

A STUDY OF PRAIRIE SOILS AND VEGETATION
OF SOUTHERN WISCONSIN

By

BENJAMIN GEORGE WAGNER

A Thesis Submitted in Partial Fulfillment
of the Requirements for the Degree of
MASTER OF SCIENCE
(Botany)
at the
UNIVERSITY OF WISCONSIN

1 9 5 1

AWIA
W/251

1/1/51
1/1/51
1/1/51

741047

APR 2 1951

Acknowledgment

The writer wishes to acknowledge the invaluable assistance given to him by Dr. J. T. Curtis of the Department of Botany during the progress of this work. Thanks are also due to the author's wife for aid in reading and copying parts of the manuscript.

Introduction

This study was undertaken in an attempt to point out certain characteristics of prairie soils and vegetation.

Certain prairie areas, to be described, were selected and the vegetation and soils were studied. For each site the frequencies of species were calculated and a presence list was compiled. For the soil samples, taken at each site and adjacent fields, the water-holding capacity was determined, along with the acidity and settling volume. Undisturbed cores from the first six inches of the soil of each site and adjacent fields were used to determine the infiltration rate of a given amount of water.

The Sites Studied

At the beginning of the work, five sites were selected as being as nearly representative as possible of the type of areas to be studied, namely high prairies with deep soils. These sites were chosen because they fitted conceptions of deep soil prairies established by historical data from old written descriptions and from surveyors' notes. At any rate certain criteria, which, judging from the old descriptions, are considered as reasonable were used to set the limits of areas. Whether or not these criteria are adequate or accurate is very nearly a matter of subjective judgment and in this respect at least, the selection of the areas differed in no way from the selection of any area or areas to be used for ecological study.

The location of the sites is as follows:

1. Section 33; Township 10 North; Range 10 East;
Columbia County in Leeds township
near Morrisonville.
2. Section 28; Township 2 North; Range 13 East;
Rock County. In La Prairie township near Tiffany.

3. Section 34; Township 3 North; Range 9 East; Green County In the township of Albany near Albany.
4. Section 32; Township 4 N; Range 8 East; Green County In Exeter Township near Exeter.
5. Section 30; Township 5 North; Range 7 East; Dane County In Primrose Township on County Trunk JG.

The Columbia county site is about $2\frac{1}{2}$ miles east of Morrisonville on land bordering an abandoned gravel pit. The use of this area as a gravel pit necessitated its being fenced off as a precaution against livestock entering the area and perhaps to mark its boundary more clearly. This fencing of the area has of course resulted in its preservation since use as a source of gravel did not include the total site. Old residents of nearby farms told the writer that as far as they knew the area had never been plowed and never grazed, except for the occasional foray of a fence-jumping cow. It is as good an example of undisturbed prairie as any in Wisconsin, if these conditions are true.

The site is traversed by a wash and has a north and south slope to either side of the wash. The slope is an estimated 12 per cent. To the north, the east and the west are pastured and cultivated fields. The south boundary is the afore-mentioned road. These fields around the

area afford an excellent chance for comparison with virgin prairie area. This area will be referred to hereinafter as the Morrisonville prairie. It is about three acres in extent.

The Rock County area is on the right-of-way of the Chicago and Northwestern railroad between Janesville and Tiffany about one mile from Tiffany. All sites on the railroad right-of-way are periodically burned. The area best suited for this study is about two acres in extent on the west side of the tracks.

This area in contrast to the Morrisonville area is quite flat, and almost treeless, perhaps closer to the popular conception of a prairie. The protection given the area by the fenced right of way has left this area almost completely undisturbed. The writer was informed by farmers that the area was ungrazed and as long as they had lived there (fifty years) had never been plowed. Here, too, the surrounding fields offer good chance for comparison with the undisturbed prairie. This area will be called the Tiffany prairie in this paper.

In aspect, the area in Green County near Albany is similar to the Tiffany area. Located about one mile south of Albany on the Milwaukee railroad right-of-way, it is flat and fairly treeless. In spite of its being protected in the same way as the Tiffany prairie it seems more dis-

turbed judging by the species that are present. There are many weeds present. This will be hereinafter known as the Albany prairie.

The other area in Green County is also on a railroad right-of-way, the railroad being the Illinois Central. It is south of Exeter. Since Exeter is no longer in existence except for some old foundations this area is best located from a reliable plat map.

This area is on the east side of the tracks and slopes very gently to the south for a long distance until it drops off rather suddenly into a wet spot. The whole site is considerably wetter than any of the other sites. It too has been protected by the right-of-way fence and directly adjacent to the area is a field. The owner of the field said that it had been plowed, but that it had been pasture for at least six years.

The Dane County area is in the Town of Primrose on County Trunk J.G. just north of the Green County line. The site is rather small and owes its protection to that fact and also to its shape, which is roughly triangular. It is bounded on the west and north by the highway which curves just at that point and by cultivated fields on the east and south. Regardless of its small size, it never-the-less contains many representative species. It will be called the Primrose prairie.

All of these areas have in common a measure of protection which has tended to preserve them. The protection has in each case been a fortuitous circumstance, rather than the result of any special effort to preserve them.

Equipment and Methods

Vegetation Study

At each site twenty quadrats, each one a meter square, were placed at random. Quadrats were determined by using a square frame of steel tubing one meter on a side, inside dimension. This frame was further divided into sixteen smaller squares, each approximately twenty-five centimeters on a side using No. 9 galvanized iron wire to set off the smaller squares. These small squares were numbered from one to sixteen starting in the upper right hand corner and proceeding as one does in numbering the sections of a township. Each time the quadrat was placed down the order of notation of species was in regard to the sixteen small squares. A chart was devised containing on its left border a list of the species and having the remainder divided into sixteen columns, numbered from one to sixteen. The occurrence of the species in any one of the sixteen small frames would be noted by a check in the appropriately numbered column. One such chart was used each time quadrat was placed down.

Frequencies of species were then calculated on a twenty quadrat basis and a 320 quadrat basis. Frequency of a species is the fraction of samples in which the species occurs expressed as a percentage of the total number of samples taken. The meter quadrat was divided into sixteen smaller squares so that occurrences of species could be noted in various parts of the large quadrat. This gives a better idea of the distribution of the species than merely the occurrence of the species in the meter quadrat.

No attempt was made to determine basal areas of species or density, due to the difficulty of accurately measuring.

Soils Study

At each site, except the Primrose prairie, three pits were dug and profile characteristics noted. In regard to prairie profiles, the writer doubts if any accurate determination of profiles by usual means can be made. Despite this an attempt was made to determine and describe profiles.

Soil samples were taken from each pit, both from the horizons and at six inch intervals. Thus while the profile designation may be doubtful, the six-inch samples insure an adequate representation.

On the Primrose site only one pit was completed due to the difficulty of digging to a comparable depth in the rocky soil. The limestone bedrock comes close to the

surface here, and in only one place was a pit dug to reach forty inches.

Samples were also taken from the adjacent fields in a similar manner. All samples were air-dried and ground to pass a two millimeter screen.

Soil Reaction

From these samples p H was determined using the Hellige-Truog soil reaction test, a colorimetric method. The method, while not quite so accurate as the glass electrode, has great value in being a rapid method and results of the two methods compare favorably (Fosberg 1949).

Water-holding Capacity

Water-holding capacity of a soil is a constant (approximately) for any one type of soil. It is the percentage of water on the dry basis retained by a soil column one centimeter in height after it has been standing in contact with water for one hour and then drained for fifteen minutes under gravity in the absence of a capillary soil column.

Hilgard cups were used, air-dry soil poured into them, and they were rapped and leveled with a spatula three or four times. Quite constant results are obtained if the

same procedure is followed for each sample, and accuracy improves with practice. The cups are of brass with a perforated bottom over which a pre-weighed paper is placed. When filled with soil they are placed in a pan containing water about one milimeter in depth. They remain in the water for at least one hour and longer if necessary to wet the soil thoroughly. After wetting they are allowed to drain for fifteen minutes, wiped dry of any excess water and weighed. The samples are then oven dried for forty-eight hours and weighed. The difference in weight is the weight of the water. The water held is expressed as a percentage of the dry weight of the soil.

Settling Volume

The settling volume is defined as the maximum volume that a given quantity of soil can maintain in an excess of water under given conditions. It was determined here for the first six inches of soil at each prairie site and adjacent field. This volume is different for different soils and is greater than the field volume. It is a measure of the aggregation of the soil; soil with good structure is well aggregated.

Fifty grams of air-dry soil were placed in a suction filter bottle, forty CC. of distilled water added and the contents stirred. The bottle was exhausted with a vacuum

pump until the contents boiled vigorously. The soil-water mixture is poured into a 100 ml. graduate and the bottle is rinsed with a fine jet of distilled water. The volume is made up to 100 cc. and the graduate shaken, allowed to stand for twenty-four hours, shaken again and allowed to stand for twenty-four hours. At the end of that time the soil volume is usually constant, having settled out leaving a more or less clear supernatant liquid. The volume of the soil is then noted. This method is modified slightly from Middleton and Byers (1934).

