DETAILED SOIL SURVEY OF THE
ALLEN FARM
NEAR DELAVAN, ILLINOIS

BY

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Thesis for the Degree of Bachelor of Science
in Agronomy

COLLEGE OF AGRICULTURE
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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

PASCHAL ALLEN

ENTITLED  DETAILED SOIL SURVEY OF THE ALLEN FARM

near Delavan, Illinois.

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF  BACHELOR OF SCIENCE

Cyril G. Hopkins

HEAD OF DEPARTMENT OF  AGRONOMY
PREFACE

My greatest difficulty after studying soils has been, to know how to apply the knowledge in ways which will make the farm most productive. I suppose new ideas are over estimated, anyway, they fade away in time, on a level with other things; and in this mood, it dawned upon me that I know no more of the nature of the soil which I had plowed and walked over all these years than that of any other soil in the locality. This gave a desire for an introduction to the soil. It seemed as though my former acquaintance of farming had more to do with the cultivation and harvesting of crops than with the soil itself, and what observations ever were taken became quite dim by the lack of thought or consideration.

After realizing the situation, attention was called to the irregularity and variation of crops, more noticeable in some kind of plants than in others, and often more marked in fields severely cropped, especially in unfavorable seasons. In harvesting oats quite a difference is often noticed in the yields of various parts of the field, even when the soil treatment has been uniform so far as known. It is quite common to get a good stand of clover in some parts of a field while other places are scattered and sometimes few and far between. Some years the whole field is good, while other years there is no stand at all. In some places, the growth of crops is often above the average while on other spots, crops are somewhat lacking in growth; this being quite noticeable in cornfields when one is riding over the country.
Do we realize what this unevenness of our fields means in the income of the farm? When a field is harvested, the average yield per acre is known, but it is seldom known or ever given a thought, that one acre of a field of corn produces seventy-five bushels, another fifty, and others thirty or twenty-five. We do know, though that it is easier to raise one hundred bushels of corn on one acre than an average of seventy-five on forty acres. It takes all the good land of a field to make up for the poorer places. If we make a study of the soil of a field and find out the places that are holding down the yield then we have made a good step for an increased production.

The better acquainted one is with the soil of his farm, the more likely will he know its needs and this is the object of the soil survey; to find all the differences possible in the soil of the fields, and by a better acquaintance with the soil, one will observe more closely and detect places that hold down yields, and will know how these variations in crops check up with the nature of the soil itself.
DETAILED SOIL SURVEY OF THE ALLEN FARM.

Location and Topography.

The Allen farm comprises an area of 560 acres, located in Dillion Township, Tazewell County, Illinois; in sections 29 and 32, Township 23, north; range 4; and west of the third principal meridian.

The farm is on the dividing line between the Illinois and the Wisconsin glaciations. The terminal morain of the latter passes through the middle of the farm while the former is entirely covered up by the glacial till and the fluvial deposits from the marginal drainage of the terminal morain. The farm consists chiefly of a loessial deposit over the Wisconsin glacial material and of a water formed soil.

The farm has a gentle slope to the west, with the exception of the morain which gives the east or upper part quite a fall; and the water courses have cut V-shaped gorges which make this land rolling. The land below the morain acts as a delta for the sloughs, and large quantities of wash material have been brought down and filled up the lower places; also covered up much of the glacial tongues or projections which happened to be in the way of water courses and not elevated enough to escape burial. This land is very flat and in many places the water courses can be turned by the plowing of a furrow.
Drainage.

The upland soil requires tile drainage, although the drainage is greatly aided by the V-shaped gorges spoken of before.

This land, where very sloping, is subject to wash, and the water courses which have much of a fall, make deep cuts in the spring if not watched. The land below the morain has natural drainage with the exception of the glacial tongues or projections from the Wisconsin glaciation. The natural drainage is brought about by a bed of sand and gravel, eight to twelve feet below the surface. Tile is often needed in places that receive large amounts of water. The sloughs and ditches "run out" when they get to this land and all except the very largest water courses are farmed over.

History.

Each forty acres is given a number as shown on the map. The N.E. 1/4 of Sec. 32; numbers XIII., XIV., XV., XVI., was bought by J. B. Allen in 1867. The farm had been under grain cultivation, except parts of XIII., which were pastured. The land was very wet in places, and the surface drainage was poor, but improvements were made in 1872 by tile drainage as shown in the map. The chief crops grown were corn, wheat, oats, rye, timothy, clover, and potatoes. Dating from 1872 a considerable amount of grain was fed to live stock, chiefly cattle and hogs. In 1879, J. B. Allen and Son started a herd of pure bred Jersey cattle and went into the dairy business. The quarter section was largely seeded down to grass and much feed was bought and fed on the farm. This system of farming con-
tinued until 1893 when the dairy cattle were culled down to family use. Since 1893, XIV. and XV. have been grain-farmed and XIII. and XV., stock-farmed.

