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Oklahoma Soil Studies.

J. H. BONE.

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OKLAHOMA SOIL STUDIES.

J. H. BONE.

SUMMARY.

Cultivation largely determines crop yields but they depend also in a large degree on heat and moisture. By cultivation we can help conserve the soil moisture and to some extent affect the heat of the soil. Uncultivated soil under similar crop conditions usually contains about 2 per cent. less moisture than cultivated soil when both are kept free from weeds.

In most Oklahoma soils the moisture question is of more importance than that of direct plant food. Compact soils are helped by deep or subsoil plowing. Surface cultivation checks evaporation.

Increasing the supply of decayed vegetable matter is desirable for most Oklahoma soils. In one case there was an average difference of 2.5 per cent. of soil moisture in the first foot of soil during the period of most active growth, in favor of the soil manured and subsoiled.

The frequency of the cultivation of crops depends upon the season. Plats having two cultivations gave larger yields than others having nine cultivations. Enough cultivation should be given to keep the weeds down and the soil in good condition. Poor cultivation affects Indian corn more than it does Kafir corn.

Soil plowed in March contained more moisture than that plowed about the middle of April. Shallow plowing did not maintain as much moisture in the soil as deep plowing. Subsoiled land contained more moisture than land not so treated. The yield of corn on a plat subsoiled in the spring was less than on a plat not subsoiled. Stubble should be plowed as soon after harvest as is convenient and harrowed occasionally until sown to wheat. Stubble plowed early will cost less to put in condition for planting, will be in better condition for the crop, the seed will germinate better and the crop will yield better.

Rolling does not tend to conserve soil moisture or increase the crop yield at this station. Rolled soil is blown by winds more readily and is not in condition to receive the rainfall to the best advantage.

Bottom land does not dry out so completely as upland, nor does it hold as much moisture when full. The surface three feet of bottom land will contain more moisture during a drouth than the same depth of upland.

There are several distinct types of soil in Oklahoma Territory. The physical properties of these soils vary because of varied conditions, but among the most important are the size of the soil grains and their relation to each other. The more sandy a soil is the less water it will hold and the more thoroughly will it dry out, other conditions being equal.

The soil moisture was much higher during the year of 1898 than during the year of 1897. Upland prairie contained a yearly average of 18.5 per cent. in 1898 and 16.6 per cent. during the year of 1897. Upland plowed soil at the depth of from 3 to 12 inches contained 18.2 per cent. of moisture during 1898 and 16.6 per cent. during 1897.

During the year the soil moisture may range from 4 or 5 per cent. to 26 or 27 per cent. Ordinary crops do well when the soil contains from 12 to 20 per cent. of moisture. Indian corn begins to suffer when the moisture gets as low as 10 per cent. while Kafir will do fairly well with that amount of moisture.

This bulletin presents work done in the study of soils for the past three years. It deals mainly with the question of soil moisture as influenced by soil culture and the influence of soil moisture and soil culture on the crop yield. Much of the work could not be discussed fully for lack of space. In the soil work there have been taken over 6,000 separate samples in the study of the experiments reported.

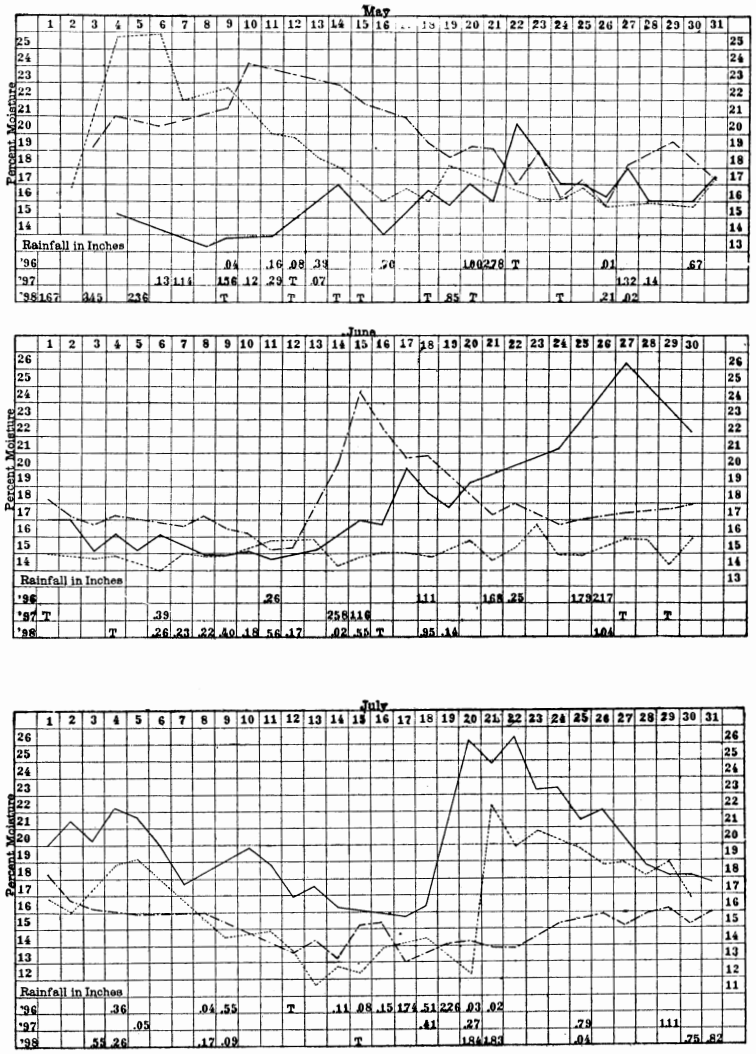
The soil of the Oklahoma Experiment Station farm used in these experiments is medium upland of average fertility, rather light in texture and easily worked. The mechanical analysis of the surface foot of this soil is given in Bulletin No. 24 of this Station. The soil is from 6 to 15 inches deep underlaid with a sticky subsoil which soon crumbles when exposed to the atmosphere. The soil is not very dark in color. The subsoil is light, somewhat yellowish. When the subsoil crops out at the surface it is often called gumbo.

In the calculation of soil moisture the weight of the soil as sampled in the field was taken as the basis for finding the per cent. of moisture. The calculation is as follows: If a sample of soil taken weighs 140 grams when fresh and weighs 112 grams

when dry it has lost 28 grams of moisture. The per cent. of moisture is found by dividing 28 by 140, which gives .20 or 20 per cent. There is therefore 20 per cent. of moisture in the soil.

We may broadly define cultivation as the preparation and care of the soil for the growth of plants. It ought to be of such a nature that it will cause the soil to more readily respond

CHARTS 1, 2, 3.—Soil Moisture in Surface Foot During May, June and July.



to the needs of the plant and to better maintain normal conditions under adverse circumstances. It is necessary that the soil be cultivated for our various crops; yet the crops do not all demand the same attention. After wheat is sown we give it no further care so far as the soil is concerned. During the most of the growing period the soil is usually damp and cold. The evaporation is slow and weeds do not interfere. On the other hand corn is a crop that requires much attention during the early part of its growth. The crop does not cover the ground and weeds must not be allowed to grow. The soil is warm and evaporation, which is rapid at this this time of the year, must be checked as much as possible.

