trace	trace	trace	trace	11.9L
Aggregate stability index	1801	1242	672	540	1125	926
Bulk density gm./cm.³	1.22	1.35	1.15	1.19	1.14	1.15
	Percent by weight					
Moisture content						
1/3 atmosphere	7.5	6.0	16.5	17.0	10.5	9.5
15 atmosphere	2.5	1.5	7.0	9.5	5.0	5.0
Available water capacity	5.0	4.5	9.5	7.5	5.5	4.5
Mechanical composition						
Sand	74	71	39	40	58	65
Silt	23	26	39	52	26	21
Clay	3	3	22	8	16	14
Organic matter	1.45	0.58	0.52	0.46	0.12	0.12

reds are frequent in the subsoils. The Ruston loam samples from near Columbia and Oxford, because of their finer texture, have in general a higher inherent productivity than the three sandy loam soils studied. For example, the loam sites had a much higher available water capacity than the sandy loam soils and as a result their characteristics have been specified separately.

The Ruston sandy loam subsoils varied considerably in mechanical composition from site to site. For example, the B horizon varied from a loamy sand in the Decatur profile to a silt loam in the Chunky profile. The C horizons varied between a sandy loam and a sandy clay loam. A single grain structure existed in the A horizons and was responsible for the high aggregate stability index values. However, in the

Table 24. Ruston sandy loam from near Saucier, Harrison County, Mississippi.

Soil property	Depth in inches 0-7	7-14	14-21	21-30	30-50	50-72
Soil horizon	A_1	A_2	B_1	B_2	B_3	C
Color	very pale brown	brownish yellow	strong brown	yellowish red	yellowish red	strong brown
Texture	sandy loam	sandy loam	sandy loam	sandy loam	sandy clay loam	sandy clay loam
Consistence	loose	very friable	friable	friable	friable	friable
Structure	single grain	weak, coarse subangular blocky	weak, coarse subangular blocky	weak, coarse blocky	weak, med. subangular blocky	weak, med. subangular blocky
pH	5.0	4.6	4.6	5.2	4.5	4.7
Cation exchange capacity m.e./100 gm.	1.18	1.63	3.35	2.90	2.13	3.10
Exchangeable potassium lbs./ac.	26L—	26L—	49L—	33L—	33L—	26L—
Available phosphorous lbs./ac.	2.6L	trace	trace	trace	trace	trace
Aggregate stability index	1685	1332	1215	1310	1300	1148
Bulk density gm./cm.^{3}	1.66	1.52	1.70	1.80	1.86	1.80
			Percent by weight			
Moisture content						
1/3 atmosphere	7.5	8.5	12.5	11.0	12.0	13.5
15 atmosphere	2.0	2.5	7.0	6.5	7.0	9.0
Available water capacity	5.5	6.0	5.5	4.5	5.0	4.5
Mechanical composition						
Sand	77	70	61	65	67	67
Silt	18	24	20	16	12	8
Clay	5	6	19	19	21	25
Organic matter	0.55	0.55	0.38	0.32	0.28	0.25

Table. 25. Ruston loam.

Soil property	Columbia, Marion County Depth in inches 0-6	6-12	Oxford, Lafayette County Depth in inches 0-8	8-30
Color	grayish brown to pale brown	reddish yellow	grayish brown	yellowish red
Texture	loam	loam	loam	sandy clay
Consistence	friable	friable	very friable	friable
Structure	essentially structureless	weak, medium blocky	essentially structureless	essentially structureless
Bulk density	1.50	1.60	1.54	1.69
		Percent by weight		
Moisture content				
60 cm. of water	17.6	20.3	—	—
1/3 atmosphere	—	—	19.5	23.1
15 atmosphere	3.6	8.2	2.6	7.0
Available water capacity	—	—	16.9	16.1
Mechanical composition				
Sand	49	30	—	—
Silt	40	44	—	—
Clay	11	26	—	—
Available water capacity in inches	1.26	1.16	2.08	5.99

subsoil where a blocky structure was prevalent the aggregate stability was still quite high.

The available water capacity of the Ruston sandy loam soils was rather low. Frequently, the available water capacity of the B horizon was twice that of the A horizon. The pH of the A horizon averaged 5.0 for the forest sites while the site under cotton has probably been limed enough to raise it to pH 5.8. The exchangeable potassium content is generally low with the maximum amounts occuring in the B_1 and B_2 horizons. Available phosphorous supply is also low.

The dominant mineral in the silt fraction (2-50 microns) was quartz. Illite was present in at least trace amounts in all horizons. Kaolinite and vermiculite were present in trace amounts at several points in the profile. Other minerals that were indicated include halloysite and montmorillonite.

In the clay fraction (less than 2 microns) kaolinite is probably the dominant mineral when the profile as a whole is considered. Within the surface 18 inches vermiculite was usually present in equal or greater amounts than kaolinite, but decreased with depth in the profile. Gibbsite was usually present in significant amounts in all soil horizons. Illite was also usually present in significant amounts and illite: vermiculite interstratifications were suggested particularly at depths between 6 and 18 inches. Halloysite was indicated in significant amounts and may have been called kaolinite in some cases. Other minerals present were lepedocrocite, goethite, and perhaps montmorillonite.