The Holt eighty (forties IX. and X.) was bought by Ralph Allen in 1890 of Mr. J. Holt. Mr. Holt was quite a stockman and fed most of his grain and forage; but in 1878, he moved to town and rented his farm which also included the south eighty of the quarter section. The renters raised and sold grain. The farm was quite wet in several places until 1890, when tiled as shown in the map. In 1893 IX. and X. were sowed to clover and pastured for a year, and corn, then a rotation of corn, oats, and clover, was begun.

In 1901, Ralph Allen bought the S.E. 1/4 of sec. 29 (numbers V., VI., VII., VIII.) of Mr. W.H. Brawner. All except VI. was in blue grass and had been since about 1879. The land was pastured by horses and cattle and considerable feed washed in the north-west corner of V. In 1904, V was broken up and planted to corn. Number VI. has been largely under cultivation, although the middle portion was in meadow when bought. Mr. Brawner said that the west fifteen acres were always cultivated, and the first two crops obtained by the present owner confirmed the fact. This land was given a heavy coating of manure in 1904 and 1905. All of the forty is now in grass.

In 1902, Ralph Allen bought the S.W. 1/4 of sec. 29 (numbers I., II., III., IV.) of Mr. W. H. Brawner. II. and IV. were seeded down to blue grass in 1879 and were pastured until 1902 when they were broken up for corn, except the north fifteen acres of II., on
which are buildings, an orchard, grove, etc. Three crops of corn have been taken off. Mr. Brawner always fed his grain and forage. He owned a large farm and a good share of the feeding was done on II and I. Number I. has only had two crops taken off of it. It has received some wash from the feed lots above, and has been the chief pasture for the fattening cattle. The forty is still used for this purpose and proves itself very profitable by carrying almost double the number of live stock kept on the average pasture. Number III. has been cropped chiefly and is a very level and fertile piece of ground.

Soils.

As stated in the preface, the object of the soil survey is to find all the differences possible in the nature of the soils in each field of the farm; the purpose of which is to get better acquainted, in order to obtain a better insight for observation and a better foundation for understanding the behavior and influences that affect the farm crops.

In describing the soil of the farm each forty acres will be discussed, more or less, as a unit; for it is the differences of each field that are important to the owner and not so much the comparison of the soil of one field with another.

It is difficult to classify soils because there are no two places exactly alike and two areas of soil formed in the same manner, having similar chemical and mechanical analysis may be quite different in physical conditions. The soils have been clas-
sified into types, and each type has its color in the map. In some places the soil map can be altered a little, and be quite accurate for there are no distinct lines between types unless it is between the glacial and water formed soils and some places, given the same color on the map, are quite different in certain respects, and notes are needed which will be given later.

There were twelve types of soil found, five representing the glacial soil; and seven, the alluvial. They are named as follows:

I. Early Wisconsin glacial soil
   1. Brown silt loam
   2. Eroded brown silt loam
   3. Dark brown silt loam
   4. Gravelly brown silt loam
   5. Sandy brown silt loam

II. Alluvial soils, or Middle Illinois glacial soil
   1. Alluvial dark brown loam
   2. Alluvial gray silt loam
   3. Black loam
   4. Black clay loam
   5. Alluvial sandy loam
   6. Brown loam on silt
   7. Black clay swamp lands.

Glacial Soils.

1. The Brown Silt Loam is the principal type of the upland
soil and is of the early Wisconsin Glaciation. The larger part of the east half of the farm is covered by this type of soil. It is also occupied by the projections or tongues of the morain, extending into the lower lying areas. The average depth to the subsoil is about eighteen inches, and the first seven inches is often a little darker than the subsurface. The subsoil is a brownish yellow running into a mottled yellowish brown. Water does not penetrate this subsoil any too freely. This soil very seldom forms hard clods unless trampled or plowed when wet, but crumbles very easily, making a very nice soil to cultivate.

2. Eroded Brown Silt Loam is the same as Number I., except that it has lost much organic matter, either by cultivation or surface washing.

3. Dark Brown Silt Loam is the same as Number I., except it is darker in color, having received organic matter through wash deposits, and generally is more moist because of the surrounding higher ground.

4. Gravelly Brown Silt Loam is that brown silt loam which is gravelly.

5. Sandy Brown Silt Loam is brown silt loam which is quite sandy.

II. Alluvial Soils.

1. Alluvial Dark Brown Loam is a deep soil in the Middle Illinois Glaciation, formed by the sloughs of the uplands. It does not include the deep drifts formed by these sloughs, nor
does it include the shallower alluvial soil which surrounds the glacial tongues, or projections of the Wisconsin Glaciation.