While cultivation is of the utmost importance, the character of our seasons has much to do with the yield of our crops. It is true that our crops do not all demand the same conditions as regards moisture and heat. This point is well illustrated when we compare the yield of Kafir and Indian corn grown upon the uplands during the season of 1897. The Indian corn was very poor and almost a failure in places while Kafir generally made good yields. Charts 1, 2 and 3 show the record of soil moisture during the years 1896, 1897, 1898 for the months of May, June and July on a plat that was kept free from weeds and crop but not cultivated. During May and until June 20, in 1897, there was more moisture in the soil than in 1896. From that date until the last of July there was far less in 1897, usually from 3 to 5 per cent. In 1896 there was a fair yield of Indian corn on the uplands, while not much more than the stalk grew in 1897. In both years there was a good yield of Kafir. In 1898 the soil moisture was ample and more uniform than in the previous two years and yet the general average is less than in either of the previous years. The crops of Indian and Kafir corn were excellent. Kafir corn has a little later season but the length of the period of growth is about that of Indian corn in most seasons. The period of growth in 1897 was somewhat longer than is usual for Kafir. In this respect Kafir corn is different from Indian corn. It grows slower in a dry time but does not die, even if the soil moisture becomes quite low. As soon as the soil receives a supply of water it will begin growing. Indian corn cannot do this, but must perish before hot winds and with dry soil. The latter apparently has more influence than the former, as bottom lands produced excellent yields of Indian corn in both seasons mentioned.

The season of 1897 was quite favorable for the cotton plant. The months during which the bolls were opening were dry and warm. The rainfall was less than an inch at the station during each of the months of September, October and November. Over the greater part of the territory less than two inches of rainfall is reported during each of these months.

While our seasons may produce a certain crop during one year to perfection, the farmer cannot depend upon it to be so continually. Crops ought to be grown in rotation, so that the soil will not become impoverished. By proper arrangement of some of the numerous crops that we might raise in Oklahoma, the farm work can be arranged so that it will continue throughout the year, and a failure in a single crop will not mean the loss of the year's work.

The fact that the bottom lands yield good crops even in unfavorable years, leads to the thought that there must be a difference in the conditions. Although the question has not been carefully studied, it is probable that the difference here is not so much on account of fertility as other conditions. Under the bottom lands there is, even in the dryest times, what is known as the water table. The height of the water in a well gives some idea as to the height of the water in the soil. This supply of water under the soil in river or creek bottoms is close enough to be available to the crop. The soil being coarser, gives up its water supply more readily. On the upland farms the conditions are not similar. The water table is far below during most of the year. The soil is finer and holds its water supply more closely, and at the same time can hold a larger amount of water.

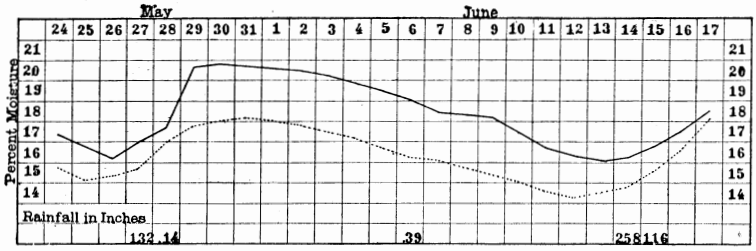
CULTIVATION, SUB-SOILING, MANURING.

Where our soils are of a compact nature with a more compact sub-soil, it is advisable to plow deep and use a sub-soil plow. This must be done at the proper time, else the crop may be injured. The soil readily dries out when loosened, and the deeper the plowing the more easily will it dry out to greater depths. Compact soil will hold moisture better than loose soil because the air cannot pass through it so rapidly. Yet, after the soil becomes saturated with water, it is usual to find a larger amount of moisture in sub-soiled than unsub-soiled ground.

A valuable adjunct to sub-soiling is barnyard manure. Too much cannot be said in advocating its use in our territory.

Prairie fires have deprived the soil of the humus matter that properly belongs to the soil. Barn-yard manure adds plant food and affects the physical conditions of the soil. Where soil

CHART 4.—Influence of Manure and Subsoiling on Soil Moisture.



Manured and Subsoiled.——————
Ordinary Plowing. - - - - - - - -

has been manured it usually shows a larger per cent. of mosture in the first foot. Chart No. 4 illustrates these points.

The heavy line represents the soil moisture in surface foot of soil in a field that was manured in 1895 and subsoiled in the fall of 1896. Indian corn grew on this field in 1897. The dotted line represents the soil moisture in the surface foot of soil in an adjoining field which was neither manured nor sub-soiled. The samples of soil were taken on these fields on the same date and the plats from which they were taken received like treatment, except that the latter field was planted in Kafir corn, and for this reason, up to the date of the last sample, June 17, the soil moisture was not so much affected by the crop as in the former field. There was an average difference of two and one-half per cent. of moisture in the first foot of the field that had been manured and sub-soiled. The lines run very uniformly throughout and only begin to approach each other at the end of the experiment when the Indian corn was no doubt drawing a far larger supply of water from the soil than the Kafir corn.

Charts 5 and 6 represent work done in 1896 to determine the influence of barnyard manure and cultivation on soil moisture. The plats are as follows:

Plats 1, 3,4, cultivated shallow, weekly.

Plat 2, cultivated shallow, weekly.

Plat 6, no cultivation.

Plat 8, cultivated shallow, frequently.

The plats were all manured except number 2. The cultivation was done with an ordinary spring-tooth cultivator.

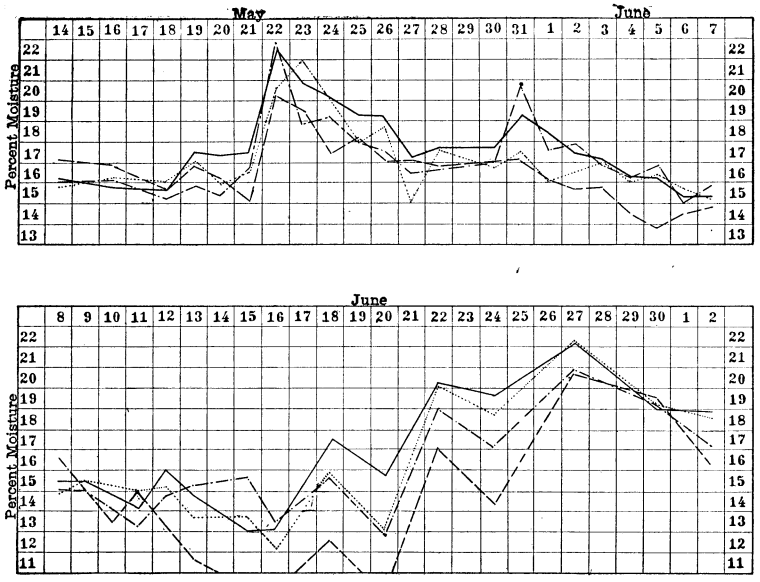
The charts show the details of the work. An average of all the samples taken gives the following per cents. of soil moisture:

Plats 1, 3, 4, average	17.0
Plat 2	16.4
Plat 6	15.7
Plat 8	16.3

Under like treatment the manured plats gave the highest per cent. of moisture, while the uncultivated plat though manured showed less moisture than the unmanured one.

There are many things that cultivation does, but the object of many who cultivate the soil is to kill the weeds. It is almost fortunate that weeds grow. They have taught some of the lessons of cultivation. We should cultivate to grow our crops, and if we do it properly there will be no weeds under ordinary circumstances. As soon as the surface soil becomes dry enough after a rain to cultivate it should be dried out to the depth of two or three inches by stirring. This serves two important purposes; it checks evaporation and kills the weeds as they are germinating. Cultivation causes the soil moisture to be more uniform in its supply to the plant. An uncultivated bare soil dries out rapidly and a crop will suffer much sooner when not cultivated.