Some idea of soil structure can be gained from this method, since soils with poor flocculation would be expected to show more volume than those with good structure. An attempt was made to measure differences in flocculation between soils by using an N solution of K Cl instead of water to saturate the soil. Soils which are deflocculated should show a decrease in volume with K Cl as compared to water and those which have good structure, viz. are already flocculated, should show little change. This procedure gave no different results here, compared to treatment in water.

Infiltration Rates

Undisturbed cores were taken at each site and adjacent fields. Beer cans with both ends cut out were driven down

into the ground from the surface. Since most surface soils were quite free of stones, no difficulty was experienced in driving the cans into the surface. They were driven in flush with the soil surface, and then removed in a chunk of soil. The can with core was broken out and wrapped in wax-paper to be transported.

This method was evolved after having tried a method similar to one described by Daubenmire (1942). That method proved unsatisfactory for these soils.

Fifty cc. of water was poured in the top of the can, the can being supported on a $\frac{1}{4}$ inch hardware cloth screen. Time for the water to be absorbed and for it to appear on the bottom was noted. Then another 50 cc. was added and the same noted as above.

It was found that best results were obtained when the soil was at field capacity, so the cores were taken within two days after a soaking rain. With soils not at field capacity the pores in the sample plugged up when water was added, and no water came through the core for 2 to 3 hours. No doubt colloidal swelling accounts for this (Lutz and Chandler 1946).

Results

Vegetation

Frequencies of the various species are given in Figure 1. As stated in a description of the methods, a total of twenty large quadrats, one meter square, and 320 small quadrats were taken at each site. This enables one to gain an idea of the way the species are distributed. For example, if the frequency per twenty quadrats is high and the frequency per 320 quadrats is low one can assume that the species are clumped. If both frequencies are high then the species must be fairly evenly distributed over the area. The method has some short-comings one of which is the fact that an evenly distributed species could give a frequency of 100 per cent using twenty quadrats and be found just once in each quadrat. This could give a frequency per 320 quadrats of 6.25 per cent. The species would not be clumped. Yet on the other hand the species could be found many times in one small square, would hence be clumped, and still give a frequency of 6.25 per cent. At best the method is merely an indication of distribution.

Some of the difficulty lies in telling whether each plant seen is an individual or part of another plant.

The results obtained here conform rather closely to those of Phoebe Green (1950) who worked exclusively on the Rock County prairies. The data for Tiffany prairie in this paper agree with Green's data the most closely.

In this study a total of 32 families was found, but because families were not found does not mean they could not have been present. The species indicated by the letter "P" in Figures 1 and 2 were present at the location but were not found in the quadrats. A total of 105 species were found in the quadrats and a total of 120 species were found over all. Some species found by Curtis and Greene (1949) or by Phoebe Green (1950) were not found. This is understandable considering the large number of species present and also that exactly the same areas were not covered by each worker.

Of the 32 families found, the Compositae was the best represented, by 31 species. The Gramineae was second with 23 species, Leguminosae third with 16. Rosaceae was represented by 6 species, followed by Umbelliferae and Asclepiadaceae each with 4 species and Ranunculaceae with 3 species. There were 25 other families, some represented only once.

Species with a presence of over 60 per cent are indi-

cated in Figures 1 and 2 by an asterisk. There are 73 such species.

Soils

A description of the profile at each site as far as the profile could be determined visually, was made. At the Morrisonville site the profile varied somewhat in thickness of horizon from pit to pit perhaps due to the slope at that place. A description follows of the prairie pits, Morrisonville:

- A₁ 0-4" Very black, full of roots, granular.
- A₂ 4"-12" Color grades to a dark brown, at 10 to 12 inches. Larger grain structure than A₁.
- B₁ 12"-21" Structure becomes nut-like, color grades to lighter brown at about 16 inches.
- B₂ 21"-26" Structure becomes larger nut. At about 17 inches color changes rather abruptly to dark red-brown.
- B₃ 26"-35" Gravel of disintegrating till, sandstone, granite, basalt, flint, and limestone rocks. Some rocks large, one foot in diameter. Horizon tan in color.
- C 35" † The gravel has little admixture of clay; is mostly stones and sand. Tan in color.

The adjacent pasture profile was as follows:

- A₁ 0-6" Black, full of roots, friable and granular.
- A₂ 6"-12" About the same as A₁ except that it is not as compacted as A₁. Compactness of A₁ probably from trampling by cattle.
- B₁ 12"-16" Lighter in color than A₂. A few pebbles appear here.
- B₂ 16"-18" Gravel starts at 16 inches. These 2 inches appeared to contain some clay.
- C 18" † Gravel down as far as was dug, about 40 inches.

Corn field profile:

This was less well-defined than the other two.

- A₁ 0-6" Dark brown, few roots. Harder to penetrate with shovel than the prairie or pasture first 6 inches.
- B₁ 6"-12" At about 6 inches the color changes abruptly to tan.
- B₂ 12"-18" Color gets darker. More clay in this horizon than preceding horizons.
- C 18" † Gravel as deep as pit was dug, 40 inches.

In all of these areas the use of "C" does not mean parent material, because these soils were largely wind or water deposited.

The Tiffany profile was rather uniform for both field and prairie. No differentiations into A₁, A₂, B₁, etc. were made because the profile was not apparently that uniform.

- A 0-24" Very black, sandy, well-granulated.
Many roots.
- B 24"-38" Color changed rather abruptly to a pale tan. Fewer roots.
- C 38" † Tan or reddish tan sand. Easily penetrated.

The horizons here were very difficult to determine and this difficulty extended to the adjacent field. The main discernible differences at each site, between the prairie and the adjacent field or pasture, was largely a matter of color and ease of penetration as offered to the spade.

The color of the A₁ layer in particular of the fields was lighter in color and more difficult to penetrate than prairie soil next to it. The visual differences appear less as one goes deeper. The difference in permeability is reflected in the rate of penetration to water as shown in Figure 8.

The Exeter prairie is well-drained but tends toward a wetter type than any of the other areas. A profile description follows:

- A 0-9" Very dark brown, well granulated, loamy soil with roots plentifully distributed throughout.
- B₁ 9"-17" The transition from A to B₁ is very abrupt and is easily seen as a color change from dark brown to a dark yellow brown. The structure grades to small nut near 17 inches and throughout the horizon there is enough clay to make the soil stiff and plastic.
- B₂ 17"-33" This horizon is a lighter color than the B₁. It contains red and yellow mottling indicating a fluctuating wet-dry condition. Near 33 inches the soil gets very sandy.
- C 33" † A white sand, with streaks of rust colored mottling. There was water at 40 inches, but this may have been because of the wet summer and not a permanent condition.

In the pasture adjacent to the prairie the profile was similar except that there were fewer roots in A₁ and was more difficult to penetrate, the B₁ layer extended to 24 inches and the B₂ to 38 inches.

The profile at the Albany site was as follows:

- A₁ 0-3" Very black, full of roots, well granulated.
- A₂ 3"-7" Less black than A₁ but not easily distinguished from it.
- B₁ 7"-24" An abrupt change from A₂, color is light brown, nut structure. Some clay.
- B₂ 24"-33" Red brown, darker than B₁, stiff and clayey. Contains little gravel.
- C 33" † A bright orange-red sand, little gravel, little clay. Easily penetrated.

The profile of the adjacent field was difficult to determine.

- A 0-7" Brown, hard, some clay, few roots.
Fine grain structure.
- B 7"-33" Red-brown, clayey.
- C 33" † Bright red sand.

On the Primrose prairie the soil is shallow and in only one instance was a depth of 40 inches reached. The profile:

- A 0-10" Very black, large granular structure, well supplied with roots.
- B₁ 10"-25" Dark brown, structure grades to nut. Fragments of chert appear in this horizon. Clay.

B₂ 25"-40" Color changes to dark red-brown,
Platy structure, stiff plastic, clay.

C This is the limestone bedrock.

The soil at Morrisonville is Carrington silt loam. It is a highly valuable agricultural soil developed from the loess cover over-lying the glacial till (Whitson et al 1916). Native vegetation was prairie.

The soil at the Tiffany site is Waukesha silt loam. It was developed under prairie vegetation or calcareous, nearly level outwash drift of the Late Wisconsin glaciation. A fine textured well-drained type. Surface nearly neutral. (Kellogg 1930).

At Exeter the soil is a Boone loam. According to the survey bulletin (Geib et al 1922) the origin of the soil is from the underlying limestone and sandstone, sandstone contributing most to its formation. Original vegetation was oak-opening and prairie. Slightly acid at surface to strongly acid deeper.

The soil at Albany is La Crosse fine sandy loam. It is derived from water-lain alluvial material and is generally acid. The original vegetation was prairie.

The Primrose prairie soil is Dodgeville silt loam, shallow phase. It is confined in Dane County, Wisconsin to the prairie regions of the southwestern portion. The survey bulletin (Whitson et al 1917) notes that the soil

is derived mainly from the weathering of the underlying limestone, but that the surface material is possibly of loessial origin. The original vegetation was prairie.