Savannah

These soils like the Ruston soil series, occur in the upper and lower Coastal Plain area. They are described as upland soils with hardpans and are derived from sandy clays. The series occurs on almost level to gently rolling topography and the natural drainage is good. Three sites were studied, one near Waynesboro under broomsedge (Andropogon virginicus) and persimmon vegetative cover, one near Poplarville under a tung orchard and another near Shubuta under a vegetative cover of loblolly pine (Pinus taeda), post oak (Quercus stellata) and broomsedge. The surface texture of the three sites varied from a sandy loam to a very fine sandy loam and from a grayish-brown to light grayish-brown in color (Tables 26, 27 and 28).

The clay content of the B_2 horizon varied between 14 and 16 percent and was usually a loam texture. The C_2 horizon was a sandy clay loam and contained 22 to 28 percent clay. The pan layer, which occurred just below the B horizon at a depth between 24 and 49 inches, had a lower clay content than the B or C_2 horizon at two of the three sites and varied in texture between a sandy loam and a sandy clay loam.

In general the moisture content at 1/3 and 15 atmosphere tensions increases with depth below the soil surface. One notable exception is the Shubuta site, where the surface soil has a rather high 1/3 atmosphere percentage. With the exception of the surface soil of the Shubuta site the available water capacity by weight varies between 6 and 9.5 percent. Broadfoot and Raney (1) reported that the available water capacity of a Savannah sandy loam surface soil was 21.5 percent by weight. This difference is accounted for by the higher clay content of that soil. The clod density values reported here do not identify the pan layer but rather show a generally dense subsoil.

The organic matter content below the 24 inch depth is less than 0.32 percent in all three profiles. In the 7- to 24-inch interval at the Waynesboro and Poplarville sites the organic matter content is between 0.55 and 0.58 percent and increases to 1.55 and 1.65 in the surface horizon. The samples from the Shubuta site had an organic matter content of 2.23 percent in the 0- to 7-inch layer and 1.05 in the 7- to 13-inch layer. This higher organic matter content in the surface soil at Shubuta probably accounts for the higher moisture percentage at a tension of 1/3 atmosphere.

Table 26. Savannah sandy loam near Poplarville, Pearl River County, Mississippi.

Soil property	Depth in inches 0-5	5-9	9-19	19-27	27-46	46+
Soil horizon	Ap	B_1	B_2	B_3	pan	C
Color	grayish brown	light yellowish-brown	brownish-yellow	brownish-yellow mottled with red	light gray mottled with red and brownish yellow	mottled light gray, red and brownish yellow
Texture	sandy loam	sandy loam	loam	sandy loam	sandy clay loam	sandy clay loam
Consistence	very friable	friable	friable	firm	firm	firm
Structure	weak massive	massive	weak, medium sub-angular blocky	moderate medium sub-angular blocky	moderate medium to coarse sub-angular blocky	weak, coarse sub-angular blocky
pH	5.9	4.7	4.5	4.6	4.5	4.6
Cation exchange capacity m.e./100 gm.	3 20	2.68	4.10	4.08	6.58	7.28
Exchangeable potassium lbs./ac.	91L —	46L—	55L—	46L—	62L—	81L—
Available phosphorous lbs./ac.	87H	trace	trace	trace	trace	trace
Aggregate stability index	1218	1272	1237	751	572	601
Clod density gm./cm.³	1.53	1.74	1.77	1.79	1.87	1.87
Moisture content			Percent by weight			
1/3 atmosphere	10	12	16	15.5	19.5	21.5
15 atmosphere	2.5	4	7	8.0	12.5	12.0
Available water capacity	7.5	8	9	7.5	7	9.5
Mechanical composition						
Sand	66	55	47	59	54	63
Silt	32	37	37	24	18	9
Clay	2	8	16	17	28	28
Organic matter	1.55	0.55	0.55	0.25	0.25	0.25

Table 27. Savannah very fine sandy loam from near Waynesboro, Wayne County, Mississippi.

Soil property	Depth in inches 0-7	7-17	17-24	24-33	33-49	49-70
Soil horizon	Ap	A_2	B_1	B_2	Pan	C
Color	light brownish gray	brownish yellow with strong brown iron concretions	yellow	brownish yellow to yellowish brown	brownish yellow and white mottled	yellowish brown mottled with white
Texture	very fine sandy loam	fine sandy loam	fine sandy loam	loam	sandy loam	sandy clay loam
Consistence	friable	friable	friable	friable to firm	firm	friable
Structure	weak, fine granular	granular	medium to coarse sub-angular blocky	weak, medium coarse sub-angular blocky	moderate strong coarse sub-angular blocky	moderate coarse sub-angular blocky
pH	4.8	4.6	4.9	4.6	5.1	4.5
Cation exchange capacity m.e./100 gm.	3.65	1.65	2.25	3.38	2.88	3.48
Exchangeable potassium lbs./ac.	85L—	36L—	36L—	39L—	39L—	26L—
Available phosphorous lbs./ac.	4.84L	trace	trace	trace	trace	trace
Aggregate stability index	1682	1090	555	644	1155	462
Clod density gm./cm.³	1.47	1.57	1.61	1.68	1.76	1.86
Moisture content			Percent by weight			
1/3 atmosphere	9.5	9.0	13.5	14.0	14.0	16.0
15 atmosphere	2.5	3.0	5.0	7.0	8.0	9.0
Available water capacity	7.0	6.0	8.5	7.0	6.0	7.0
Mechanical composition						
Sand	76	58	56	40	58	49
Silt	20	33	30	46	30	27
Clay	4	9	14	14	12	24
Organic matter	1.65	0 58	0.55	0.32	0.32	0.25