CHARTS 5 and 6.—Influence of Cultivation and Manure on Soil Moisture.



Plats 1, 3, 5,—Cultivated shallow, weekly, manured. ———
Plat 2,— Cultivated shallow, weekly. - - - - - - - -
Plat 6,—No Cultivation, manured. — — — —
Plat 8,—Cultivated shallow, frequently, manured. — - — - —

CULTIVATION OF INDIAN CORN.—1897.

An experiment was conducted in 1896 to determine the effect of deep and shallow cultivation on the yield of Indian corn, There was a decided difference in favor of shallow cultivation. The yield of grain on three plats cultivated deep was 37 bushels; on five plats cultivated shallow, 44 bushels; on one plat not cultivated except that the weeds were scraped off with a hoe, 42 bushels per acre. The yield of stover on three plats cultivated deep was 2,835 pounds; on five plats cultivated shallow, 3,348 pounds; and on one plat not cultivated, 2,904 pounds per acre.

In 1897 experiments were conducted to determine the influence of cultivation on the yield and content of soil moisture. Owing to the character of the season the work was interfered with, no plat being cultivated more than four times. Only the yield of fodder, which includes the grain, is given:

Table I.—Soil Moisture and Crop Yield, Indian Corn.

Plat.	Method.	Times Cultivated	Soil Moisture, per ct.			Yield of Fodder
			Apr. 15 to May 14	May 14 to June 17	June 17	
97	Shallow, weekly	3	16.7	18.7	18.7	7050
98	Scraped with hoe	2	17.3	16.1	15.8	6650
99	Deep, weekly	3	16.4	18.5	19 5	5650
100	Shallow, weekly	3	17.3	18.3	16.4	7450
101	Shallow, twice a week	4	17.0	18.4	19.7	6850
102	Shallow, twice a week	4	16.5	18.3	18.4	6850
103	Deep twice, then shallow	3	17.3	19.0	19.3	6600
104	Shallow, weekly	3	16.5	18.6	18.9	6900
105	Shallow, weekly	3	16.8	18.0	17.6	6900
106	Deep, weekly	3	16.7	18.8	21.0	6200
107	Shallow, after rains only	4	16.3	18.2	19.2	5350
108	Shallow, when needed	2	16.3	17.9	19.2	7500

Plats 97, 101, 107, were cultivated with a spring-tooth cultivator, which runs shallow and stirs the first two or three inches of soil, though it can be run deeper. It is an excellent implement for killing weeds and leaving the the soil in good condition. Plats 100 and 102 were cultivated with the Tower cultivator. This implement stirs the soil to a uniform depth by means of flat shovels. Plat 105 was cultivated with a disc cultivator. Plat 106 was cultivated with a five shovel cultivator on which there was fastened a drag to smooth the soil after it. Plat 103 was cultivated the first two times with a double shovel and then with the Tower. Plats 99 and 106 were cultivated with the ordinary double shovel plow. Plat 107 was cultivated with the spring-tooth as soon as the soil would would permit

and plat 108 was cultivated enough to keep the weeds down.

Five samples of soil were taken from April 15 to May 14 and their average is given above showing the plats to be quite uniform in regard to moisture. This record of soil moisture was kept during the time and a few days after cultivation ceased and the average is given in the second column.

The average yield of two plats cultivated deep was 5,929 pounds of fodder; nine plats cultivated shallow, 6,825 pounds; and one plat not cultivated, 6,650 pounds of fodder per acre. The average per cent. of soil moisture in the surface foot of soil in the two plats cultivated deep was 16.7; nine plats cultivated shallow, 18.3; and one plat not cultivated, 16.1.

A comparison of the soil moisture with the yield shows that the plats having the most moisture in the surface foot of soil gave the smallest yield. This would seem to indicate that the deep cultivation injured the crop by destroying the roots, thus preventing the plants from availing themselves of the water supply.

CULTIVATION OF KAFIR CORN.—1897.

In 1897 an experiment in the cultivation of Kafir corn was conducted with practically the same results as those obtained in the cultivation of Indian corn, so far as the soil moisture was concerned. The experiment was a duplicate of that on the Indian corn. Two plats cultivated deep gave an average of 13.9 per cent. of soil moisture; nine plats cultivated shallow, 13.7; and one plat not cultivated, but the weeds kept scraped off with the hoe, 11.9 per cent. of soil moisture. In this case the plats cultivated deep gave the smallest yield. It would seem probable from these experiments that it is not so much a question of soil moisture as it is the preservation of the plant roots. The plat giving the highest average of soil moisture in both cases was cultivated weekly; the first two weeks with a deep working cultivator and then followed by a shallow working cultivator. The table gives the details of the work.

Table II.—Soil Moisture and Crop Yield, Kafir Corn.

Plat.	Method.	Times Cultivated	Soil Moisture per ct.			Yield per acre	
			May 24	May 24 to June 28	Lowest	Grain Bu.	Stover lbs
70	Shallow, weekly	9	15.0	13.3	6.9	35.8	6768
71	Scraped with hoe	2	15.0	11.9	4.6	32.9	6298
72	Deep, weekly	10	15.2	13.5	7.4	31.3	4508
73	Shallow, weekly	9	15.5	12.8	6.9	26.1	4778
74	Shallow, twice a week	15	15.9	13.1	7.6	30.4	5676
75	Shallow, twice a week	15	15.9	14.4	7.5	26.0	4766
76	Deep twice, then shallow	9	16.9	14.5	9.6	28.8	5226
77	Shallow, weekly	10	15.3	13.7	8.2	30.3	5242
78	Shallow, weekly	10	16.9	14.3	7.9	31.3	5288
79	Deep, weekly	10	16.0	14.0	8.2	26.2	4292
80	Shallow after rains only	6	15.4	14.1	8.4	27.5	4262
81	Shallow, when needed	3	15.7	13.7	8.2	32.5	4818

In this experiment the ordinary cultivators were used. For deep cultivation the double shovel was used. On plats 70, 74, 80 and 81 the spring-tooth was used, and plats 73 and 75 were cultivated with the Tower cultivator. Plats 77 and 78 were cultivated with a five-shovel cultivator. Plat 78 was leveled by a drag fastened to the cultivator. Plat 80 was cultivated as soon after rains as the soil would permit, and 81 was cultivated just often enough to keep the weeds down.

The first column under soil moisture gives the per cent. of moisture in the first foot of soil on the date that the cultivation began. The second column gives the average per cent. of moisture in the first foot during cultivation and the last gives the lowest per cent. found on the plats during cultivation.

CULTIVATION OF INDIAN AND KAFIR CORN.—1898.

The experiments of former years were continued with some modifications. The following plan was adopted: Twelve plats were planted to Indian corn and twelve to Kafir corn and cultivated in the same order.

Plat 1.—Cultivated weekly with a spring-tooth cultivator.

Plat 2.—Cultivated weekly with a level working cultivator.

Plat 3.—Cultivated weekly with a double shovel cultivator.

Plat 4.—No cultivation, weeds scraped off with a hoe.

Plat 5.—Cultivated weekly. Double shovel was used first two times after which the spring-tooth was used.

Plat 6.—Cultivated after rains only with the spring-tooth cultivator.

Plat 7.—Cultivated twice a week with a spring-tooth cultivator.

Plat 8.—Cultivated twice a week with a level working cultivator.

Plat 9.—Cultivated weekly with a double shovel cultivator.

Plat 10.—Cultivated only as needed with the spring-tooth.

Plat 11.—Cultivated weekly with a five-shovel cultivator with a leveler attached.