The results of the soil reaction and water-holding capacity tests are recorded in the tables, a table for each area. Figures 3, 4, 5, 6 and 7 are for the Morrisonville, Tiffany, Exeter, Albany, and Primrose sites respectively. The water-holding capacity results are graphed to give a better picture of the differences between the cultivated fields and the prairies. Figures 3a, 4a, 5a, 6a, and 7a are for the Morrisonville, Tiffany, Exeter, Albany, and Primrose sites respectively.

There does not seem to be any decisive difference between the acidity of the prairie and the adjacent fields or pastures for any one site. In some instances the p H of the field may be higher than the adjoining prairie and in some cases lower. In most cases the p H is about 6.0-7.0 at the surface, drops for the next few inches, then tends to rise near the bottom of the pit. At the Primrose site and Morrisonville site the p H at the bottom of the pit was higher than in the top layers. This is no doubt due to the calcareous nature of the subsoil.

In general, the water holding capacities were higher in the prairie throughout most of the profile though an exception to this occurs in the Tiffany area. This shows

up rather well on the graphs. The water-holding capacity is related to structure, organic matter content, colloid content of the soil, and the treatment given the soil (Lutz and Chandler 1946).

The infiltration data for the various stations, shown in Figure 8 shows the differences between the areas very well. In each case the rate of infiltration of water for the prairie was markedly different than that of the adjoining field. Most agriculturists know by observation and experience that there are differences between cultivated (i.e. used) areas and virgin areas. This data substantiates that. Other workers have noted differences too (Daubenmire 1942, Jenny 1932, Baver 1948). Structure is affected by cultivation.

The settling volume of soils is also an indication of soil structure. Values obtained here are listed in the table in Figure 8. Here, too, in every instance there was a considerable difference between the prairie site and the pasture or field. Treatment has affected structure.

Discussion of Vegetation Study

As noted before the results of this study and that of Phoebe Green (1950) agree closely. Green found 108 species in the quadrats, the writer found 105. Where Green found 36 families, 32 families were found here. In both cases the Compositae was represented by the most species; 34 in Green's work, 31 here. But where Green found only 10 species of Leguminosae and 10 species of Gramineae, the writer noted 16 species for Leguminosae and 22 species for Gramineae. This is not surprising considering that Green worked only in one area while the writer worked in five. Furthermore, variability seems to be a prime feature of the prairie. In addition some species had very low frequencies, for example Muhlenbergia racemosa and Bromus inermis.

The size of the area may have an effect on the composition, since the areas are small and are surrounded by cultivated fields. Thus a catastrophe of some sort occurring on one of these areas could completely or nearly wipe out certain species present. The presence of the cultivated fields would reduce the probability of the area being

repopulated by migrants from other areas. Curtis and Greene (1949) recognize this possibility. This no doubt accounts in part for the variability of the area.

In large areas, such as that covered by Weaver and Fitzpatrick (1934) in their survey, variability seems to be geographical. They found Stipa spartea, for instance, was more common in the north, Boutelona species in the south. In the small area studied here, Stipa spartea was represented on each site.

Green found Stipa spartea with a frequency of 48 per cent. The writer found it in 100 per cent of the 20 quadrats at Tiffany in the same township in which Green worked. In both cases Stipa spartea was the most plentiful species of Gramineae on the Rock county site. This was not true at every site, though Stipa spartea was well-represented at each place except the Primrose and Exeter prairies.

Seventy-one species, those marked with an asterisk in Figures 1 and 2, had a presence of over 60 per cent. These do not compare with Curtis and Greene's study. They found 21 species with a presence of over 60 per cent. Presence is stand-frequency.

The number of species per family agrees closely with the results of Curtis and Greene in the order of occurrence, but not percentagewise. They found Compositae to have 27.4 per cent of the species; the writer found it to be

comprised of 26 per cent of the species; Gramineae, Curtis and Greene 9.7 per cent, the writer 20 per cent. Leguminosae, Curtis and Greene 7.2 per cent, the writer 13.4 per cent. Asclepiadaceae and Umbelliferae were ranked fourth and fifth by Curtis and Greene, here they both ranked fifth with Rosaceae fourth.

In Illinois, Sorghastrum nutans is a species with high frequency, (Sampson, 1921), but in Wisconsin it is rather poorly represented compared to such forms as the Andropogons or Stipa spartea. Sorghastrum is a southern species. Phoebe Green found a lack of comparison between Illinois and Wisconsin prairies and thinks this may be due to poor drainage of the Illinois prairies.

Conclusions on Vegetation Study

While the composition of the prairie vegetation of southern Wisconsin may vary from place to place within this general area and on high, deep-soil prairies, yet over the general area the composition appears to be fairly uniform. This is brought out by three studies, the writer's and two others, in which quite comparable results were obtained. Today there are fields surrounding these relics of the prairie. The author feels that even if there were not such a condition and one were sampling a virgin prairie area the size of southern Wisconsin, he would still select his

stations as widely separated as these are now, just in order to get a representative survey. There would of course be no need to use subjective judgement, as one must now, to decide whether an area was representative of prairie. The results obtained would probably be close to the ones obtained here.

The data indicates that the characteristics of the vegetation of the high prairies of southern Wisconsin as shown in these studies are reasonably constant and will probably be found to be constant by workers hereafter. Similar studies in other areas would be interesting as comparisons.

Discussion of Soils Study

Profile

The visual description of the profile while perhaps more qualitative than quantitative, yet brings out differences between the virgin soil and the cultivated soil that are helpful in forming an opinion of the effect of use. It is generally recognized that soils high in organic matter are darker in color than those which are not (Lutz and Chandler, 1946). Jenny (1933) in Missouri found that fields under cultivation for 60 years lost 38 per cent of their organic matter and 33 per cent of the available bases compared to virgin prairie soils of the same type. This is probably a similar situation with respect to the fields adjacent to the prairie sites studied here, and would account for the difference in color between the virgin and the cultivated sites.

The ease of penetrability by the shovel when the pits were dug was greater in virgin than cultivated areas. Penetrability is affected by grazing and tillage. This was brought out in a study by Keen and Cashin (1932) in which

they measured penetrability to soils with a machine-driven rod. They found that the trampling of sheep had the same effect as a roller being hauled over the soil, and in fact had comparable data on the effect of heavy tilling machinery. The compaction effect was felt to ten centimeters in depth. Subsequent plowing failed to entirely relieve the condition. Wahlenberg, et al (1939) rated the penetrability of ungrazed, unburned land at 100. Grazed, unburned land had a rating of 64 on the same basis. They decided that trampling affected the surface and upper levels by compaction and by breaking the aggregates down so that they would clog up pores.

According to Baver (1948) the effect of sod roots on aggregation is too poorly known to hazard a guess as to the effect, though it is noted that plentiful roots in the soil are accompanied by good soil structure.

Soil Reaction

Due to the variable results of the soil reaction tests little will be said about them. The p H varied as much from pit to pit on the same site as they did from site to site, in one case, as for example Tiffany, even more. This variability seems to be characteristic of these areas. The p H of the adjacent fields may be affected by the application of agricultural lime. Jenny (1933) noted that the acidity

of cultivated pastures increased over that of a virgin prairie area. The p H went from 5.34 to 5.01. He considered the p H 5.01 decidedly more acid than p H 5.34. Leaching apparently is the principle cause of the removal of bases and hence results in an increase in soil acidity. (Lutz and Chandler 1946). Grasslands are generally considered to have less acidity than forest soils. Some of the variations in results here may be due to time of sampling, since some pits were dug in summer and some in fall.

Water-holding Capacity

The water-holding capacity of the prairie soils was generally higher in the prairie sites with the exception of the Tiffany area. Partch (1948), who made some water-holding capacity determinations on prairie soils got results in the same range for the same depths. The water-holding-capacity appears to be rather constant for any one soil type.

Work by Feustal and Byers(1936) shows that organic matter has a high water-holding capacity value. This may account for some of the differences in water-holding capacity between the virgin areas and the prairies studied here. Cultivation causes rapid oxidation of organic matter in soils. Clay and organic matter mixed together, have a high water-holding capacity too, but not as high as organic matter

alone. The higher values for the second six inches on the fields at the Morrisonville site may be a result of this combination. The cornfield top layer was plowed and no doubt organic matter was incorporated at a lower depth. Perhaps the "A" layers were gone and the clay was closer to the top. Certainly in both the cornfield and the pasture, the gravel occurred much closer to the surface.

Infiltration

The data shows a marked difference between virgin and prairie areas. Daubenmire (1942) in a study of virgin and grazed prairies of southeastern Washington found much the same effect, though not perhaps as pronounced as it was here.

According to Baver (1948) the permeability of the soil for water is a function of the amount and size-distribution of the pores. It is an index of certain structural relationships. The work done here was used to give an idea of structure, since it was assumed that the differences were due to differences in structure, a lack of structure giving lower infiltration rates.