The pH of the Ap horizon ranges between 4.8 and 5.9. Below the surface layer the pH ranges between 4.4 and 5.1. The cation exchange capacity of the surface soil ranges between 3.2 and 5.3 m.e. per 100 gm. and tends to increase with depth below the soil surface except for a minimum which occurs in the A_2 and B_1 horizons. The exchangeable potassium content of these soils is low and the available phosphorous is low or present only in trace amounts. The higher available phosphorous content and pH of the surface soil at Poplarville indicate the addition of phosphorous fertilizer and lime.

The X-ray diffraction data for the silt fractions (2-50 microns), in all soil horizons, indicated a dominance of quartz. Illite type clay minerals occurred in significant amounts in all soil horizons. Frequently small amounts of kaolinite, halloysite and vermiculite were present. Trace amounts of montmorillonite were indicated in a few instances.

In the clay fraction (less than 2.0 microns) of the surface horizon vermiculite was the dominant mineral at all sites. In the case of the Shubuta site, vermiculite was the dominant mineral to a depth of 52 inches, while the data from the Poplarville site indicated a dominance of vermiculite only in the A, B_1, and B_2 horizons or to a depth of 19 inches. Samples from the surface horizon of the Waynesboro profile were dominant in vermiculite while all other horizons were dominant in kaolinite.

All horizons at each site contained large amounts of kaolinite and sometimes halloysite. Illite was frequently

Table 28. Savannah very fine sandy loam near Shubuta, Clarke County, Mississippi.

Soil property	Depth in inches						
	0-7	7-13	13-18	18-24	24-41	41-52	52+
Soil horizon	A_1	A_2	B_1	B_2	Pan	C_1	C_2
Color	grayish brown to light brownish gray	pale yellow to light brownish gray	yellow	yellow mottled with brownish yellow	yellowish brown mottled	yellowish brown mottled	white stratified with pale brown
Texture	very fine sandy loam	very fine sandy loam	very fine sandy loam	sandy loam hard	sandy loam	sandy loam	sandy clay loam
Consistence	slightly hard	hard	hard		very hard	firm	friable
Structure	weak fine granular	granular	weak medium sub-angular blocky	weak medium to coarse sub-angular blocky	coarse sub-angular blocky	weak coarse sub-angular blocky	stratified
pH	5.0	4.6	4.4	4.4	4.4	4.7	4.5
Cation exchange capacity m.e./100 gm.	5.28	3.55	3.58	4.20	3.40	5.32	6.62
Exchangeable potassium lbs./ac.	72L—	62L—	65L—	68L—	59L—	78L—	88L—
Available phosphorous lbs./ac.	trace	trace	trace	trace	trace	trace	trace
Aggregate stability index	1149	1172	434	423	368	331	418
Clod density gm./cm.³	1.54	1.70	1.73	1.92	1.85	1.82	1.84
	Percent by weight						
Moisture content							
1/3 atmosphere	17.5	12.5	13.5	14.0	12.5	14.5	17.0
15 atmosphere	4.0	3.0	4.5	4.5	4.5	7.5	9.0
Available water capacity	13.5	9.5	9.0	9.5	8.0	7.0	8.0
Mechanical composition							
Sand	46	48	53	53	57	60	63
Silt	48	45	35	31	30	32	15
Clay	6	7	12	16	13	8	22
Organic matter	2.23	1.05	0.38	0.32	0 25	0.22	0.20

Table 29. Norfolk loamy fine sand from near McNeill, Pearl River County, Mississippi.

	Depth in inches					
Soil property	0-4	4-12	12-24	24-35	35-48	48+
Soil horizon	A_1	A_2	B_2	B_3	C	D
Color	very dark grayish brown	light yellowish brown	yellowish brown	brownish yellow	yellowish brown mottled with red	yellowish brown mottled with brownish yellow
Texture	fine loamy sand	sandy loam	sandy loam	sandy loam	sandy loam	sandy clay loam
Consistence	very friable	loose	friable	very friable	loose	very firm
Structure	weak fine granular	granular	weak, coarse sub-angular blocky	weak, coarse sub-angular blocky	granular	massive
pH	5.0	5.2	4.8	4.7	4.8	4.6
Cation exchange capacity m.e./100 gm.	3.28	0.95	3.52	1.93	1.70	3.15
Exchangeable potassium lbs./ac.	62L—	42L—	78L—	49L—	39L—	39L—
Available phosphorous lbs./ac.	3.5L	trace	trace	trace	trace	trace
Aggregate stability index	1982	794	1125	1246	1276	1480
Bulk density gm./cm.^{3}	1.40	1.75	1.58	1.73	1.84	1.90
Moisture content			Percent by weight			
1/3 atmosphere	9.3	9.7	12.0	10.4	10.9	15.8
15 atmosphere	2.1	1.7	5.7	4.0	6.0	10.5
Available water capacity	7.2	8.0	6.3	6.4	4.9	5.3
Mechanical composition						
Sand	79	72	65	68	71	63
Silt	16	21	22	19	10	7
Clay	5	7	13	13	19	30
Organic matter	0.78	0.70	0.46	0.25	0.25	0.22

present in significant amounts and was often interstratified with vermiculite. Montmorillonite was present in a few cases in relatively small amounts. Gibbsite is frequently found in these soils. These data indicated the presence of significant quantities of quartz particularly in the A, B_1, and B_2 horizons.