Plat 12.—Cultivated the same as plat 5.

The following table gives the moisture content of the plats planted to Indian and Kafir corn during the growth of the crop and the yield of both crops under similar cultivation:

Table III.—Soil Moisture and Crop Yield, Indian and Kafir Corn.

PLAT.	Times Cultivated		Av. Moisture per cent		Yield of Grain. Bu. per Acre.	
	Corn	Kafir	Corn	Kafir	Corn	Kafir
1	5	5	14.6	15.9	55.2	43.4
2	5	5	15.4	16.7	46.1	38.9
3	5	5	13 7	15.3	55.6	47.4
4	1	1	13.4	15.6	39.3	45.3
5	5	5	14.3	16.5	45.8	48.4
6	6	4	14.0	15.4	44.7	58.3
7	9	9	13.9	16.3	46.9	51.1
8	9	9	14.3	16.3	46.0	47.8
9	5	5	14.6	15.8	50.7	48.1
10	2	2	14 3	15.7	54.2	47.6
11	5	5	14.6	15.7	47.8	43.5
12	5	5	14.1	16.5	50.4	38.6

Plats 1, 2, 6, 7, 8, 10, 11, were cultivated with shallow working implements and gave an average yield of 48.7 bushels of Indian corn per acre, while plats of the same number gave an average yield of 47.2 bushels of Kafir corn per acre. Plats 3 and 9 were cultivated with deep working implements and gave an average yield of 53.1 bushels of Indian corn, while plats of the same number gave an average yield of 47.7 bushels of Kafir corn. The figures show the first decided difference in favor of deep cultivation for the past three years. The largest yields of cotton and castor beans were also found on plats having deep cultivation. It is probable that the character of the season had much to do in producing this result. The decided variations in in the yields of some of the Kafir plats can in part be accounted for from the fact that chinch bugs were very bad on all the plats but affected some more severely than others. Plats 2 and 12 are noticeable examples. Lack of cultivation is more detrimental to Indian corn than it is to Kafir corn.

Soil moisture was determined for the surface foot on all the plats of corn from April 23 until August 19, and the figures

giving the average moisture content are averages for 18 samples taken on each plat, the plats all being sampled on the same day.

Soil moisture was determined on Kafir plats from May 27 until August 31, during which time 20 samples were taken on each plat. Plat number 2, cultivated weekly with a level working cultivator, gave the highest per cent. of soil moisture with both crops. Frequent cultivation did not conserve soil moisture nor increase the crop over other plats cultivated with the same implement. A plat cultivated twice showed a higher moisture content and gave a larger yield when the crop was Indian corn. The results were slightly in favor of frequent cultivation of Kafir corn.

If the soil is put in good condition when the crop is planted one good harrowing at the time the Indian corn is well up and two or three cultivations at the proper time is sufficient to insure a good crop if other conditions are favorable. Kafir corn is more tender and slower in growth than is Indian corn. It cannot be harrowed after it is up without danger of killing many of the plants. For these reasons the soil should be put in better condition before planting. Cultivation should be frequent enough to keep the soil in good condition. Frequent cultivation does not materially change the crop yield or content of soil mosture.

DEPTH OF PLOWING AND SUB-SOILING.

The purpose of this experiment was to determine the best depth of plowing in the spring for corn and to study the influence of the different methods of plowing on soil moisture. Seven plats were plowed on April 1 and 2, 1898:

Plat 1.—4 inches deep.

Plat 2.—6 inches deep.

Plat 3.—8 inches deep.

Plat 4.—10 to 12 inches deep.

Plat 5.—8 inches deep and sub-soiled in each furrow to 15 inches deep.

Plat 6.—6 inches deep with a disc plow, sub-soiled 10 inches deep.

Plat 7.—6 inches deep with disc plow, sub-soiled 12 to 14 inches deep.

Plat 8.—8 inches deep. as plat 3, but one week later.

Samples for soil moisture were taken from March 1 to August 22. It was planned to sample the surface foot four times a week, the second foot twice a week and the third foot once a week.

This was carried out with few exceptions for the surface foot, but the second and third feet were not sampled during June and July. Soil moisture records were kept during March to note if any difference existed in the plats in regard to moisture. The plats were found to be as uniform as might be expected. The plats were all put in good condition and planted to Indian corn on April 11. The corn was up on April 22. A few days later the plats were rolled and harrowed. They were each cultivated on May 14, 27 and June 17. The crop was mature on August 22. After May 1 the season was an unusually wet one and the corn made a good yield. The effects of the different methods of plowing was not so marked on the soil moisture as one would expect in a dryer season. The difference of a week in the time of plowing plat 8 had a marked effect on the per cent. of soil moisture contained in the surface foot during April. The effect was not so marked during the remainder of the season, although plat 8 contained less moisture than any other plat during the whole period. The surface three feet contained on the average one-half per cent. less moisture during the period than plat 3. Chart number 7 shows the per cent. of soil moisture found in plats 3 and 8 during the month of April. These plats contain the same per cent. of moisture in the surface foot during March while during April plat 3 contained 2.2 per cent. more moisture than plat 8. Table number IV gives the average per cent. of soil moisture in the first three feet of soil of all the plats for each month and a summary for the whole period:

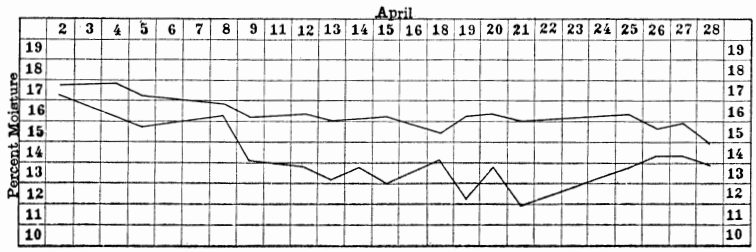
Table IV.— Average per cent. of Soil Moisture by Months, 1898.

MONTH.	Depth in Inches	PLAT NUMBER.							
		1	2	3	4	5	6	7	8
March	0-12.	17.3	17.5	17.6	18.0	17.6	18.0	17.7	17.6
March	12-24.	18.6	18.5	18.4	19.0	18.1	19.0	18.4	18.8
March	24-36.	15.0	16.6	15.7	17.6	18.0	17.9	17.7	16.8
April	0-12.	16.4	16.5	16.3	16.7	16.4	16.7	16.1	14.1
April	12-24.	18.5	17.9	17.6	18.8	18.9	18.2	19.1	17.9
April	24-36.	17.5	16.6	17.7	16.8	17.6	17.3	17.5	16.8
May	0-12.	19.7	20.2	20.3	20.5	19.9	20.2	19.6	20.2
May	12-24.	18.3	18.3	18.6	18.9	19.4	17.9	17.7	17.9
May	24-36	17.7	16.8	17.4	17.0	17.4	18.0	17.2	17.2
June	0-12.	16.0	15.8	16.6	16.7	17.2	16.4	16.0	16.2
July	0-12.	12.8	11.6	12.6	12.2	12.9	12.6	11.4	12.4
August	0-12.	16.6	17.3	16.4	16.2	17.9	15.4	15.3	15.9
August	12-24.	17 0	15.2	15.7	16.8	15.9	15.9	15.0	14.0
August	24-36.	20.1	15.7	15.2	15.3	16.9	16.7	16.2	14.2
Total Average for Period, March 1 to August 22.									
	0 12.	16.5	16.6	16.8	16.9	17.0	16.8	16.3	16.2
	12-24.	18.3	17.8	17.8	18.6	18.3	18.1	18.1	17.7
	24-36.	17.0	16.6	16.7	17.0	17.6	17.6	17.4	16.7
Average	0-36.	16.9	16 9	17.0	17.2	17.4	17.1	16.7	16.5

No implement is more useful in conserving soil moistnre than is the ordinary plow. The difference of a few weeks in the time of plowing has much more to do with the condition of the seed bed than the depth of plowing. Unplowed land will lose moisture much more rapidly than plowed land.