This Alluvial Dark Brown Loam is from twenty to over forty inches in depth. The subsoil is very fine and silty and easily penetrated by water; and from eight to twelve feet below is a bed of gravel which makes excellent underdrainage.

2. Alluvial Gray Silt Loam is a gray silt brought down by the sloughs and deposited on the lower part of the farm. It is of the same source and nature as the Alluvial Dark Brown Loam and is largely mixed with this type. It is also found in layers in the Black Loam Soil. In forty Number I, there are about three acres of this material, unmixed with other material, and for this reason it was set aside as a type.

3. Black Loam is a deep black drift of dirt formed by sloughs in the lower part of the farm, and is slightly higher than the surrounding land. The depth is over forty inches and the soil is somewhat stratified.

4. Black Clay Loam is the deep alluvial deposits in the Wisconsin Glaciation. The soil is black and fine, from twenty to over forty inches in depth, found along the banks and old courses of sloughs, and in the low flat places or pockets in the Wisconsin Glaciation.

5. Alluvial Sandy Loam is a sandy loam adjacent to, or surrounded by the Black Loam soil. Aside from its sandy nature it is very similar to the Black Loam.

6. Brown Loam on Silt is an alluvial soil in the Middle Illinois
Glaciation which is from four to ten inches deep and rests on the Brown Silt Loam, or the projections of the Wisconsin Glaciation.

7. Black Clay Swamp Land is a very black soil which resembles a swamp. It is quite low and shows evidences of having been under water. The subsoil is whitish in color and the surface and subsoil shows signs of much undecayed vegetation. The depth of this soil is from eighteen to twenty-four inches.

Description of the Fields.

In the description of the soils of each forty, section 32 will be discussed first, beginning with IX. and X., and followed in numerical order; then section 29 will be taken up, beginning with Number I and followed in the same order. It will be noted that forties are grouped in their respective quarter sections.

Fields IX. and X. (The Holt Eighty).

The east forty, or X., borders on to the Terminal Morain of the Wisconsin glaciation; plainly marked in the map by the Brown Silt Loam. This eighty is the delta of three large sloughs, one from the north, one from the south, and the other from the east. No. X. only receives wash from the latter. This eighty is mostly alluvial soil, except the east part, the south-west corner and the islands as shown in the map. These places were high enough to escape burial.

The slough which enters from the east, drains about two hundred
acres of land above, and in normal conditions most of this water soaks away in the ground when reaching the lower land; due to the good under-drainage. The outlet of this slough is now on the north side of field X. This was not the case thirty years ago; for the slough flowed down the middle of the eighty, well illustrated by the Black Loam soil, or blue colored area on the map.

This Black Loam is a deep drift, over forty inches in depth, more or less stratified. In some places it is slightly sandy, as illustrated by the Alluvial Sandy Loam, and is more elevated than the soils on either side. These sloughs when reaching this more level or flat land, deposit wash material on their banks until the streams get higher than the surrounding land and even after the courses of streams are changed, some of these drifts are situated such that they get much of the sediment in time of floods. This is the case of the drift in this eighty, although the south and west parts are very seldom overflowed of later years; yet after heavy down-pours much wash is deposited on the north side of field X., marked "a".

The soil of this forty gives indications that the slough once flowed on the south side of the drift. This may account for the final deposits made on the above, because the direction of the currents would have a tendency to force the water west, even if the ground was higher.

The Alluvial Dark Brown Loam is over forty inches deep in the north-west corner of X., but gets shallower in field IX. It also gets shallower to the east, grading into the Brown Loam on Silt.
The Alluvial Dark Brown Loam in the south part of X. is about twenty to twenty-six inches in depth. It is not so moist as that in the north because the slough flows the other way, but it was quite wet before tiled, as shown in the map.

The Black Clay Swamp Land on the south side in the middle of the eighty, is lower than the surrounding land and gives indications of once being a large pond where vegetation grew up and died down, making the top soil very rich in organic matter. The water was supplied by the sloughs and a sort of apocket was formed by the high Glacial soil to the west and the alluvial drift to the north. The subsoil is whitish in color, not being oxidized. The soil has been very productive since drained.

The Brown Silt Loam, marked "B" on the map in the north-east corner of field X., is a sort of an island being surrounded by alluvial soil. It is quite a characteristic spot of the field, probably due to the location. The water, at one time, must have flowed on the south side of this spot which would account for the deep deposit of Black Clay Loam, as shown in the map. The soil directly west of this Black Clay Loam is very shallow and resembles a soil of the nature of Brown Silt Loam with the surface washed away and a little alluvial soil put in its place.