Norfolk

The Norfolk soils occur only in the lower Coastal Plain area. These upland soils are developed from sandy Coastal Plain materials. They are well drained and occur on almost level to gently rolling topography. The Norfolk soils from the McNeill and Fontainebleau sites (Tables 29 and 30) were under longleaf pine (Pinus palustris), broomsedge (Andropogon virginicus) and wire grass (Cynodon dactylon) cover while the Poplarville site (Table 31) had been under continuous cultivation for six years.

The surface soil textures varied from a loamy fine sand to a fine sandy loam. The surface soil contained 4 to 7 percent clay while the B horizon had a clay content of 9 to 17 percent. Frequently, the Norfolk soil is quite uniform in texture with depth.

Although the aggregate stability data for this soil is difficult to interpret, it appears adequate to a depth of 48 inches. It must be emphasized, that where a single-grain structure occurs, it is not aggregate stability that is being measured but rather the stability of the particles and their packing order.

The available water capacity of the Norfolk soils appears to be intermediate between the Ruston sandy loam and Savannah soils. The greatest available water capacity occurs in the A_2, B_1 and B_{21} horizons. The surface 6 inches of Norfolk soil has an available water capacity of about 0.6 inches. Thus, as is the case with the Ruston and the Savannah soils, frequent recharge of the available water supply is necessary for sustained plant growth.

The bulk density values for this soil are difficult to evaluate. The bulk density of the surface soils which have a single-grained structure was determined by packing a sample of known oven-dry weight into a graduated cylinder and its volume measured. The bulk density of those horizons forming clods was determined by the clod method.

The pH range was 4.4 to 5.4 for all profiles. In the surface soil the pH ranged between 4.7 and 5.2 and was frequently quite uniform with depth. As shown previously for the Ruston soils, the cation exchange capacity was a minimum in the A_2 horizon. The A_1 horizon had a cation exchange capacity between 3.0 and 3.6 m.e. per 100 gm., while the A_2 was between 0.95 and 1.5 m.e. per 100 gm.

The organic matter content of the surface soil is between 0.78 and 2.47 percent by weight and drops rather sharply to 0.70 or 0.86 in the adjacent horizon. The exchangeable potassium content is low and only trace amounts of available phosphorous are indicated.

In the silt fraction (2-50 microns) quartz was present in large amounts. Illite was usually found in all soil horizons. Kaolinite, halloysite and vermiculite (14A⁰ material) occurred, but less frequently and in smaller amounts than illite. When illite and vermiculite were present, interstratifications of these minerals were frequently indicated.

Table 30. Norfolk fine sandy loam from near Fontainebleau, Jackson County, Mississippi.

	Depth in inches							
Soil property	0-5	5-11	11-21	21-26	26-47	47-72	72-84	84+
Soil horizon	A_1	A_2	B_{21}	B_{22}	B_3	C_1	C_2	C_3
Color	grayish brown	olive yellow	yellow	yellow	yellow	olive yellow mottled	mottled yellowish brown	light gray
Texture	fine sandy loam	fine sandy loam	fine sandy loam	fine sandy loam	fine sandy loam	fine sandy loam	sandy loam	fine loamy sand
Consistence	loose	loose	friable	very friable	very friable	friable	friable	very friable
Structure	single grain	single grain	weak, coarse sub-angular blocky	massive	massive	massive	massive	single grain
pH	4.7	4.6	4.6	4.6	4.5	4.4	4.4	4.6
Cation exchange capacity m.e./100 gm.	3.60	1.52	3.02	2.50	2.02	2.90	2.35	2.08
Exchangeable potassium lbs/ac.	42L—	20L—	33L—	23L—	23L—	23L—	23L—	16L—
Available phosphorous lbs./ac.	2.6L	trace	trace	trace	trace	trace	trace	trace
Aggregate stability index	1680	1235	1303	1332	1580	279	380	552
Bulk density gm./cm.³	1.36	1.49	1.54	1.67	1.70	1.80	1.77	1.85
	Percent by weight							
Moisture content								
1/3 atmosphere	9.6	10.7	12.3	10.2	10.6	12.2	10.7	7.6
15 atmosphere	2.9	2.7	5.2	4.2	3.5	5.0	4.5	2.7
Available water capacity	6.7	8.0	7.1	6.0	7.1	7.2	6.2	4.9
Mechanical composition								
Sand	64	65	55	54	55	65	69	79
Silt	29	28	30	35	34	21	17	12
Clay	7	7	15	11	11	14	14	9
Organic matter	2.47	0.86	0.70	0.62	0.56	0.55	0.55	0.46

Table 31. Norfolk fine sandy loam from Poplarville, Pearl River County, Mississippi.