About the middle of June '98, a part of a plat of ground was plowed immediately after harvesting the wheat crop. So far as could be seen there was no difference in the plat at that time. One month later, July 15, the moisture was determined both in the plowed and the unplowed parts. The samples were taken within about ten feet of each other. The plowed part contained

CHART 7.—Influence of Late Plowing on Soil Moisture.— Upper line plowed April 3; lower line, plowed April 11



14.9 per cent. of moisture and the unplowed part 10.9 per cent. The plowed land had over one third more moisture in the surface foot than the unplowed land.

Much moisture is lost by the soil during the summer months, especially if the soil is not plowed. If a portion of this moisture can be retained in the soil the following crop will be materially benefited. Any observing farmer knows that stubble will plow better, as a rule, soon after harvest than later, and that early plowing will be easier to put in condition for sowing It is quite probable that the extra amount of soil moisture retained by early plowing causes the land to be in better condi-

Table V.—Per Cent. Moisture in Surface Foot of Plowed Land.

DATE.	Plowed July 28.		Plowed Sept. 1		Plowed July 28	
	Plat 1	Plat 2	Plat 4	Plat 5	Plat 7	Plat 8
July 28	17.3	15.5	15.3	15.9	15.1	14.9
August 30	17.7	17.4	15.1	12.5	16.9	16.0
September 9	17.6	17.9	11.0	11.1	17.4	6.8
September 13	16.3	16.5	13.1	13.1	16 9	15.9
September 16	17.1	16.6	9.6	9.6	15.1	16.8

tion. The following table will illustrate this point better than it can be told. The dates refer to the year 1898. The figures given under the plat numbers show the per cent. of soil moisture found.

Plats 1 and 8 were plowed four inches deep. Plats 2 and 7 were plowed eight inches deep as were also plats 4 and 5. In a more striking way the ill effects were shown in the field conditions. The plats plowed on September 1 were cloddy and hard to plow and put in condition for sowing to wheat. The seed did not germinate well and did not do well for some time after coming up. By the middle of September the plats plowed on the first of that month contained slightly more than one half as much moisture as those plowed one month earlier. It is much better farm practice to plow as soon after harvest as is convenient. It will usually require less labor to plow the land and put it in condition for sowing. Unplowed land will allow more rainwater to run off the surface than plowed land. Cloddy dry soil will allow much more moisture to be lost than will moist mellow soil. A few per cent. more moisture in the soil will cause wheat to germinate better and come up sooner.

INFLUENCE OF THE ROLLER ON SOIL MOISTURE.

Three plats were put in good condition for planting June 3.

Plat 11.—Received no further treatment.

Plat 13.—Was rolled.

Plat 16.—Was rolled and harrowed.

The plats were drilled in sorghum on June 3. Soil samples were taken to the depth of one foot from that date until August 11. On June 3, three samples were taken to the depth of one foot and gave the following per cent. of moisture to each plat:

PLAT NO.	June 3	June 3 to Aug. 11	Sec. Foot Aug. 11	Yield per Dry Fodder, lbs.
Plat 11	13.6	14.1	19.0	1950
Plat 13	12.9	13.8	17.5	1820
Plat 16	12.6	13.5	16.5	1420

It is evident from these figures that there was a difference in these plats at the beginning of the experiment. This difference continued throughout the experiment and is expressed almost exactly in the average for the period and in the per cent. of soil moisture found in the second foot on August 11. These

figures would seem to indicate that there was no influence on the soil moisture in the surface foot. If there was any influence it was on the second foot and the rolled plats lost moisture, at least they contained much less at the end of the experiment than the unrolled plat. This fact was shown in a more striking way in Bulletin 24 of this station.

MOISTURE CONTENT OF UPLAND AND BOTTOM LAND, JULY AND AUGUST, 1898.

The bottom land sampled was that of Stillwater creek, a considerable distance from the creek bed. The soil is that of typical bottom land, red in color, darker for about 12 inches than deeper on account of organic matter, becoming sandier in the second and third feet. The field from which the samples were taken was supposed to have been plowed about 6 inches deep. It had been in corn for several years The upland soil in comparison with this was typical upland dark prairie soil plowed about 6 inches deep. Both fields were planted to Indian corn The crop was at about the same stage of maturity during the experiment. The corn in both fields was fully developed and ready for cutting at the time the experiment closed, August 16. The table gives the per cent. of moisture found in both fields from July 11 to August 16:

Table VI.—Soil Moisture in the Surface Foot.

MONTH.	Bo tom	Upland	MONTH.	Bottom	Upland
July 11	13.4	9.0	August 1	18.0	16.8
July 12	11.7	7.7	August 2	20.3	22.0
July 13	14.2	8.2	August 3	20.3	19.5
July 14	13.8	9.3	August 5	16.4	18.6
July 15	12.1	8.3	August 6	16.0	16.4
July 16	14.4	7.2	August 8	16.7	19.6
July 18	14.5	7.9	August 9	16.7	21.5
July 21	18.9	18.6	August 10	16.3	17.9
July 22	17.8	19.7	August 11	15.9	18.5
July 23	17.4	20.6	August 12	16.0	16.7
July 25	15.9	16.1	August 13	15.4	16.4
July 26	16.2	16.6	August 16	14.2	13.1
July 27	14.9	14.6			
July 28	15.2	13.6			
July 30	14.4	10.8			
Average	15.0	12.6	Average	16 9	18 1
Average for July and August,				*15.8*	*15.5*

On August 11 the surface two feet were sampled and on August 16 the surface three feet were sampled with the following results:

	August 11		August 16	
	Bottom	Upland	Bottom	Upland
First foot	15.9	18.5	14.2	13.1
Second foot	17.4	17.1	17.0	16.6
Third foot	....	....	20.6	15.7
Average	16.7	17.8	17.3	15.1

It will be noticed that during July the upland contained 2.4 per cent. less moisture in the surface foot than the bottom land. From July 11 to 18 the soil mosture in the upland ranged from about 7 per cent. to a little more than 9 per cent., while the bottom land ranged from about 12 to nearly 14.5 per cent. During August the surface foot of upland soil contained 1.2 per cent. more moisture than the bottom land. In either case the soil moisture was abundant for crop growth except in the upland during the first half of July, but this was the only time that the moisture was low during the whole growing period.

That there is a marked difference in the water supply available in these soils is well shown in the amount of moisture contained in the surface three feet of soil on August 16 when the crop was maturing. There was a difference of 2.2 per cent. in favor of the bottom land and the third foot of the bottom land was almost saturated while the same depth of upland was but little more than half saturated. It is mainly on this account that the bottom lands can withstand a drouth better than the uplands. From August 11 to 16 the surface foot of upland lost three times as much moisture as the bottom land.

IRRIGATION, 1898.

The unusually wet season made the experiment in irrigation of no avail. One plat of Indian corn and two plats of sugar beets were irrigated as it was thought necessary. During April and May the irrigated plats showed more moisture, but during June, July and August the reverse was usually true. In every case the yield was slightly larger on the irrigated plats.