The south side of this forty seems to be the most ununiform piece of ground on the farm, having types of soil of very different natures, and it has proved itself to be so, by the unevenness of the crops produced upon it. Some years on a single row of corn, the growth of the plants could be graded from choice to poor. The
middle of the eighty north and south has always been very uniform and the types represented are very similar types.

The Brown Silt Loam in the south-west corner of field IX, is a good example of the type and is a part of quite a large area which extends off to the south and west. This soil is higher than the alluvial soil to the east, and the water collects on the east side and forms a slough which enters this forty and flows around to the west as shown in the map. This slough brings in large quantities of wash material. The islands of Brown Silt Loam in the center of the forty are quite similar in production to the surrounding soil. They probably have been subject to overflow. The Brown Loam on Silt in the north-west corner, is hardly noticeable. It is the Brown Silt Loam overlaid with a shallow covering of Alluvial Dark Brown Loam, and is slightly elevated such that the water generally turns to the south and flows around it.

Brown Silt Loam is not penetrated by water as is the alluvial soil. On the east side of these islands of Brown Silt Loam, the ground water is checked, making the soil more moist in these places.

The North-east Quarter of Section 32.

Forty Number XIII. (N.W. 40 of N.E.1/4 of sec. 32)

This forty is largely of the Wisconsin Glaciation, classified as Brown Silt Loam and is slightly rolling. Along the slough, as shown in the map, is the Black Clay Loam, varying from twenty to over forty inches in depth. This soil is very rich and fine, and the larger areas are well drained; the slough being several feet
lower. The large area in the middle of the forty on the south side is a broad flat low place and is a good example of how a deep alluvial soil is formed in the morain. In the south eastern part of the forty is some Gravelly Brown Silt Loam. These places are generally found on high spots or side hills. The stones are from the size of hens' eggs to much smaller and are well mixed with the glacial silt. The production of this type is about equal to the Brown Silt Loam.

Forty Number XIV. (N.E. 40 of N.E.1/4 of Sec.32)

This forty is also gifted with some Gravelly Brown Silt Loam. The slough has left less of the Black Clay Loam and has made a deep cut for its bed. The same type is represented in the north-east corner of the forty, which is a low place that has been deprived of an outlet at some time and wash material has been collected in sufficient amounts to make the type.

Forty Number XV. (S.W. 40 of N.E.1/4 of Sec. 32)

This forty is made up simply of Brown Silt Loam and Dark Brown Silt Loam. The two types are very uniform. The slope of the land can be determined by the water courses as shown in the map. The west side of the forty is about the edge of the Terminal Morain and the land is quite rolling as might be suspected. The drainage is provided by the ravines/or lower places, some of which are aided by tile.
Forty Number XVI. (S.E. 40 of N.E. 1/4 of Sec. 32)

This forty is very similar to field XV. and the lay of the land may also be determined by the water courses quite plainly marked by the Dark Brown Silt Loam. This forty has two patches of Black Clay Loam in low flat areas where all the wash from the surrounding sides have collected and formed a deep black soil of about twenty-four inches depth. The places have been under water and probably vegetation has grown up and died down. In recent years, better outlets have been provided, and with the aid of the tile these spots have been very productive.

Section Twenty-nine

Forty Number I. (N.W. 40 of S.W. 1/4 of Sec. 29)

The greater part of this forty is Brown and Dark Brown Silt Loam. It is a very flat and level piece of ground and is so situated that the northern half has never been overflowed by any large currents of water. There is a slight elevation at point "b" and "c", otherwise the north half is almost level. The slough which flows west through this forty has only taken this course of late years. It used to run off to the south-west. The wash which this slough has recently brought down is a gray silt. Although other sloughs bring down the same material, yet in this forty the material is so distinct as separate from other material, that it was classified as a type by itself. This soil is from six to forty inches in depth, and is a good example of how these sloughs deposit material on their banks, and get higher than the surrounding land. At point "a" is a spot
which has been shut off from an outlet by the slough deposits, and when tramped by live stock in wet times a pond is formed.

The Brown Loam on Silt is from twenty-two to twenty-six inches in depth. The Black Loam is a drift formed by the slough having a depth of thirty to forty or more inches. The elevation is above the soil on all sides except the east.

Forty Number II (N.E. 40 of S.W. 1/4 of Sec. 32)

This forty has considerable Brown Silt Loam in the northern part and is somewhat elevated. There are also two other spots of Brown Silt Loam as shown in the map; and these two islands are surrounded by the shallower type of alluvial soil, or Brown Loam on Silt. The Alluvial Dark Brown Loam is a very good example of the type, and many places reach the depth of over forty inches. This deep deposit may explain why the water now flows on west. The Black Clay Loam is from twenty to twenty-four inches in depth and is very wet and springy because of the poor underdrainage and seepage of the morains above. The Brown Silt Loam islands also act as a blockade to the ground water.