Soil property	0-7	7-11	11-18	18-28	28-37	37-52	52 +
	Depth in inches						
Soil horizon	Ap	B_1	B_{21}	B_{22}	B_3	C_1	C_2
Color	grayish brown	yellowish brown	yellowish brown	brownish yellow	brownish yellow mottled with brown and red	brownish yellow mottled with red and yellow	brownish yellow mottled with red and white
Texture	fine sandy loam	loam	loam	fine sandy loam	fine sandy loam	sandy loam	sandy loam
Consistence	friable	friable	friable	friable	friable	friable	friable
Structure	single grain	weak coarse sub-angular blocky	weak coarse sub-angular blocky	weak medium sub-angular blocky	weak medium sub-angular blocky	weak medium sub-angular blocky	
pH	5.2	4.6	4.6	4.6	5.2	5.4	5.0
Cation exchange capacity m.e./100 gm.	3.00	3.80	3.40	3.10	2.25	2.78	2.28
Exchangeable potassium lbs./ac.	85L—	46L—	42L—	36L—	26L—	46L—	36L—
Available phosphorous lbs./ac.	trace	trace	trace	trace	trace	trace	trace
Aggregate stability index	466	638	710	955	585	675	275
Bulk density gm./cm.^{3}	1.66	1.82	1.68	1.77	1.79	1.80	1.75
				Percent by weight			
Moisture content							
1/3 atmosphere	7.2	14.3	13.1	12.4	10.1	12.2	12.0
15 atmosphere	2.4	6.0	5.3	5.6	4.5	6.7	6.3
Available water capacity	4.8	8.3	7.8	6.8	5.6	5.5	5.7
Mechanical composition							
Sand	69	50	47	53	63	60	70
Silt	27	33	44	37	31	30	13
Clay	4	17	9	10	6	10	17
Organic matter	1.15	0.70	0.55	0.46	0.46	0.25	0.23

In the clay fraction (less than 2 microns) of the profile at Poplarville, kaolinite was the dominant mineral at all depths investigated. Data from the other two profiles indicated a dominance of vermiculite (14A^0 material) in the surface 24 to 30 inches. Below this depth kaolinite and halloysite was dominant. Vermiculite was, however, present in significant amounts to a depth of 52 inches in the Poplarville profile.

Gibbsite was present in significant amounts throughout the entire soil profile. Illite was commonly indicated, but the amount appeared to decrease with depth.

From the X-ray patterns trace amounts of montmorillonite were suggested particularly at the lower depths.

Noxapater

Noxapater soils are usually described as poorly drained colluvial soils developed from sandy Coastal Plain materials. The soil described in Table 32 had a vegetative cover of mixed grass, pine, and oak. The limited information makes it difficult to draw conclusions about the physical nature of this soil. Inadequate drainage appears to be the major factor limiting its suitability for agricultural production.

Lakeland

The Lakeland series are upland soils developed from sands and loamy sands of the lower Coastal Plain area. They are generally said to occur in the flatwoods of the Coastal Plain but in Mississippi are more frequent in the southern portion of the lower Coastal Plain area. They are associated with the Norfolk soils and are similar in color. The soil described in Table 34 had a vegetative cover of live oak (Quercus virginiana) and longleaf pine (Pinus palustris) while the sites described in Tables 33 and 35 were under turkey oak (Quercus laevis), wire grass (Cynodon dactylon) broomsedge (Andropogon virginicus) and palmetto (Sabal louisiana). All sites were level to gently sloping.

Both of the Hurley sites had a sand content ranging between 90 and 96 percent by weight in the surface 52 inches. The Leakesville samples showed a sand content of 80 to 89 percent within the surface 48 inches. The data in Table 33 showed a marked decrease in sand content below 52 inches and at 72 inches indicated a loam texture.

The bulk density values for the Hurley sites were very similar and generally increased with depth. The bulk density at Leakesville was much lower. The Hurley sites have similar moisture percentages at 1/3 atmosphere and 15 atmosphere tensions in the surface 52 inches of depth. The finer texture, below 52 inches of the sample described in Table 33, resulted in higher 1/3

Table 32. Noxapater silt loam from near Richton, Perry County, Mississippi.

Soil property	Depth in inches 0-6	6-12
Color	dark gray	Light gray mottled with yellow and brown
Texture	silt loam	silt loam
Consistence	firm	friable
Bulk density gm./cm.^{3}	1.30	1.46
	Percent by weight	
Moisture content		
60 cm. of water	35.2	25.2
15 atmosphere	6.5	8.7
Mechanical composition		
Sand	17	13
Silt	70	64
Clay	13	23

Table 33. Lakeland fine sand from 3 miles west of Hurley, Jackson County, Mississippi.