The five soils the analyses of which are given above are types of well known soils in the territory. They are distinct not only in their color and appearance, but in their relation to plant growth. In the analyses the grains of soil are measured millimeters. It takes about 25 millimeters to make one inch. The coarseness or fineness of a soil is determined by the size of determined by the size of the soil grains, while the size of these

grains and their relation to each other determines most of their properties in relation to water. A clay soil contains much of the finest materials while a sandy soil has much of the coarsest materials. The table shows that the black jack soil is the

Table VII. —Mechanical Analysis of Soils.

CONVENTIONAL NAMES.	Diameter of Grains in Millimeters	Creek Bottom	Blackjack	Upland, Light	Alkali	Upland, Red	Sand
Gravel	2-1	0.00	0.00	0.00	0.00	0.00	0.05
Coarse sand	1-0.5	0.08	0.00	0.05	0.02	0·00	0.20
Medium sand	0.5-0.25	0.59	0 02	0.11	0.07	0.00	4.11
Fine sand	0.25-0.1	9.81	40.11	18.77	10.47	8.57	71.00
Very fine sand	0.1-0.05	63.65	44.76	10.07	26.26	35.62	18.91
Silt	0.05-0.01	16.78	9.04	48.85	35.44	27.73	3.34
Fine silt	0.01-0.005	2.43	1.78	5.67	3.06	6.03	0.41
Clay	0.005-0.0001	3 44	2.96	9.97	19.92	16 91	0.00
Moisture in air dry sample		0.70	0.25	2.23	1.69	1 20	0.10
Organic Matter		3.19	1.52	4.58	3.99	5.29	3.70

coarsest and the upland soil containing a large amount of silt is the finest. The former soil allows the water to pass down through it, is almost always in a condition to work and allows the water to evaporate readily. It cannot hold so much water about its soil grains because of their size. As the grains become smaller they have more surface to the same amount of soil. Thus it is that upland light soil or a clay will hold more water than a sandy soil. But at the same time the clay soil will hold its mosture more tenaciously and prevent evaporation. Neither can the plant withdraw the water so thoroughly as in a coarser soil. In a laboratory way these analyses show the relation of the soils to water, but their natural position determines very largely their adaptability to crops. It is not so much because bottom land is a sandy loam that it will raise good corn as it is that there is in reach of the plant a supply of water which is not available to plants growing on uplands. If the uplands were as coarse as the bottoms they would be much the worse off. The uplands must have a water supply and this can be had more abundantly than the bottom lands only through their power to hold the water they receive. That they do this is clearly shown in the following experiment:

In this experiment the soils were put in to a tube of known dimensions and tapped till the soil would not settle any more and then weighed. The weight of this amount of soil (water free) when compared with the weight of the same bulk of water gives its apparent specific gravity. These tubes after being

Table VIII.—Relation of Soils to Water.

No.	DESCRIPTION.	Apparent Specific Gravity	Water Capacity	Evaporating Power	Holding Power
34	Clay soil	1.26	36.67	52.84	17.27
35	River bottom, Guthrie	1.58	22.53	68.14	7.09
36	River bottom, Cleo	1.68	14.42	70.10	5.20
37	Upland	1.25	34.02	60.23	13.85
38	River bottom, Edmond	1.54	22 83	67.24	7.70
39	Upland, Norman	1.35	30.18	57.80	12.73
40	Upland, Okla. Exp. Sta. Stillwater	1.36	30.20	59.46	12.24
41	Bottom, two miles east of Lamont	1.45	21.1	63.49	7.7
42	Medium corn land	1.18	40.1	61.5	15.40
43	Upland, three miles east of Fairview	1.27	33.3	62 82	12.40
44	Second bottom, Perkins	1.66	19.1	80.55	3.7
45	Sand, rather fine	1.71	15.9	91.14	1.5

weighed were set in water until the soil in them had taken up all the water it would, or until they came to approximately constant weight. From the last weight the amount of water absorbed, or the full water capacity of the soil is determined The tubes containing the soil full of water were then set in the open air and so arranged that nothing but the top of the tubes was exposed. Their weights were determined from time to time and from these their evaporating power was calculated.

CHART 8. *1897.* *Soil Moisture.* *1898.*

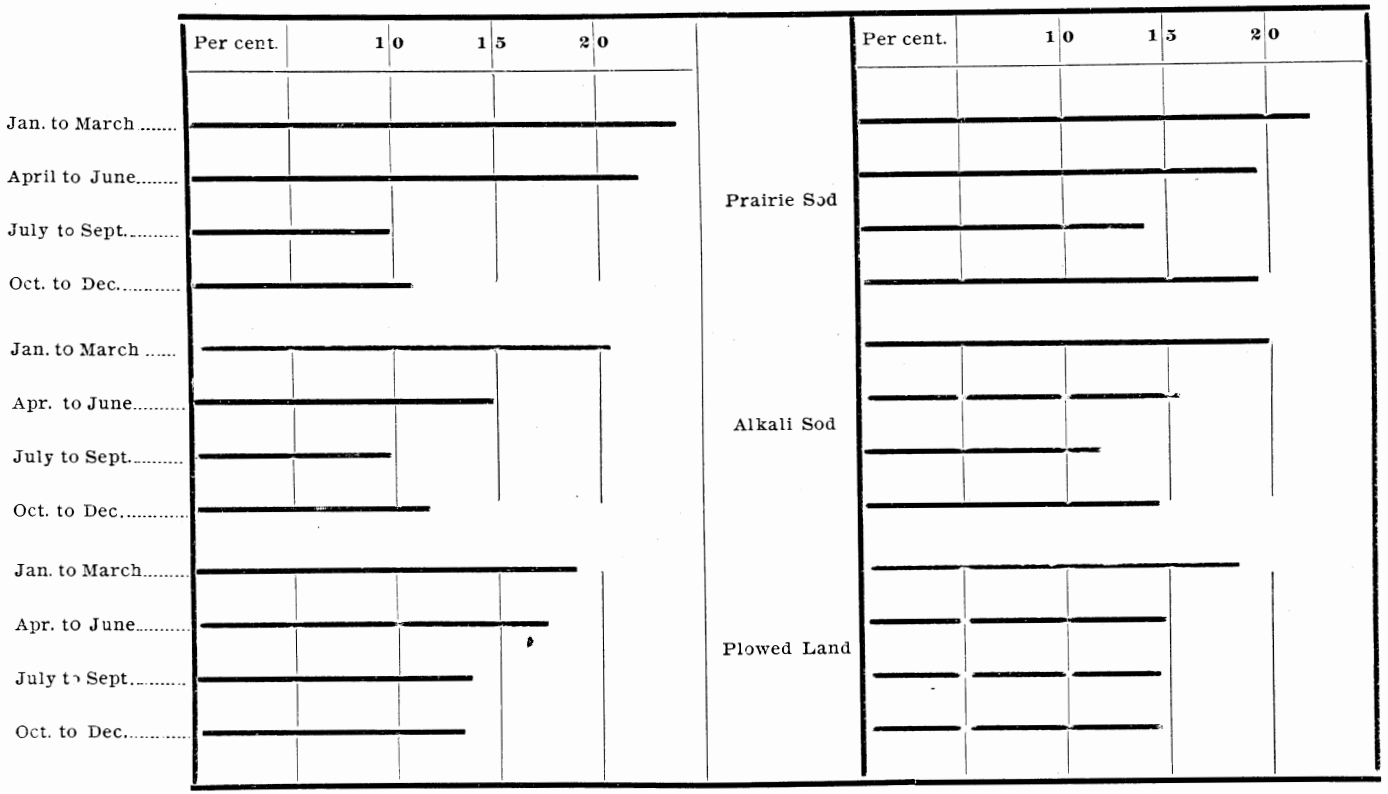


Chart 8 shows the average condition of the soil moisture for the years or 1897 and 1898. Soil moisture was taken on three plats. One was plowed land that was kept free from weeds but not cultivated. The plats of prairie and alkali land were not pastured and represented ordinary upland.