It is generally established that use unfavorably affects structure (Jenny 1933). This seems to be the result of a loss of aggregation resulting from a loss of organic matter which gives rise to cementing agents (Gish and Browning

1948; Gilmour et al 1948) and to the actual mechanical breakdown of granules by tillage operations, the trampling of animals, and the impact of raindrops on the exposed area (Baver 1948). Baver quoted Russian papers. A great deal of work on tillage effect has been done by Russian workers. Aggregation here does not refer to mere flocculation, but to particles held together so tightly as to be water-stable; that is, do not disperse in water.

Settling Volume

The results as shown in Figure 9 are very definite; the volume of the soils of the virgin prairie are higher than those of the pasture for any one site. This method is also a measure of structure in that the amount of aggregation affects the volume. Soils which are well aggregated or have stable aggregates will have more volume under these saturated conditions than a soil of the same type which does not have a stable structure (Jackson and Tanner 1949; Middleton and Byers 1934).

Since aggregation is involved here too, the same discussion will suffice for this as for the infiltration data. At any rate we have shown that differences in settling volume exist and assume that they are the result of the effect of cultivation on aggregation.

Conclusions on the Soil Study

The study brought out differences between the soils of the virgin areas and those of the areas under cultivation which were discernible in color changes especially of the A horizon, in ease of penetrability, and in measurable structural changes. Also the water-holding capacity seems to be related to the organic matter present and to possibly the clay content. The p H values were variable.

The conclusion then seems rather obvious; that differences between the virgin prairie soils and the soils of the cultivated fields do exist and are measurable. They seem further to be born out by work in other parts of the country. These differences are apparently the result of cultivation affecting the loss of organic matter and loss of stable aggregates.

Summary

A vegetational analysis was made on five deep soil high prairies in southern Wisconsin. The results agreed closely with those of other workers.

Accompanying the vegetational study was a study of the soils of the prairie and the fields adjacent to them. Certain structural deteriorations, apparently the result of cultivation were noted in the cultivated areas.

References

1. Baver, L. D., Soil Physics. John Wiley and Sons, New York, 1948.
2. Curtis, J. T. and H. C. Greene, A study of relic Wisconsin prairies by the species-presence method. *Ecol* 30:83-92, 1949.
3. Daubenmire, R. F. and W. E. Colwell, Some edaphic changes due to over-grazing in the Agropyron-Poa prairie of southeastern Washington. *Ecol* 23:32-41, 1942.
4. Feustal, I. C. and H. G. Byers, The comparative moisture-absorbing and moisture-retaining capacities of peat and soil mixtures. U. S. D. A. Tech. Bull. 532, 1936.
5. Fosberg, M. A., Soil and site conditions typical of the maple-basswood association in southern Wisconsin. M. S. thesis, U. of Wis., 1949.
6. Geib, W. J. et al., Soil survey of Green county, Wisconsin. Field Operations of the Bureau of Soils, 24th Report. U. S. D. A., 1922.
7. Gish, Roger E. and G. M. Browning, Factors affecting the stability of soil aggregates. *Soil Sci. Soc. Am. Proc.* 13:51-55, 1948.
8. Gilmour, C. M., O. M. Allen and E. Truog, Soil aggregation as influenced by the growth of mold species, kind of soil and of organic matter. *Soil Sci. Soc. Am. Proc.* 13: 292-295, 1948.
9. Gray's New Manuel of Botany, 7th ed. Illus. American Book Co., New York, 1908.

10. Green, Phoebe Ann, Ecological composition of high prairie relics in Rock county, Wisconsin. Trans. Wis. Acad. Sciences, Arts and Letters, 40:159-173, 1950.
11. Jackson, M. L. and C. B. Tanner, Soil Physics, Methods of Measurement. Mimeog. Madison, Wisconsin, 1949.
12. Jenny, Hans, Soil fertility losses under Missouri conditions. Missouri Agr. Expt. Sta. Bull. 324, 1933.
13. Keen, B. A. and G. H. Cashin, The physical effect of sheep-folding on the soil. Journ. Agric. Sci. 22:124-126, 1932.
14. Kellogg, Charles E., Preliminary study of the profits of the principal soil types of Wisconsin. Wis. Geol. and Nat. Hist. Survey Bull. 77A, Soil Series 54, Published by the State, Madison, Wisconsin, 1930.
15. Lutz, Harold J. and Robert F. Chandler, Jr., Forest Soils, John Wiley and Sons, New York, 1946.
16. Middleton, H. E. and H. G. Byers, The settling volume of soils. Soil Sci. 37:15, 1934.
17. Partch, Max L., Habitat studies of soil moisture in relation to plants and plant communities. Ph. D. thesis, Univ. of Wis., 1949.
18. Sampson, H. C., An ecological survey of the prairie vegetation of Illinois. Ill. Nat. Hist. Survey, 13:523-577, 1921.
19. Wahlenberg, W. G., S. W. Greene and H. R. Reed, Effects of fire and cattle grazing on long-leaf pine stands as studied at McNeil, Miss. U. S. D. A. Tech. Bull. 683, 1939.
20. Weaver, J. E. and T. J. Fitzpatrick, The Prairie. Ecol. Monog. 4:109-295, 1934.
21. Whitson, A. R. et al., Soil survey of Columbia county, Wisconsin. Wis. Geol. and Nat. Hist. Survey Bull. 49, Soil Series 14. Published by the State, Madison, Wis., 1916.
22. Whitson, A. R. et al., Soil survey of Dane county, Wisconsin. Wis. Geol. and Nat. Hist. Survey

Bull. 53A, Soil Series 20. Published by the
State, Madison, Wisconsin, 1917.

Figure 1--Table of frequencies of species on the 5 sites studied

Species	Morrisonville		Tiffany		Exeter		Albany		Primrose	
	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.
*Achillea Millefolium	P	5.0	.63	65.0	12.81	P	25.0	12.81	P	25.0
*Agropyron Repens	5.0	.31	95.0	23.13	P	35.0	3.43	P	65.0	10.0
*Ambrosia artemisiifolia	P	5.0	5.0	2.19	P	5.0	2.19	P	5.0	2.19
*Amorpha canescens	80.0	31.88	40.0	9.38	5.0	2.19	100.0	52.19	60.0	14.69
Amphicarpa brocteata	10.0	1.25	25.0	6.88	55.0	22.81	60.0	14.69	60.0	14.69
*Andropogon Gopardi	25.0	6.88	25.0	5.63	5.0	2.19	100.0	52.19	60.0	14.69
*Andropogon scoparius	60.0	16.56	25.0	5.63	55.0	22.81	60.0	14.69	60.0	14.69
Anemone canadensis	10.0	5.00	25.0	5.63	55.0	22.81	60.0	14.69	60.0	14.69
*Anemone cylindrica	10.0	1.88	25.0	5.63	55.0	22.81	60.0	14.69	60.0	14.69
*Antennaria spp.	P	1.88	25.0	5.63	55.0	22.81	60.0	14.69	60.0	14.69
Asclepias amplexicaulis	P	1.88	25.0	5.63	55.0	22.81	60.0	14.69	60.0	14.69
*Asclepias syriaca	P	1.88	25.0	5.63	55.0	22.81	60.0	14.69	60.0	14.69
*Asclepias verticillata	P	1.88	25.0	5.63	55.0	22.81	60.0	14.69	60.0	14.69
*Aster azureus	10.0	3.13	15.0	1.88	100.0	69.69	15.0	3.13	45.0	13.13
*Aster ericoides	20.0	5.63	65.0	17.81	5.0	.31	15.0	3.13	10.0	1.88
*Aster laevis	25.0	5.63	30.0	3.44	P	2.50	10.0	.62	5.0	.31
Aster novae-angliae										
Aster ptarmicoides										
Avena sativa										
Baptisia leucantha										
Baptisia leucophaea										
Bouteloua curtipendula										
Bromus inermis	5.0	.31	10.0	1.25	5.0	.31	10.0	.62	10.0	1.25
Brauneria pallida										

*Species with a presence value of over 60 per cent.