Soil property	Depth in inches 0-5	5-18	18-28	28-41	41-52	52-72	72+
Soil horizon	A_1	A_2	B_{21}	B_{22}	B_3	C	D
Color	grayish brown	yellow	light yellowish brown	brownish yellow mottled with pale strong brown	brownish yellow mottled with pale brown	brownish yellow	brownish yellow mottled with red
Texture	fine sand	fine sand	fine sand	fine sand	fine sand	sandy loam	loam
Consistence	loose	loose	loose	loose	loose	friable	friable
Structure	single grain	single grain	single grain	single grain	single grain	weak coarse sub-angular blocky	weak coarse sub-angular blocky
pH	4.3	5.0	5.1	5.0	5.4	4.7	4.5
Cation exchange capacity m.e./100 gm.	2.60	0.60	0.95	0.70	1.03	1.93	2.90
Exchangeable potassium lbs./ac.	23L—	13L—	23L—	23L—	26L—	52L—	39L—
Available phosphorous lbs./ac.	6.6L—	3.1L—	2.6L—	trace	trace	trace	trace
Bulk density gm./cm.^{3}	1.41	1.42	1.44	1.46	1.67	1.72	1.80
				Percent by weight			
Moisture content							
1/3 atmosphere	5.0	3.5	2.8	3.4	3.6	9.9	15.0
15 atmosphere	2.8	0.7	0.7	0.7	1.8	3.5	7.2
Available water capacity	2.2	2.8	2.1	2.7	1.8	6.4	7.8
Mechanical composition							
Sand	92	91	96	93	90	57	51
Silt	6	5	1	2	4	30	30
Clay	2	4	3	5	6	13	19
Organic matter	1.65	0.46	0.32	0.25	0.25	0.25	0.18

atmosphere and 15 atmosphere moisture percentages. The Leakesville site had somewhat higher moisture contents at 1/3 atmosphere and 15 atmosphere tensions. It must be emphasized that in the calculation of the available water capacity the 1/3 atmosphere percentage has been used as the upper limit of available water. In these sandy soils the moisture content at the upper limit of available water is probably higher than the 1/3 atmosphere percentage. Thus these soils probably have a larger available water

Table 34. Lakeland fine sand from 3 miles south of Hurley, Jackson County, Mississippi.

Soil property	Depth in inches 0-5	5-14	14-28	28-42	42-54	54-70	70-76
Soil horizon	A_1	A_2	B_{21}	B_{22}	B_3	C_1	C_2
Color	grayish brown	brownish yellow	brownish yellow	yellow	brownish yellow	reddish yellow	very pale brown
Texture	fine sand	fine sand	fine sand	fine sand	fine sand	fine sand	fine sand
Consistence	loose	loose	very friable	loose	friable	loose	loose
Structure	single grain	single grain	single grain	single grain	single grain	single grain	single grain
pH	6.1	4.9	5.5	5.6	4.8	6.6	6.4
Cation exchange capacity m.e./100 gm.	2.05	0.80	0.88	0.90	0.78	0.88	0.25
Exchangeable potassium lbs./ac.	20L—	10L—	10L—	10L—	13L—	16L—	7L—
Available phosphorous lbs./ac.	3.5L	trace	trace	trace	trace	3.5L	3.5L
Bulk density gm./cm.^{3}	1.37	1.37	1.40	1.46	1.64	1.45	1.49
Moisture content				Percent by weight			
1/3 atmosphere	4.4	3.6	3.6	3.4	3.1	2.8	2.0
15 atmosphere	2.2	1.4	1.4	1.4	1.2	1.4	0.7
Available water capacity	2.2	2.2	2.2	2.0	1.9	1.4	1.3
Mechanical composition							
Sand	92	93	90	91	94	95	96
Silt	2	2	5	5	2	2	2
Clay	6	5	5	4	4	3	2
Organic matter	1.55	0.42	0.38	0.32	0.32	0.32	0.25

Table 35. Lakeland loamy sand from Leakesville, Greene County, Mississippi.

Soil property	Depth in inches 0-4	4-9	9-18	18-33	33-48	48+
Soil horizon	A_1	A_2	B_1	B_{21}	B_{22}	C
Color	dark yellowish brown	brownish yellow	brownish yellow	strong brown	yellowish red	reddish yellow
Texture	loamy sand	loamy sand	loamy sand	loamy sand	loamy sand	sand
Consistence	loose	slightly compact	friable	friable	loose	loose
Structure	single grain	single grain	single grain	weak granular	single grain	single grain
pH	4.6	5.4	5.0	5.6	4.8	4.8
Cation exchange capacity m.e./100 gm.	1.88	1.00	1.30	1.15	1.05	1.10
Exchangeable potassium lbs./ ac.	20L—	16L—	20L—	16L—	20L—	20L—
Available phosphorous lbs./ac.	trace	trace	trace	trace	trace	trace
Bulk density gm./cm.^{3}	1.23	1.32	1.34	1.18	1.24	1.29
Moisture content			Percent by weight			
1/3 atmosphere	5.7	5.3	8.2	5.9	4.8	3.1
15 atmosphere	2.4	2.3	2.2	2.5	1.6	1.5
Available water capacity	3.3	3.0	6.0	3.4	3.2	1.6
Mechanical composition						
Sand	83	81	80	80	82	89
Silt	9	11	12	10	10	4
Clay	8	8	8	10	8	7
Organic matter	1.33	0.62	0.62	0.46	0.42	0.38

capacity than recorded here. Whatever the true capacity, however, it is very low.

The A_1 horizon had an organic matter content of 1.33 to 1.65 percent by weight which decreased to 0.42 to 0.62 in the A_2 horizon from which it decreased progressively with soil depth. In general, the Lakeland soils investigated were rather acid and in this regard were similar to the Norfolk soils. The soil described in Table 34 appeared to be the least acid while the soil described in Table 33 was the most acid.