Forty Number III. (S.W. 40 of S.W. 1/4 of Sec. 29)

The north-west corner of this forty is Brown Silt Loam but probably has been overflowed. The forty has a gradual slope to the west but the fall is greatest to the south-west corner, and the water goes in that direction. The Brown Loam on Silt in this field is not far from the Alluvial Dark Brown Silt Loam, being quite deep except at point "a", which is more elevated and more shallow. The type in
the west part of the field is also shallower. The Dark Brown Silt Loam in the east part is an exposed area of Glacial soil. It is four feet lower than the Black Loam to the south which is a high drift of alluvial soil. In this forty this drift is quite prominent because of its elevation, and the physical conditions are peculiar because it gets drier than the surrounding land. The Alluvial Dark Brown Loam in the south half is a deep black soil varying from twenty to forty inches to subsoil. The subsoil is a fine silt.

Forty Number IV. (S.E. 40 of S.W.1/4 of Sec. 29)

This forty contains a tip of the Terminal Morain, a part of which is a sort of an island, being cut off on both sides by water courses where black clay loam has been deposited. This Black Clay Loam is from twenty to over forty inches deep. The west part of the forty is the chief dumping ground of the slough which enters from the east and it spreads all over the south-west region. The greater part of the Alluvial Dark Brown Soil is over forty inches deep, and many places are over sixty inches. The land is almost level and the water can be turned in almost any direction. In normal conditions the water soaks away in the ground.

Forty Number V. (N.W.40 of S.E. 1/4 of Sec. 29)

This forty is both high and low and the Brown Silt Loam needs no explanation. In the south-west corner is the Black Clay Loam, from twenty to forty inches in depth. This corner is well drained because of the slough, which is somewhat lower. The soil of the north-west corner is of the same nature and formation. It is a low flat land
and all the wash that comes down is inclined to remain; thus making a deep black soil. The slough which enters from the north brings in most of the material, although two short channels in the east account for some of the material. The eastern part of this type is so that the water does not flow off quickly, making it quite wet, but this is now tile-drained, as shown in the map. The depth is from twenty-four to thirty-six inches, except at point "a", where there is a slight elevation and the depth is about eighteen inches.

Forty Number VI. (N.E.40 of S.E. 1/4 of Sec. 29)

This forty is quite level on the east side and more or less rolling on the west. The latter has been more or less severely cropped, which may account for the Eroded Brown Silt Loam. In the north-west corner is a good example of the Black Clay Loam, quite flat and gets its share of the wash that comes that way. It is well drained by a tile. A large area on the east/side is classified as Dark Brown Silt Loam and some of it is not far from the Black Clay Loam, being a low level place and holds what wash comes that way. This part of the field is lower than at point "a" and the natural drainage is to the east, but the under drainage is cared for by a tile having an outlet to the north.

Forty Number VII. (S.W. 40 of S.E. 1/4 of Sec. 29)

This forty is quite rolling, yet very uniform. The greater part is Brown Silt Loam. There is a patch of Gravelly and Sandy Brown Silt Loam, and also Eroded Brown Silt Loam in the north-east corner.
The slough which flows through this field is about twelve feet deep but before the forty was seeded down to grass it was farmed over. This is a good example of how these water courses wash and fill up. A good example of Black Clay Loam is in the north-west corner.

Forty Number VIII. (S.E. 40 of S.E. 1/4 of Sec. 29)

This forty is of the same nature as the one west but the slough is not so deep. The Black Clay Loam in the north east corner is not a good example of the type. It is a spot which has been deprived of an outlet and has been under water and tramped by live stock.
CHEMICAL ANALYSIS

A few chemical determinations were made for nitrogen and phosphorus from samples of various parts of the farm. It was necessary to collect the samples before the soil survey was completed, and some of the samples are not as good representatives of types as might be had. No samples of the minor types were taken and in some cases, the analysis of only the surface soil was made.

The samples were collected by the method used by the Illinois Experiment Station. Each sample is divided into three parts;—the surface, subsurface, and subsoil. Duplicates were run in all the determinations.

From the results of the Illinois Experiment Station, it seemed unnecessary to make determinations for potassium. It has been estimated that the average fertile soils of the United States, seven inches in depth, contains 6,600 pounds of potassium per acre, the Wisconsin Morain soils of Illinois contain 7,400 pounds, and the Middle Illinois Glacial prairie 8,400 pounds; and all experimental work shows these soils to be well supplied with potassium.