Figure 1 (Continued)

Species	Morrisonville		Tiffany		Exeter		Albany		Primrose	
	Freq. per 20	Freq. per 320	Freq. per 20	Freq. per 320	Freq. per 20	Freq. per 320	Freq. per 20	Freq. per 320	Freq. per 20	Freq. per 320
*Carex spp.	65.0	22.50	40.0	5.63	90.0	69.69	P	25.0	4.06	
*Ceanothus americanus	P		15.0	2.81			5.0	1.88		
*Cirsium discolor			P		25.0	1.56	P			
*Comandra umbellata	75.0	5.0	65.0	30.63	35.0	4.69	5.0	.31	5.0	.31
*Convolvulus sepium	P		25.0	6.25	P		P		5.0	.63
*Coreopsis palmata	85.0	47.50	15.0	2.50						
*Desmodium canadense	P		P		5.0	.94	5.0	.31		
*Desmodium illinoense	P		P		30.0	4.69	35.0	5.00		
*Dodecatheon Meadia	5.0	.31	P		P		P		P	
*Equisetum arvense	10.0	1.25	5.0	.63	15.0	1.25	100.0	65.31		
Eragrostis pectinacea					5.0	.94				
Eragrostis spectabilis							5.0	.31		
Erigeron canadensis					15.0	5.00				
Erigeron ramosus			10.0	2.19						
*Eryngium vuccifolium	15.0	1.88	P		60.0	15.0	P			
*Euphorbia corollata	100.0	30.00	85.0	16.56	70.0	10.94	95.0	49.38	75.0	14.06
Fragaria spp.					55.0	20.31				
*Galium boreale	65.0	41.25	P		P					
*Gentiana Andrewsii			30.0	8.44	10.0	2.50			10.0	.94
*Helianthus occidentalis	P		40.0	22.81			P			
*Helianthus rigidus	70.0	28.75	65.0	42.5	P		5.0	.63	25.0	13.75
*Heliopsis scabra	5.0	.63	P		P					
Heuchera Richard-soniana	10.0	.63	5.0	.63						
Hypericum perforatum			P						10.0	2.81
Kuhnia eupatorioides			P						70.0	11.56

Figure 1 (Continued)

Species	Morrisonville		Tiffany		Exeter		Albany		Primrose	
	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.
*Lactuca canadensis	20.0	1.56		10.0	18.75	10.0	.62			
*Lespedeza capitata			P	90.0	24.69	20.0	6.88			
*Liatris aspera	25.0	3.75	10.0	15.0	.94					
Lilium michiganensis	20.0	.94		P						
Linum catharticum	5.0	.31								
Linaria vulgaris	5.0	.31	5.0	.63						
*Lithospermum canescens	20.0	2.19	P							
Medicago lupulina									25.0	6.88
*Melilotus alba	P		P						5.0	.31
Melilotus officinalis			10.0		14.06	P			85.0	17.81
*Monarda fistulosa	15.0	1.88		70.0	26.25	40.0	15.31		50.0	28.75
Muhlenbergia racemosa	50.0	10.31		10.0	4.38					
Oenothera biennis			5.0	5.0	.31					
*Oxalis violacea	10.0	4.06	35.0	5.0	.31	5.0	.31		P	
*Panicum Leibergeri	75.0	25.31	60.0	30.0	6.56	10.0	6.88		5.0	2.81
*Panicum praecoxius	5.0	1.56	15.0	65.0	6.88					
*Panicum Scribnerianum	P		55.0	55.0	19.69	20.0	1.25		10.0	2.19
Petalostemum candidum				5.0	.31				15.0	2.19
*Petalostemum purpureum	P		20.0	20.0	1.88				5.0	.31
Phleum pratense			5.0	5.0	.31					
*Phlox pilosa	80.0	14.38	30.0	P					75.0	12.81
Physalis heterophylla									5.0	.31
*Physalis virginiana	20.0	3.44	5.0	5.0	.31	5.0	.62		80.0	13.13
*Poa pratensis	95.0	70.31	45.0	95.0	38.75	100.0	99.79		100.0	96.88

Figure 1 (Continued)

Species	Morrisonville		Tiffany		Exeter		Albany		Primrose	
	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 20 quad.	Freq. per 320 quad.
<i>Polygonatum biflorum</i>	40.0	7.81								
<i>Populus tremuloides</i>										
* <i>Potentilla arguta</i>			10.0	.94	5.0	.31	5.0	.31		
<i>Potentilla canadensis</i>					60.0	10.00	25.0	2.19		
* <i>Ratibida pinnata</i>	5.0	.31	45.0	8.75	30.0	6.88	5.0	1.56	15.0	2.19
<i>Rhus glabra</i>					10.0	.94				
<i>Rhus rhadicans</i>							5.0	.31		
* <i>Rosa</i> spp.	65.0	4.38	35.0	9.06	5.0	.31	10.0	2.50	95.0	16.25
* <i>Rubus villosus</i>	20.0	3.13			60.0	21.25	P			
<i>Rudbeckia hirta</i>	10.0	.63	P							
<i>Salix humilis</i>	5.0	2.81	P							
<i>Setaria lutescens</i>							85.0	20.31		
* <i>Silphium terebinth-</i> <i>inaceum</i>	75.0	23.13	P		P		P			
<i>Solidago altissima</i>	5.0	1.25								
* <i>Solidago graminifolia</i>	35.0	5.00			5.0	4.06			P	
* <i>Solidago juncea</i>	40.0	16.56	P		40.0	14.06	P		20.0	19.38
<i>Solidago missourien-</i> <i>sis</i>					25.0	4.69				
<i>Solidago nemoralis</i>	20.0	10.00	20.0	5.63	25.0	4.69				
* <i>Solidago rigida</i>	20.0	1.25	15.0	4.38	5.0	.31			15.0	1.56
* <i>Solidago speciosa</i>			10.0	3.13	10.0	.94			25.0	5.94
* <i>Sorghastrum nutans</i>	25.0	6.56	5.0	1.25	40.0	25.63	P		70.0	27.06
* <i>Sporosolus hetero-</i> <i>lepis</i>	95.0	73.13	10.0	3.13	10.0	1.25	P		55.0	19.06
* <i>Stipa spartea</i>	50.0	12.50	100.0	86.56	P		85.0	45.63	10.0	1.56

Figure 1 (Continued)

Species	Morrisonville		Tiffany		Exeter		Albany		Primrose	
	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.	Freq. per 20 quad.	Freq. per 320 quad.
<i>Sisyrinchium campestre</i>			5.0	.31	15.0	4.38				
<i>Thalictrum dasycarpum</i>					P		30.0	3.44		
* <i>Tradescantia ohioensis</i>	5.0	.31	40.0	6.25	85.0	40.31				
<i>Trifolium agrarium</i>					55.0	22.81	5.0	.31		
<i>Trifolium pratense</i>					15.0	4.38	30.0	3.13		
* <i>Viola pedatifida</i>	50.0	7.50	30.0	5.63					55.0	5.31
<i>Vicia villosa</i>	10.0	1.56								
<i>Zizia aptera</i>	5.0	.63	10.0	2.81						

Figure 2--Presence list of additional species not found in the quadrats.

Additional Species	Site				
	Morrisonville	Tiffany	Exeter	Albany	Primrose
Apocynum androsaemifolius		P	P		
Asclepias Sullivantii	P	P			
Calamagrostis canadensis			P	P	
Chenopodium album		P	P		
*Elymus canadensis	P	P	P	P	P
*Koeleria cristata	P	P	P	P	
*Panicum virgatum	P	P	P	P	
*Quercus velutina		P	P	P	
Robinia Pseudo-Accacia	P				
*Silphium integrifolium	P	P	P	P	
*Silphium laciniatum	P	P	P	P	
Spartina Michauxiana		P	P	P	
Taenidia integerrima		P	P	P	
Tragopogon pratensis		P	P	P	
Zizia aurea		P			

*Species with a presence value of over 60 per cent.

Figure 3--Table of the pH and water-holding capacity values for the Morrisonville prairie at 6 inch intervals.

Depth in inches	Pit									
	1		2		3		Pasture		Cornfield	
	pH	WHC	pH	WHC	pH	WHC	pH	WHC	pH	WHC
0- 6	7.0	62.0	5.3	62.0	5.2	64.5	7.0	59.9	6.5	55.8
6-12	6.0	59.1	5.3	58.5	5.5	58.5	7.0	64.4	6.5	67.8
12-18	5.5	50.0	4.5	51.0	5.2	52.6	7.5	53.5	5.3	49.5
18-24	5.5	46.0	5.5	45.0	5.0	46.3	8.5	34.0	8.5	27.1
24-30	8.0	43.6	5.0	43.0	5.5	43.2	8.5	23.9	-	-
30-36	8.0	42.0	5.3	42.3	6.5	42.4	-	-	-	-
36-42	-	-	8.5	36.0	8.0	37.1	-	-	-	-

Figure 3a--Table of the pH and water-holding capacity values for the Morrisonville prairie at horizon intervals.