The cation exchange capacity of the A_1 horizon varied between 1.88 and 2.60 m.e. per 100 gm. which was significantly lower than that for the Norfolk soils. The exchangeable potassium content was very low and usually only traces of available phosphorous were present. This soil apparently had a lower inherent fertility than the other soils which were studied in this region.

X-ray diffraction patterns of the silt fraction (2-50 microns) indicated the presence of a large amount of quartz. Illite was commonly present throughout the profile. Vermiculite and kaolinite did not occur as frequently as illite but often were present in trace amounts.

In the clay fraction (less than 2 microns) from the samples from Leakesville and 3 miles west of Hurley vermiculite was probably the dominant mineral. Kaolinite was also present in quantity and increased with depth in the profile. Illite was also present in significant amounts, particularly below a depth of 9 inches. At depths below 18 inches considerable vermiculite: illite interstratification was noted. The 0- to 5-inch horizon of the Hurley sample appeared to have been mixed with silt and so was ignored.

In the sample of coarse clay (0.2-2 micron) from 3 miles south of Hurley as in the clay fraction discussed above, vermiculite and kaolinite minerals predominated. Gibbsite was also present in significant amounts. Illite was noted in three different horizons in the profile and in the same horizons vermiculite; illite interstratifications were indicated. In the fine clay (less than 0.2 micron) the X-ray patterns for every horizon were rather non-descript, diffuse and difficult to interpret. It appeared that vermiculite (14A^0) was dominant throughout the profile. Illite was indicated throughout the profile with interstratification of illite and vermiculite occurring in the upper 28 inches. Some montmorillonite was suggested above the 28 inch depth while some halloysite and kaolinite was suggested below this depth.

Summary of Data on Soils from the Lower Coastal Plain Area

Physical properties: In general, the structure of these soils as it pertains to air and water movement is satisfactory. The Savannah soils are said to have a pan layer beginning at 24 to 33 inches and extending to 41 to 49 inches. The methods used in this study failed to define the pan layer.

These soils have a low available water capacity. On the basis of the available water capacity in the surface 36 inches, these soils rank in the following descending order: Savannah, Norfolk, Ruston, Lakeland. The surface 12 inches of Savannah soils have an available water capacity ranging between 1.2 and 2.3 inches and an average of 1.7 inches. It must be emphasized that the available water capacity in each case is based on the assumption that the 1/3 atmosphere moisture percentages represent the upper limit of available water. In addition, the applicability of the clod density values to field conditions may be questioned.

Chemical properties: Of the soils studied in this area the Ruston had a slightly higher average pH in the surface soil than all others, while the Savannah was the lowest. The pH of the A_1 horizon of the Savannah was 4.9 and that of the Ruston 5.4. The average pH of the C horizon of the Lakeland soils was 5.3, while that of the Ruston and Norfolk was 4.8 and that of the Savannah was 4.6.

On the basis of the cation exchange capacity of the C horizon, these soils rank in descending order as follows:

Savannah, Ruston, Norfolk, Lakeland. There are two notable exceptions to this ranking when all soil horizons are considered. The first is the interchange of the Norfolk and Ruston on the basis of the higher cation exchange capacity of the A_1 and A_2 horizons of the Norfolk soils. This interchange reflects the fact that the A_1 and A_2 horizons of the Norfolk soil have higher clay and organic matter content than the Ruston. The second exception occurs when the cation exchange capacity of the B_1 and B_2 horizons is considered. Using the cation exchange capacity of the B_1 and B_2 horizons as a criterion these soils are ranked in descending order as follows: Ruston, Savannah, Norfolk, Lakeland.

The inherent fertility of these soils is low. The Ruston soils have the greatest supply of exchangeable potassium, followed in order by Savannah, Norfolk and Lakeland. The average exchangeable potassium content of the A_1 horizons of the Savannah soils under study was larger than that for the other soils and is the only exception to the order given above. The available phosphorous content of all of these soils is so low that comparisons are difficult to make.

Mineralogy: Although it was not possible to characterize the silt fraction completely with the X-ray diffraction patterns that were obtained, the patterns for all the soils suggested the same result. Quartz was the dominant mineral, with illite and vermiculite ($14A^0$) clay minerals occurring in lesser amounts. Small amounts of kaolinite and halloysite were sometimes present, and there were traces of montmorillonite.

The mineral composition of the clay less than 2 microns in diameter varied with depth below the soil surface. Vermiculite ($14A^0$) was the dominant mineral in the surface horizon and usually decreased somewhat with depth in the profile. There appeared to be considerable variation between sites within the same soil series. For example the Waynesboro profile of Savannah was dominant in vermiculite only in the surface horizon while the Shubuta site was dominant in vermiculite to a depth of 52 inches. When vermiculite was not the dominant mineral kaolinite or halloysite was dominant.

COASTAL FLATWOODS

Bladen

The Bladen soils are low-terrace soils developed from heavy Coastal Plain materials. They are poorly drained and occur in flat low places or on poorly defined drainage ways. The native vegetation is cypress (Taxodium distichum), slash pine (Pinus elliottii), marsh grass, and sedges.