On the other hand, Central Illinois soils are only moderately well supplied with nitrogen, and they are even deficient in phosphorus when compared with the average fertile soils of the United States. The average United States normal fertile soil contains 2,000 pounds of phosphorus, seven inches deep per acre, while the Wisconsin Morain soil contains about 1,200 pounds and the Middle Illinois Glacial soil only 1,000 pounds. For this reason a few
samples were analyzed for nitrogen and phosphorus.

The Illinois Experiment Station in the Tazewell County Survey, has analyzed a sample of Brown Silt Loam taken in forty Number XIV, and by permission this data is given in Table I.

TABLE I.

This sample was collected and analyzed by the Illinois Experiment Station. Cultivated field

<table>
<thead>
<tr>
<th>Soil</th>
<th>Depth in inches</th>
<th>Nitrogen %</th>
<th>Lbs. per acre</th>
<th>Available lbs. per A.</th>
<th>Phosphorus %</th>
<th>Lbs. per acre</th>
<th>Available lbs. per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>7</td>
<td>.215</td>
<td>4816</td>
<td>96</td>
<td>.043</td>
<td>963</td>
<td>9.6</td>
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<tr>
<td>Subsurface</td>
<td>11</td>
<td>.150</td>
<td>5610</td>
<td>.036</td>
<td>1446</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsoil</td>
<td>22</td>
<td>.071</td>
<td>5467</td>
<td>.038</td>
<td>2826</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td></td>
<td>15893</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

In the tables are shown the percentages of nitrogen and phosphorus, and from the percentages, the approximate amounts of these elements are estimated in pounds per acre. Approximately an acre of surface soil, seven inches deep, weighs 2,240,000 pounds or 320,000 pounds to the inch. The subsurface weighs about 340,000 pounds per inch and the subsoil 350,000 pounds; and from this, the amounts of fertility in the surface, subsurface and subsoil are estimated. By comparing the results with the average fertile soil we can obtain some idea of the productive capacity of the soils.

Another comparison may be obtained by estimating the amounts of plant food, which is likely to become available to the crops each year. This may be done by assuming that the equivalent of one percent of the phosphorus, and two percent of the nitrogen in the
the surface soils becomes available to the crop each year, and by comparing the amounts of available fertility with the amounts required for the production of crops, corn for example, some idea of the stock of fertility may be shown. If the total nitrogen and phosphorus found in the surface, subsurface and subsoil be considered, of course a smaller percentage of availability must be used.

In studying the chemical analysis the average of the fertile soils of the United States is the best standard we have for comparison of the fertility in the soil. The amounts of nitrogen and phosphorus in a crop of corn yielding 100 bushels per acre may also be used as a standard for comparison. The average United States fertile soils per acre, seven inches deep, contain 5,600 pounds of nitrogen, of which 112 pounds are available, and 200 pounds of phosphorus, of which 20 pounds are available.

One hundred bushels of corn contain 100 pounds of nitrogen and 17 pounds of phosphorus and including the stalk contain 148 pounds of nitrogen and 23 pounds of phosphorus.

It will be noticed that the surface soil of Brown Silt Loam (Table I.) is lower in fertility than the average fertile soil and contains less available nitrogen and phosphorus than is found in one hundred bushels of corn, not even including the stalk. The subsurface and subsoil are no better in phosphorus and the latter contains a much smaller percentage of nitrogen. The estimated available pounds per acre gives 96 pounds of nitrogen and 9.6 pounds of phosphorus which is not sufficient to raise one hundred bushels of corn. The analysis shows that phosphorus is noticeably deficient according to this suggested rate of availability.
Table II.
Sample was collected in a cultivated Field.

<table>
<thead>
<tr>
<th>Soil</th>
<th>Depth in inches</th>
<th>Nitrogen Lbs. per acre</th>
<th>Available lbs. per A. %</th>
<th>Phosphorus Lbs. per acre</th>
<th>Available lbs. per A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>7</td>
<td>.210</td>
<td>4704</td>
<td>.049</td>
<td>1099</td>
</tr>
<tr>
<td>Subsurface</td>
<td>10</td>
<td>.037</td>
<td>1258</td>
<td>.030</td>
<td>2415</td>
</tr>
<tr>
<td>Subsoil</td>
<td>23</td>
<td>.030</td>
<td>2415</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The nitrogen from the blue grass pasture (Table III.) is only slightly above the cultivated sample (Table II.) and it seems too low. The phosphorus is even lower in the blue grass soil excepting the subsoil. The subsoil shows .002% higher than that in Table II. The reader must be guided by the percentage compositions when comparing one soil with another. The depth must always be observed when comparing the pounds per acre; for example, the subsurface in Table III. is eleven inches and the subsurface in Table II. is ten inches. Table III. is thus favored with an extra inch and is on a different basis for comparison of the pounds per acre.