Pit

Horizon	2			3			Pasture			Cornfield		
	Depth	pH	WHC	Depth	pH	WHC	Depth	pH	WHC	Depth	pH	WHC
A1	0-4	7.0	61.9	0-16	5.2	57.8	0-6	7.0	59.9	0-6	6.5	55.8
A2	4-12	5.5	56.6	-	-	-	6-12	7.0	64.4	-	-	-
B1	12-21	5.5	49.3	23-28	5.0	47.0	12-16	7.5	54.5	6-12	6.5	67.8
B2	21-26	6.5	48.5	28-36	6.0	30.8	26-32	5.7	45.8	16-18	8.5	36.0
B3	26-35	8.0	31.8	-	-	-	32-36	8.0	30.4	-	-	-
C	35+	8.0	26.9	36+	8.0	26.0	36+	8.0	27.0	18+	8.5	24.0
										18+	8.5	27.1

Depth in inches

36-42

30-36

24-30

18-24

12-18

6-12

0-6

20

30

40

50

60

70

% water-holding capacity

Prairie

Pasture

Cornfield

Fig. 3b Graph of the water-holding capacity values Morrisonville area

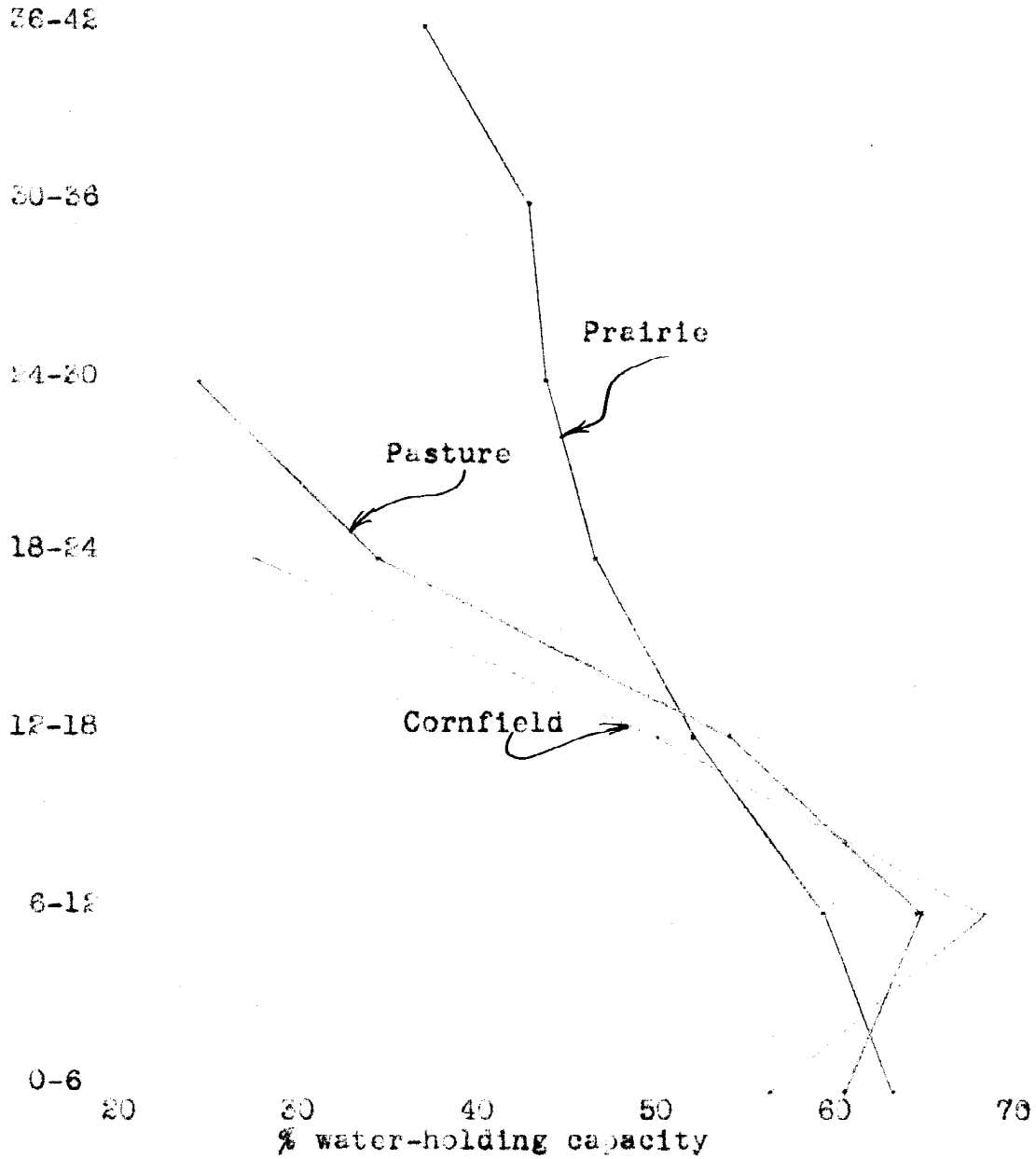


Figure 4--Table of the pH and water-holding capacity values for the Tiffany prairie at 6 inch intervals.

Depth in Inches	Pit							
	1		2		3		Field	
	pH	WHC	pH	WHC	pH	WHC	pH	WHC
0- 6	6.0	37.8	6.5	38.0	6.5	36.8	6.0	38.9
6-12	5.0	37.4	6.0	38.1	5.5	36.5	5.5	36.7
12-18	4.5	28.3	5.5	33.5	5.5	27.8	5.0	34.3
18-24	4.5	24.4	5.0	29.2	5.5	28.0	4.5	29.7
24-30	4.5	24.0	5.0	25.4	5.0	24.0	4.5	28.4
30-36	4.5	22.9	5.5	23.8	5.5	23.0	5.0	27.3
36-40	5.0	22.7	5.8	22.1	5.5	23.5	5.5	26.0

Figure 4a--Table of the pH and water-holding capacity values for the Tiffany prairie at horizon intervals.

Horizon	Depth in inches	Pit							
		1		2		3		Field	
		pH	WHC	pH	WHC	pH	WHC	pH	WHC
A	0-24	5.5	31.5	5.5	32.6	6.0	32.0	5.0	34.5
B	24-38	5.0	23.4	5.5	23.0	5.0	24.5	5.0	28.0
C	38+	4.5	21.4	5.0	22.0	5.0	21.0	5.5	25.0

Depth in inches

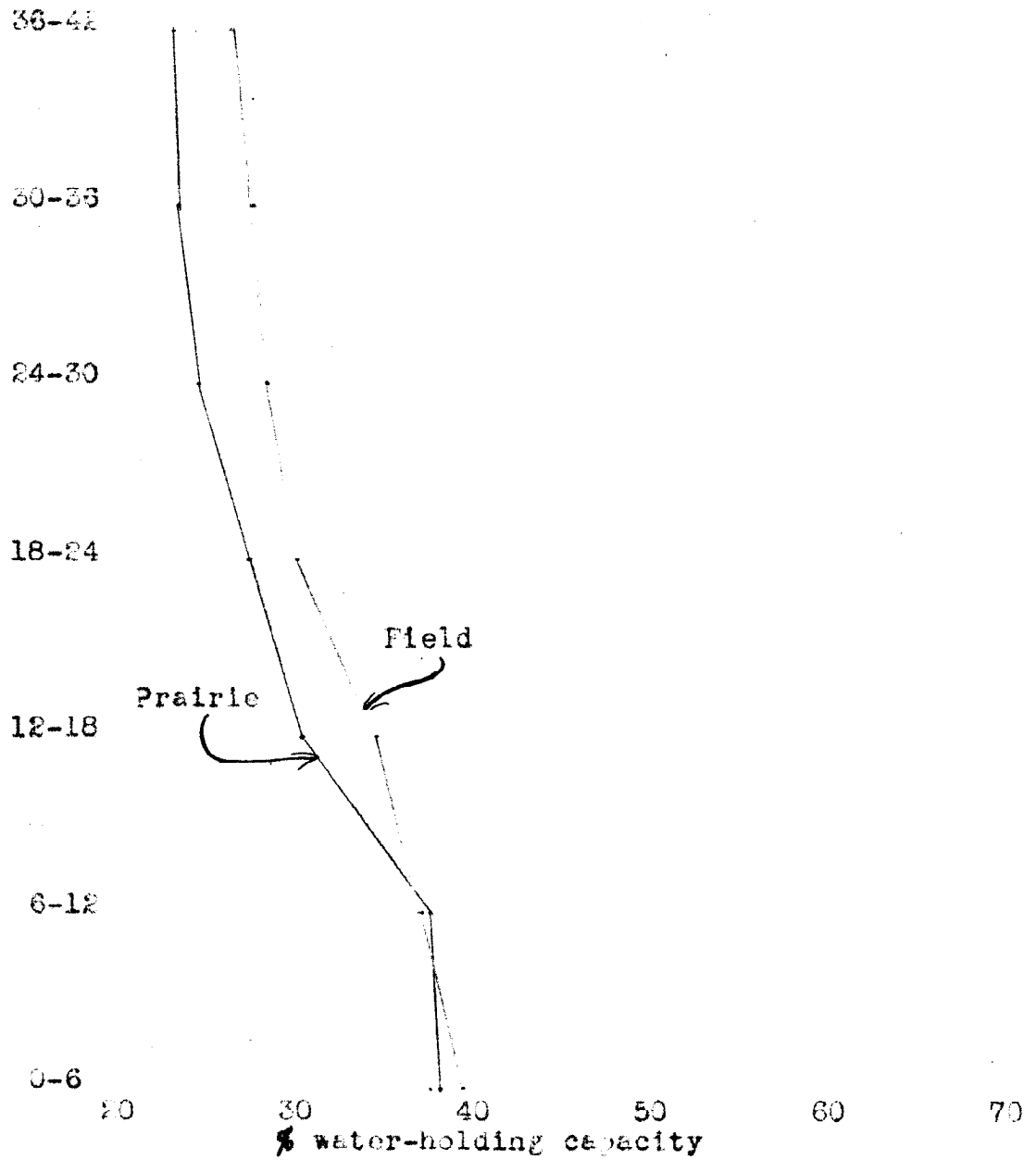


Fig. 4b Graph of the water-holding capacity values Tiffany area

Figure 5--Table of the pH and water-holding capacity values for the Exeter prairie at 6 inch intervals.