Two profiles have been investigated and the physical and chemical data reported in Tables 36 and 37. Both of these sites were cutover land on which slash pine, cypress, grasses, and sedges were growing. The Santa Rosa site had a uniform silt loam texture throughout the entire depth investigated. The Kiln site had relatively uniform loam texture within the surface 14 inches, but the texture of the 14 to 24 inch layer was a clay loam.

The surface 15 inches appeared to have a very desirable physical condition. The aggregate stability was high and the clod density was within the desirable range. Below 15 inches the aggregate stability markedly decreased and the clod density increased. The available water capacity of the surface 12 inches ranged between 2.2 and 2.9 inches. It would appear that drainage is the soil physical condition limiting production. The compacted zone below 15 inches contributes to poor drainage.

The A_1 horizons had a pH range of 4.2 to 5.1. The pH below the A_1 horizon was constantly between 4.6 and 4.7. The exchangeable potassium content was low but is probably in better supply than in the Lakeland soils previously discussed. The available phosphorous content was low to very low, with only trace amounts indicated below the Bg horizon. However, the two sites had at least measurable amounts of available phosphorous in the surface horizons. This may reflect phosphorous made available from organic sources.

Table 36. Bladen loam from near Kiln, Hancock County, Mississippi.

Soil property	Depth in inches 0-6	6-14	14-24
Soil horizon	A_1	Bg	G
Color	very dark gray with brownish gray streaks	dark gray faintly mottled with yellowish brown	dark gray faintly mottled with yellowish brown
Texture	loam	loam	clay loam
Consistence	slightly sticky	slightly sticky	very sticky
Structure	moderate fine granular	weak coarse subangular blocky	massive
pH	5.1	4.7	4.6
Cation exchange capacity m.e./100 gm.	9.08	7.30	9.08
Exchangeable potassium lbs./ac.	55L—	29L—	33L—
Available phosphorous lbs./ac.	3.96	trace	trace
Aggregate stability index	1752	1050	700
Clod density gm./cm.^{3}	1.42	1.48	1.90
		Percent by weight	
Moisture content			
1/3 atmosphere	22	19	22
15 atmosphere	8.5	7.5	12.5
Available water capacity	13.5	11.5	9.5
Available water capacity in inches	1.2	1.4	—
Mechanical composition			
Sand	48	43	36
Silt	36	37	37
Clay	16	20	27
Organic matter	3.13	2.35	1.55

Table 37. Bladen silt loam from near Santa Rosa, Hancock County, Mississippi.

Soil property	Depth in inches 0-7	7-15	15-27	27+
Soil horizon	A_1	Bg	G_1	G_2
Color	very dark grayish brown to black	very dark grayish brown mottled with rust brown	dark gray highly mottled with yellowish brown	dark gray faintly mottled with yellowish brown
Texture	silt loam	silt loam	silt loam	silt loam
Consistence	slightly sticky	slightly sticky	sticky	very sticky
Structure	moderate medium granular	weak coarse subangular blocky	weak, very coarse subangular blocky	massive
pH	4.2	4.6	4.7	4.6
Cation exchange capacity m.e./100 gm.	6.85	5.05	7.15	6.78
Exchangeable potassium lbs./ac.	39L—	26L—	26L—	68L—
Available phosphorous lbs./ac.	4.84	3.08	trace	trace
Aggregate stability index	1800	1073	455	240
Clod density gm./cm.^{3}	1.39	1.40	1.68	1.70
		Percent by weight		
Moisture content				
1/3 atmosphere	24	23	25	23.5
15 atmosphere	6.5	6.0	8.5	4.5
Available water capacity	17.5	17.0	16.5	19.0
Available water capacity in inches	1.7	1.9	—	—
Mechanical composition				
Sand	23	23	20	21
Silt	63	61	60	62
Clay	14	16	20	17
Organic matter	3.86	2.47	1.25	1.23

The cation exchange capacity of these soils was higher than that measured for the soils in upper and lower Coastal Plain areas discussed previously. This fact reflects the higher clay and organic matter content of the Bladen soils.

In the silt fraction (2-50 microns) quartz was the only indentifiable mineral in the surface horizon and was dominant at all depths. Some kaolinite and perhaps halloysite were indicated at the 6- to 15-inch depth. Illite was also indicated at the 6- to 15-inch depth while montmorillonite appeared in trace amounts only at depths below 15 inches.

In the coarse clay fraction (0.2-2 microns) kaolinite was present in large amounts at all depths in the profile. Halloysite may also have been present. Illite and vermiculite commonly appeared as separate entities as well as in interstratifications. In the surface horizon, illite: vermiculite interstratification was suggested, while at 7- to 27-inch depth vermiculite: montmorillonite interstratification was suggested. Quartz appeared at all depths.

Kaolin type minerals were dominant at all depths in the fine clay fraction (less than 0.2 microns). Both halloysite and kaolinite may have been present. Vermiculite was present in sizeable amounts as a separate entity and interstratified with montmorillonite. This interstratification was more evident in the lowest horizons investigated. Some illite and illite:vermiculite interstratification was also suggested in the lower horizons.

It is apparent that these soils and the Savannah, Ruston, Norfolk and Lakeland soils have a similar mineralogical composition. The Bladen soils seem higher in kaolin.

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