Table III.
Sample was taken in a blue grass pasture.

<table>
<thead>
<tr>
<th>Soil</th>
<th>Depth in inches</th>
<th>Nitrogen Lbs. per acre</th>
<th>Available lbs. per A. %</th>
<th>Phosphorus Lbs. per acre</th>
<th>Available lbs. per A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>7</td>
<td>.220</td>
<td>4928</td>
<td>.036</td>
<td>806</td>
</tr>
<tr>
<td>Subsurface</td>
<td>11</td>
<td>.034</td>
<td>1171</td>
<td>.032</td>
<td>2464</td>
</tr>
<tr>
<td>Subsoil</td>
<td>22</td>
<td>.032</td>
<td>2464</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table IV.
Eroded Brown Silt Loam

Cultivated field. A heavy coating of manure had been applied to this soil.

<table>
<thead>
<tr>
<th>Soil</th>
<th>Depth in inches</th>
<th>Nitrogen Lbs. per acre</th>
<th>Available lbs. per A.</th>
<th>Phosphorus Lbs. per acre</th>
<th>Available lbs. per A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>7</td>
<td>.185</td>
<td>4144</td>
<td>83</td>
<td>.044</td>
</tr>
<tr>
<td>Subsurface</td>
<td>7</td>
<td>.150</td>
<td>3570</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsoil</td>
<td>26</td>
<td>.090</td>
<td>7380</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td></td>
<td>15094</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Eroded Brown Silt Loam (Table IV.) is about equal in phosphorus to Brown Silt Loam. The nitrogen results are too high and not a fair example of the type; for a heavy coating of manure had been applied where the sample was taken.

Table V.
Dark Brown Silt Loam

Cultivated Field

<table>
<thead>
<tr>
<th>Soil</th>
<th>Depth in inches</th>
<th>Nitrogen Lbs. per acre</th>
<th>Available lbs. per A.</th>
<th>Phosphorus Lbs. per acre</th>
<th>Available lbs. per A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>7</td>
<td>.197</td>
<td>4413</td>
<td>88</td>
<td>.035</td>
</tr>
<tr>
<td>Subsurface</td>
<td>13</td>
<td>.119</td>
<td>5735</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsoil</td>
<td>20</td>
<td>.098</td>
<td>6860</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td></td>
<td>17008</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blue grass field.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
</tr>
</tbody>
</table>
The analysis of Dark Brown Silt Loam in Table V. is about the same in phosphorus as Brown Silt Loam, but the percentage of nitrogen in the cultivated sample seems low for the type. The subsurface soil is deeper, however, and gives a higher total amount of nitrogen.

Table VI.

Brown Loam on Silt

<table>
<thead>
<tr>
<th>Soil</th>
<th>Depth in inches</th>
<th>Nitrogen Lbs. per acre</th>
<th>Available lbs. per A. %</th>
<th>Phosphorus Lbs. per acre</th>
<th>Available lbs. per A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>7</td>
<td>.189 4236</td>
<td>85</td>
<td>.054 1209</td>
<td>12</td>
</tr>
<tr>
<td>Subsurface</td>
<td>13</td>
<td>.187 9013</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>13249</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Brown Loam on Silt (Table VI.) seems to hold up its nitrogen content in the subsurface soil. The surface seems to be low in nitrogen for the type when compared with Brown Silt Loam. The phosphorus content is higher than the Brown Silt Loam; yet it is deficient when the surface soil is compared with the average fertile soil. A one hundred bushel crop of corn would have to look to the subsurface soil for one-half of the phosphorus needed.
Cultivated Field

Table VII.

Black Clay Swamp Land

<table>
<thead>
<tr>
<th>Soil</th>
<th>Depth in inches</th>
<th>Nitrogen Lbs./acre</th>
<th>Available lbs./A.</th>
<th>Phosphorus Lbs./acre</th>
<th>Available lbs./A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>7</td>
<td>.298</td>
<td>6675</td>
<td>134</td>
<td>.062</td>
</tr>
<tr>
<td>Subsurface</td>
<td>14</td>
<td>.177</td>
<td>8425</td>
<td>.057</td>
<td>2713</td>
</tr>
<tr>
<td>Subsoil</td>
<td>19</td>
<td>.043</td>
<td>2359</td>
<td>.060</td>
<td>3990</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td></td>
<td>17959</td>
<td></td>
<td>8091</td>
</tr>
</tbody>
</table>

Black Clay Swamp Land (Table VII.) is above the normal soil in nitrogen; yet the subsoil is very low and shows it by its color, being whitish. The phosphorus is high when compared with the other soils of the farm but is lower than the phosphorus in the normal soil and the availability of the phosphorus must be increased or the phosphorus in the subsurface must be drawn upon in order to produce one hundred bushels of corn per acre without addition of phosphorus.