Depth in inches	Pit							
	1		2		3		Pasture	
	pH	WHC	pH	WHC	pH	WHC	pH	WHC
0- 6	4.5	51.6	6.5	50.6	6.8	49.1	6.0	39.6
6-12	5.8	37.5	5.5	36.5	5.5	38.4	5.8	(21.0)
12-18	6.0	38.4	4.5	35.5	4.5	36.0	5.0	32.8
18-24	4.5	34.3	4.5	34.1	4.5	34.7	5.0	29.6
24-30	4.5	28.8	4.5	27.0	4.5	29.0	4.5	31.0
30-36	5.0	25.4	4.5	25.3	5.0	26.5	4.5	29.1
36-42	5.3	25.8	4.5	22.1	5.8	26.0	4.5	22.2

Figure 5a--Table of the pH and water-holding capacity values for the Exeter prairie at horizon intervals.

		Pit									
		1		2		3		Pasture			
Horizon	Depth	pH	WHC	Depth	WHC	Depth	pH	WHC	pH		
A	0-9	6.0	54.1	0-9	47.0	0-9	6.5	48.6	0-9	6.0	38.5
B											
B ₁	9-17	5.5	37.6	9-17	37.0	9-17	5.5	38.7	9-24	5.0	36.9
B ₂	17-33	6.5	31.7	17-33	33.5	17-33	4.5	32.0	24-38	5.0	27.1
C	33+	5.5	20.7	33+	24.6	33+	5.0	24.1	38+	5.3	31.4

Depth in inches

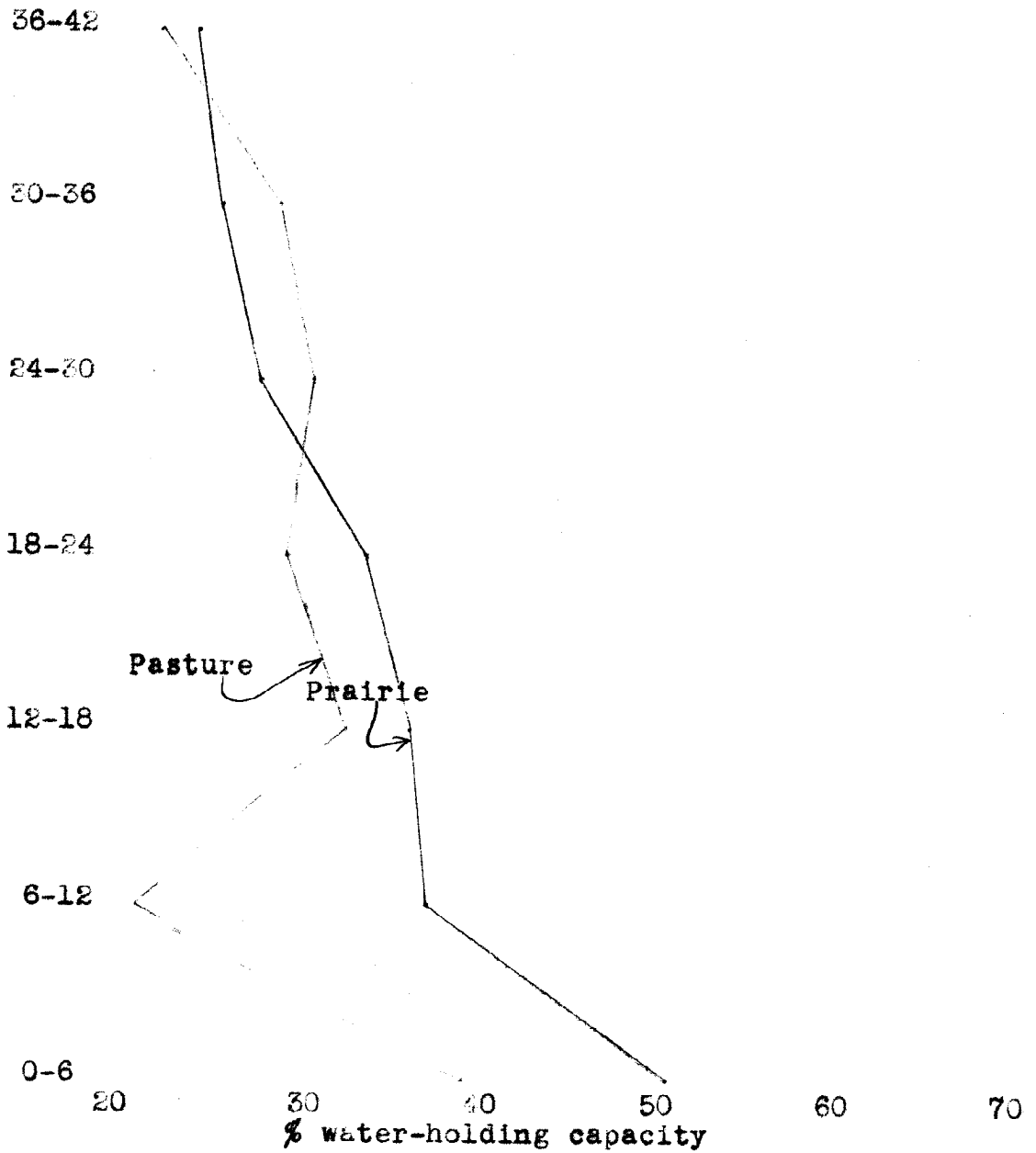


Fig. 5b Graph of the water-holding capacity values Exeter area

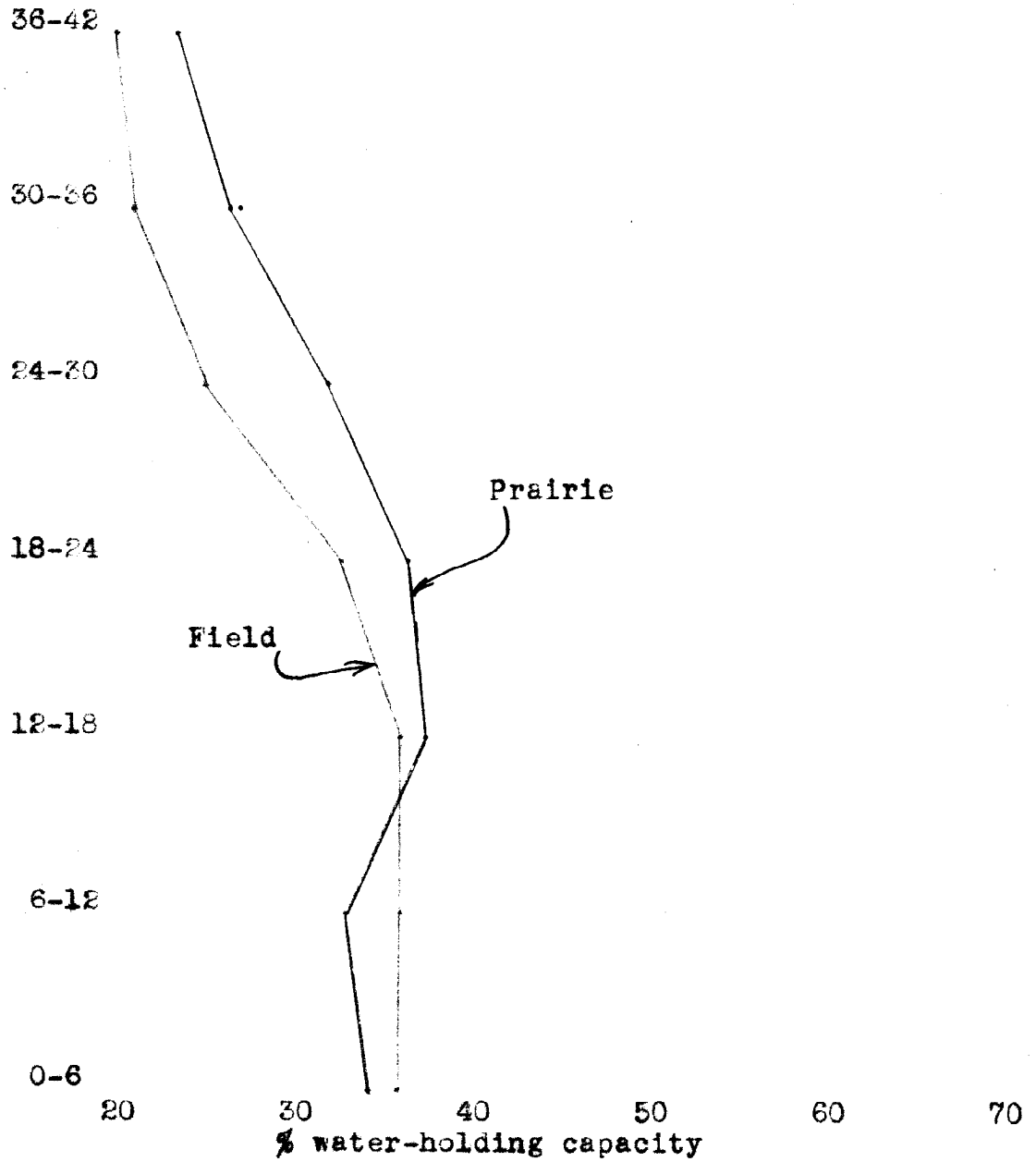
Figure 6. Table of the pH and water-holding capacity values for the Albany prairie at 6 inch intervals.