Table IX.—Monthly Averages of Soil Moisture in Per Cent., 1897.

MONTH.	Prairie Sod		Plowed Land	
	Ordin'ry 0-12 in	Alkali 0-12 in.	0-3 in.	3-12 in.
January	23.7	20.2	16.4	16.1
February	22.8	22.2	20.7	20 8
March	24.5	19.6	18.1	18.6
April	24.2	16.8	16.1	18 1
May	22.9	16.0	18.2	19.7
June	19.0	12.7	15.0	18.1
July	8.2	8.3	12.5	15.2
August	13.0	12.6	13.5	15.5
September	8.6	9.4	12.3	15.6
October	8.6	8.9	9.1	13.4
November	10.5	11.9	11.8	13.5
December	13.3	14.3	15.4	14.7
Monthly Average of Soil Moisture in Per Cent., 1898.				
January	18.7	17.5	14.6	17.6
February	22.9	21.3	20.8	21.8
March	23.0	21.6	17.8	18.7
April	21.7	17.4	13.0	15.9
May	21.5	16.2	15.5	18.8
June	14.7	13.5	12.1	15.1
July	13.2	11.5	11.9	16.4
August	16.7	12.9	13.4	17.8
September	12.6	12.5	11.2	15.4
October	13.4	10.7	10.4	15.0
November	21.0	16.6	11.9	15.6
December	22.6	16.8	16.7	18.7

HUMIDITY AND RAINFALL.

The following table gives the humidity of the air and the rainfall for each month of the year of 1898. By humidity is meant the amount of water in the air. The figures give the per cent. of water in the air and if the humidity is 50, the air is half full of water at the time of observation. On a damp foggy morning the hygrometer would show that the air was at the point of saturation and the reading would be 100. The readings change with the temperature and the amount of water in the air and there is a marked difference in the forenoon and afternoon readings. The table gives the average daily readings for both forenoon and afternoon and the general average for each month. The readings were taken about 7 a. m. and 2 p. m. each day:

Table X.—Humidity and Rainfall at Okla. Exp. Station, 1898.

MONTH.	Humidity.			Rainfall
	A. M.	P. M.	Av.	
January	79.5	55.1	67.3	3.53
February	73.6	41 5	57.5	3.00
March	73.7	56.2	64.9	2.75
April	68.4	48.6	58.5	0.58
May	78.1	64.9	71.5	8.56
June	86.3	65.1	75 7	4.72
July	81.0	58.0	69.5	6.35
August	84.3	58.2	76.2	2.86
September	82.1	54 6	68.3	2.72
October	75.4	49.2	62.3	4.19
November	69.4	48.3	58.8	0.68
December	77.9	59.0	68 4	2.68

Table XI.—Soil Temperature at Different Depths for 1898.

MONTH.	Soil Depth in Inches.							
	Air	Surface	2	4	6	12	24	36
January—								
Monthly mean	35.6	41.3	39.2	38.65	39.05	41.35	44.9	47.2
Highest	11th	11th	11th	11th	11th	12th	14th	21st
	71.0	74.0	61.0	51.0	50.0	48.0	47.5	49.0
Lowest	1st&2d	1st	2d	2d	2d	26&27th	4 days	3 days
	12.0	15.0	29.0	33.0	35.0	38.5	43.0	45.5
Range in Temperature—								
Monthly range	59.0	59.0	32.0	18.0	15.0	9.5	4.5	3.5
Mean daily	20.5	18.35	7.0	3.9	1.7	.4	.03	.03
Greatest daily	2d	2d	6th	5th	19th	1st&12th	8th	4 days
	44 0	42.0	17.0	13.0	5.5	1.5	1.5	.5
Least daily	14th	19th	26&27th	3 days	4 days	12 days	16 days	25 days
	5 0	1.0	.0	.0	.0	.0	.0	.0
February—								
Monthly mean	43.6	44 95	41.7	41.35	41.6	42.9	45.0	50.75
Highest	16th	16th	8th	9th	9th	9th	18th	18th
	73.0	70.0	55.0	51.0	50.0	48.0	47.5	48.0
Lowest	2&3rd	3rd	3rd	4th	3&4th	4th	5th	5, 6, 7th
	15.0	20.0	30.0	33.0	34.5	37.5	42.0	44.5
Range in Temperature—								
Monthly range	58.0	50.0	25.0	18.0	15.5	10.5	5.5	3.5
Mean daily	26.9	22.3	9.6	4.6	2.7	.5	.02	.02
Greatest daily	16th	27&28th	27th	12th	8th	8th	13 days	13 days
	38.0	37.0	20.0	10.0	5.5	2.5	.5	.5
Least daily	20th	9th	3 days	21st	4 days	11 days	15 days	15 days
	13.0	.0	.0	.0	.0	.0	.0	.0
March—								
Monthly mean	47.8	49.7	47.2	46.8	46.95	48.15	49.05	48.55
Highest	18&21st	16th	18&21st	18th	18&21st	21st	21st	23&24th
	75.0	79.0	66.0	61.0	58.0	55.0	53.0	52.0
Lowest	23rd	24th	3&15th	3rd	2&5th	6th	6th	6th
	21.0	30.0	33.0	36.0	40.0	44.0	45.5	47.0
Range in Temperature—								
Monthly range	54.0	49.0	33.0	25.0	18.0	11.0	7.5	5.0
Mean daily	24.7	18.9	9.13	4.9	3.0	.6	.04	.03
Greatest daily	22nd	15th	15th	6th	22nd	22nd	7 days	10 days
	51.0	44.0	23.0	10.0	7.5	2.5	.5	.5
Least daily	12th	12th	12&26th	18th	2nd	9 days	21 days	21 days
	7.0	3.0	.0	.0	.0	.0	.0	.0

Table IX.—Continued.