Table VIII.

Alluvial Dark Brown Loam

Cultivated Field

<table>
<thead>
<tr>
<th>Soil</th>
<th>Depth in inches</th>
<th>Nitrogen Lbs./acre</th>
<th>Available lbs./A.</th>
<th>Phosphorus Lbs./acre</th>
<th>Available lbs./A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>7</td>
<td>.198</td>
<td>4435</td>
<td>.073</td>
<td>1635</td>
</tr>
<tr>
<td>Subsurface</td>
<td>23</td>
<td></td>
<td></td>
<td>4379</td>
<td></td>
</tr>
<tr>
<td>Subsoil</td>
<td>10</td>
<td>.054</td>
<td>1890</td>
<td>1890</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td></td>
<td></td>
<td>7904</td>
<td></td>
</tr>
</tbody>
</table>
The Alluvial Dark Brown Loam in Table VIII. shows a high percentage of phosphorus, especially in the surface soil; it is not very far from the normal fertile soil. This sample was taken in a cultivated field which probably has received much wash from a feed lot. The nitrogen content seems to be low for the type and especially for the location. Nitrogen is easily leached from a soil while phosphorus remains in an insoluble form and if the spot is low in nitrogen it may be accounted for in this manner. Much of the surface water soaks away in the ground at the place where the sample was collected. During the survey a boring of about eight feet was made near this point and the subsoil was a loose, silty and sandy soil. Table IX. seems to be a good example of the type.

Cultivated Field. Table IX.

<table>
<thead>
<tr>
<th>Soil</th>
<th>Depth in inches</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lbs. per acre</td>
<td>Available lbs. per acre</td>
</tr>
<tr>
<td>Surface</td>
<td>7</td>
<td>.226</td>
<td>5062</td>
</tr>
<tr>
<td>Subsurface</td>
<td>13</td>
<td>1812</td>
<td>.041</td>
</tr>
<tr>
<td>Subsoil</td>
<td>20</td>
<td>2660</td>
<td>.033</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>5390</td>
<td>5390</td>
</tr>
</tbody>
</table>

Table X.
Black Clay Loam

Blue Grass field

<table>
<thead>
<tr>
<th>Soil</th>
<th>Depth in inches</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lbs. per acre</td>
<td>Available lbs. per acre</td>
</tr>
<tr>
<td>Surface</td>
<td>7</td>
<td>.337</td>
<td>7539</td>
</tr>
<tr>
<td>Subsurface</td>
<td>15</td>
<td>.182</td>
<td>9282</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>15821</td>
<td>2620</td>
</tr>
</tbody>
</table>
Table X. is Black Clay Loam taken in a blue grass pasture. The nitrogen content is high both in the surface and subsurface but the analysis for the phosphorus is low when compared with the alluvial soils of the farm.

Table XI.
Black Loam

Blue grass field number I. received wash from a feed lot

<table>
<thead>
<tr>
<th>Soil</th>
<th>Depth in inches</th>
<th>Nitrogen Lbs. per acre</th>
<th>Available lbs. per A.</th>
<th>Phosphorus Lbs. per acre</th>
<th>Available lbs. per A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>7</td>
<td>.329</td>
<td>7369</td>
<td>147</td>
<td>.076</td>
</tr>
<tr>
<td>Cultivated field Surface</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table XI. shows a surface sample of Black Loam which was taken from a place that received wash from a feed lot and is not a good example for the type. The field from which the sample was taken only has had two crops taken from it. The analysis shows the nitrogen to be above the normal fertile soil and the phosphorus is not far behind.

The phosphorus from the other surface sample, in the cultivated field, is a good example of the type.
SUMMARY

In summing up the results from the Detailed Soil Survey, the following conclusions may be drawn.

1. A detailed soil survey of a farm shows the soil formation, the nature and kind of soil, and also points out the characteristics of various places.

2. There are more differences found in the Alluvial than the Glacial formed soils.

3. There are marked differences in the soil of a single field.

4. The Glacial soils are very uniform in depth to the subsoil, also in physical conditions and plant production.

5. The Alluvial soils are very non-uniform in depth to subsoil and sometimes in physical conditions.

6. The soils of the farm are deficient in phosphorus when compared with the normal soil.

7. Many of the soils of the farm are below the normal in nitrogen and the use of leguminous plants is necessary in order to keep up the supply.

8. The soil is generally somewhat richer than the subsoil in phosphorus, and much richer in nitrogen. The surface soil is richer in nitrogen than the subsurface.