Depth in inches	Pit							
	1		2		3		Field	
	pH	WHC	pH	WHC	pH	WHC	pH	WHC
0- 6	6.3	32.7	6.0	33.0	6.5	37.0	6.0	35.8
6-12	5.5	32.4	6.0	32.0	6.5	35.6	5.0	36.1
12-18	5.5	39.1	5.5	36.7	5.5	36.1	5.0	36.0
18-24	4.5	39.4	6.0	36.0	5.0	33.2	4.5	32.7
24-30	4.0	32.9	6.0	32.5	5.0	31.3	5.5	25.0
30-36	4.5	24.7	6.0	25.7	5.0	27.8	5.5	21.0
36-42	-	-	5.5	22.4	5.5	24.0	5.5	20.1

Figure 6a--Table of the pH and water-holding capacity values for the Albany prairie at horizon intervals.

Horizon	Pit											
	1			2			3			Field		
	Depth	pH	WHC	Depth	pH	WHC	Depth	pH	WHC	Depth	pH	WHC
A1	0-3	6.0	35.8	0-3	6.0	34.6	0-3	6.5	38.2	-	-	-
A2	3-7	5.5	34.2	3-7	5.5	34.0	3-7	6.5	36.5	-	-	-
B1	7-24	5.5	34.2	7-24	5.5	33.2	7-24	5.5	35.0	--	-	-
B2	24-33	4.0	31.6	24-33	4.0	30.0	24-33	5.0	32.2	-	-	-
C	33+	4.5	21.3	33+	5.5	21.5	33+	5.0	22.8	-	-	-
A	-	-	-	-	-	-	-	-	-	0-7	6.0	34.0
B	-	--	-	-	-	-	-	-	-	7-33	5.0	26.0
C	-	-	-	-	-	-	-	-	-	33+	5.5	20.5

Depth in inches



Fig, 6b Graph of the water-holding capacity values Albany area

Figure 7--Table of the pH and water-holding capacity values for the Primrose prairie at 6 inch intervals.

Depth in inches	Pit			
	1		Field	
	pH	WHC	pH	WHC
0- 6	7.5	69.6	8.0	60.1
6-12	7.0	58.8	7.0	59.0
12-18	7.0	59.6	7.0	59.0
18-24	7.5	52.4	8.0	35.0
24-30	8.0	52.5	-	-
30-36	8.0	63.2	-	-
36-42	8.5	78.4	-	-

Figure 7a--Table of the pH and water-holding capacity values for the Primrose prairie at horizon intervals.

Horizon	Depth in inches	Pit	
		1	
		pH	WHC
A	0-10	7.5	64.4
B ₁	10-25	8.0	64.0
B ₂	25-40	8.0	64.0

Depth in inches

36-42

30-36

24-30

Prairie

18-24

Field

12-18

6-12

0-6

20

30

40

50

60

70

% water-holding capacity

Fig. 7b Graph of the water-holding capacity values
Primrose area

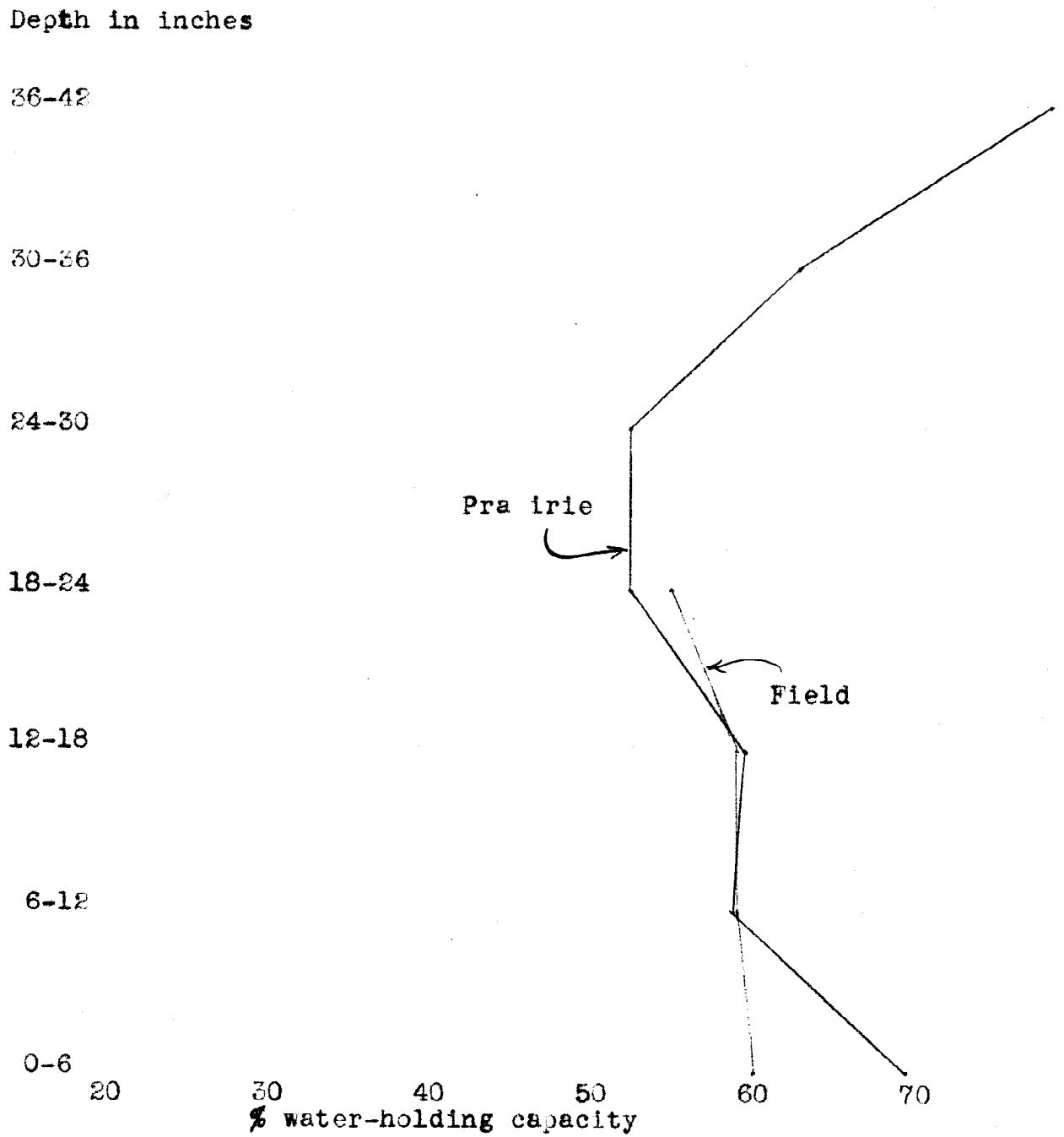


Figure 8--Table of infiltration rates for the prairie and cultivated fields.

Location	Time for 1st 50 cc. to be absorbed	Time for 1st 50 cc. to pass through core	Time for 2nd 50 cc. to be absorbed	Time for 2nd 50 cc. to pass through core
Prairie, Morrisonville	.08 Min.	.10 Min.	.53 Min.	.05 Min.
Pasture, Morrisonville	134.00 Min.	17.00 Min.	222.00 Min.	46.00 Min.
Cornfield, Morrisonville	30.00 Min.	7.00 Min.	720.00 Min.	3.00 Min.
Prairie, Tiffany	.42 Min.	8.00 Min.	11.00 Min.	9.00 Min.
Field, Tiffany	88.00 Min.	19.00 Min.	144.00 Min.	42.00 Min.
Prairie, Exeter	10.00 Min.	4.00 Min.	29.00 Min.	1.50 Min.
Field, Exeter	180.00 Min.	85.00 Min.	--	--
Prairie, Albany	13.00 Min.	6.00 Min.	58.00 Min.	57.00 Min.
Field, Albany	26.00 Min.	19.00 Min.	83.00 Min.	78.00 Min.
Prairie, Primrose	.08 Min.	.10 Min.	.50 Min.	.03 Min.
Field, Primrose	3.00 Min.	6.17 Min.	36.00 Min.	3.00 Min.

Figure 9--Table of settling volume in water
in centimeters. First 6 inches of
soil.

Pit	Settling Volume in Water (cc.)				
	Morrisonville	Tiffany	Exeter	Albany	Primrose
1	63.0	55.5	59.0	46.0	68.0
2	59.5	55.5	60.0	44.0	--
3	67.0	55.5	59.0	48.0	--
Pasture or Field	58.5	51.0	56.0	41.5	64.0
Cornfield	56.5	---	---	---	---

Approved John T. Curtis

Date Jan 22, 1951