MONTH	SOIL DEPTH IN INCHES							
	Air	Surface	2	4	6	12	24	26
April—								
Monthly mean	59.5	62.5	58.65	56.55	55.9	55.7	54.3	53.2
Highest	16th	16th	25th	25th	17th	16&28th	29&30th	30th
	86.0	98.0	78.0	70.0	66.0	62.5	60.0	58.0
Lowest	6th	1st	6th	6th	6th	6th	1&2nd	2nd
	26.0	36.0	36.0	38.0	41.0	46.5	48.5	49.5
Range in Temperature—								
Monthly range	60.0	62.0	42.0	32.0	25.0	16.0	11.5	8.5
Mean daily	26.9	25.65	17.06	9.9	5.3	.86	.02	.02
Greates daily	26th	16th	9th	15th	6&9th	16th	10th	17th
	45.0	48.0	33.0	15.5	9.0	5.0	1.0	1.0
Least daily	30th	4th	4th	4th	16&12	14 days	14 days	22 days
	9.0	1.0	1.0	1.5	.0	.0	.0	.0
May—								
Monthly mean	77.37	72.5	69.49	67.45	67.0	66.0	63.1	60.95
Highest	28th	25th	29&30th	29th	31st	23rd	31st	30th
	90.0	99.5	94.0	84.5	85.0	77.5	70.5	66.5
Lowest	6th	6th	6th	6th	6th	6&7th	8th	7, 8, 9th
	41.0	47.0	47.0	50.0	52.0	57.0	58.0	58.0
Range in Temperature—								
Monthly range	49 0	52.5	47.0	34.5	33.0	20.5	12.5	8.5
Mean daily	20.1	17.14	12.9	8.7	6.5	.7	.02	.02
Greatest daily	30th	30th	30th	28th	31st	23rd	14 days	12 days
	32.0	32.0	27.0	26.0	12.0	10.0	.5	.5
Least daily	4th	19th	4&5th	5th	4&5th	13 days	17 days	19 days
	3.0	.5	.0	.0	.0	.0	.0	.0
June—								
Monthly mean	77 1	82.3	80.4	78.3	77.3	75.9	73.25	69.3
Highest	25th	1st	18&25th	3 days	25&26th	26th	24&28th	28th
	95.0	100.0	95.0	88.5	85.0	80.0	75.0	72.0
Lowest	2nd	12th	13th	13th	10th	10th	4th	1st
	61.0	67.5	68.0	68.5	70.0	72.5	70.5	66.5
Range in Temperature—								
Monthly range	34.0	32.5	27.0	20.0	15.0	8.5	4.5	5.5
Mean daily	19.6	19.5	15.3	6.7	6.4	.5	.02	.02
Greatest daily	2nd	2nd	1st	1st	24th	24th	13 days	14 days
	29.0	29.0	23.0	15.5	13.5	4.5	.5	5.
Least daily	15th	7th	13th	13th	15th	13 days	18 days	17 days
	13.0	3.0	2.0	3.0	3.0	.0	.0	.0
July—								
Monthly mean	78.0	86.4	83.6	80.6	79.7	78.3	75.5	73.0
Highest	28th	19th	19th	19th	19th	26&30th	25&30th	28&31st
	97 0	111.5	101.0	92.0	86.0	81.0	77.0	74.5
Lowest	12th	14th	12th	12th	12th	15&16th	12th	5 days
	54.0	61.0	68.0	70.0	73.0	75.5	74.0	72.0
Range in Temperature—								
Monthly range	43.0	50.5	33.0	22.0	13.0	3.0	8.5	2.5
Mean daily	21.2	25.3	14.9	8.5	4.6	3.2	.5	.2
Greatest daily	12th	17th	12th	9th	12th	31st	12th	10 days
	31.0	39.5	26.0	16.0	7.0	3.0	1.5	.5
Least daily	20th	3rd	30th	31st	31st	16th	16 days	21 days
	10.0	.0	2.0	.0	2.0	.0	.0	.0
August—								
Monthly mean	76.5	82.5	81.5	79.5	78.5	77.8	75.5	73.7
Highest	19&23rd	30th	19th	23rd	21&23rd	23&24th	5 days	25&31st
	96.0	113.5	100.5	94.0	89.0	82.0	78.0	75.0
Lowest	12th	12th	16th	2&12th	2nd	3rd	14th	3 days
	58.0	63.0	66.0	70.0	70.0	73.5	73.0	72.5
Range in Temperature—								
Monthly range	38.0	50.5	34.5	24.0	19.0	8.5	5.0	2.5
Mean daily	22.8	25.8	15.4	10.4	.5	.3	.03	.02
Greatest daily	30th	30th	27th	31st	21st	7th	3 days	10 days
	35.0	46.5	26.0	21.5	11.0	2.0	1.0	.5
Least daily	3rd	1st	1st	1st	7th	17 days	13 days	21 days
	12.0	4.0	3.5	2.5	.5	.0	.0	.0
September—								
Monthly mean	72.0	77.5	76.1	73.5	80.6	74.4	73.6	72 4
Highest	16&26th	4th	5th	3rd	3rd	4&5th	4&5th	1&6th
	97.0	107.0	96.0	88.5	85.5	81.5	78.0	75.0
Lowest	3 days	8th	9th	7&8th	7th	12th	13th	15th
	46.0	50.0	50.0	65.0	65.0	68.5	70.5	70.5

Table IX.—Continued.

MONTH	Soil Depth in Inches							
	Air	Surface	3	4	6	12	24	26
Range in Temperature—								
Monthly range	51.0	57.0	46.0	23.5	20.5	13.0	7.5	4.5
Mean daily	25.0	25.0	16.1	9.1	4.9	.6	.03	.01
Greatest daily	14th	9th	25th	16th	13th	25th	1st	6 days
	35.0	43.0	29.5	15.0	8.5	3.5	2.0	.5
Least daily	11th	18th	10&18th	10th	10&11th	12 days	17 days	24 days
	8.0	.0	.0	.5	.0	.0	.0	.0
October—								
Monthly mean	57.4	63.8	62.3	60.7	61.1	64.5	65.8	66.9
Highest	3rd	3rd	2nd	4th	4th	4th	4th	3, 4, 5th
	99.0	107.0	98.0	85.0	80.5	76.0	73.5	72.0
Lowest	26th	22&26th	22nd	22nd	26th	28th	27th	31st
	26.0	32.0	39.0	43.5	46.0	52.5	56.5	59.5
Range in Temperature—								
Monthly range	73.0	75.0	59.0	41.5	36.5	23.5	17.0	12.5
Mean daily	26.7	27.6	15.6	8.2	3.7	1.4	.5	.3
Greatest daily	28th	28th	28th	5th	4th	17th	27th	20th
	42.0	47.0	29.0	17.0	6.5	2.0	1.5	1.0
Lowest daily	17th	19th	19th	24th	17&25th	9 days	11 days	14 days
	14.0	2.0	2.0	.5	.5	.0	.0	.0
November—								
Monthly mean	44.7	50.2	49.1	48.3	48.7	50.8	54.5	56.6
Highest	19th	19th	4th	4&5th	7th	5th	4&5th	4&8th
	83.0	87.0	72.0	63.5	68.0	59.5	59.5	60.0
Lowest	22nd	15th	15th	24th	23rd	28th	28&29th	28th
	14.0	22.0	32.5	36.0	37.5	43.0	48.5	52.0
Range in Temperature—								
Monthly range	66.0	65.0	39.5	27.5	30.5	16.5	11.0	8.0
Mean daily	23.7	26.8	13.7	7.1	2.9	.9	1.1	.02
Greatest daily	19th	19th	19th	20th	21st	1, 8, 22d	1&13th	13&19th
	51 0	50.0	28.0	15.0	6.5	2.0	1.5	1.0
Least daily	8th	9&27th	23rd	8&21st	10&21st	11 days	13 days	21 days
	10.0	4.0	.0	.0	.0	.0	.0	.0
December—								
Monthly mean	40.8	43 1	37.4	37.7	38.6	41.1	45.2	48.2
Highest	27&28th	11th	2nd	2nd	2nd	2&3rd	1&3rd	1st
	65.0	66.0	54.0	49.0	46.0	46.5	49.5	52.0
Lowest	10th	10th	14th	14th	14&16th	14&16th	15&17th	17th
	8.0	12.0	27.0	31.5	33.5	37.0	42.5	46.0
Range in Temperature—								
Monthly range	57.0	54.0	27.0	17.5	12.5	9.5	7.0	6.6
Mean daily	20.4	19.4	7.2	3.0	1.2	.2	.06	.14
Greatest daily	30th	27th	2nd	22nd	27th	5 days	4 days	9 days
	38.0	35.0	17.5	13.5	5.0	1.0	.5	.5
Least daily	19th	11th	11&19th	4 days	8 days	22 days	27 days	22 days
	8.0	1.0	.0	.0	.0	.0	.0	.0