

T H E S I S

A DETERMINATION OF THE VARIATION OF SOIL MOISTURE
IN THREE PLOTS OF SOIL DURING ONE MONTH'S GROWING PERIOD

by

Orville M. Kiser
Herman A. Praeger

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A DETERMINATION OF THE VARIATION OF SOIL MOISTURE IN THREE PLOTS OF SOIL DURING ONE MONTH'S GROWING PERIOD.

In choosing this work for our thesis we have intended to show the variation of soil moisture to a depth of four feet in three different plots; wheat, corn, and alfalfa, respectively, during the spring season from April 22 to May 21, '08. The wheat and alfalfa made a good growth during this time while the corn was planted toward the end of the month and was coming up at the close of the experiment. On account of the impossibility of having the soil of uniform texture throughout, the variation of each plot from day to day was not as it should have been, and, besides the chances of errors creeping in, caused some of the results to appear erroneous, yet as a whole the data shows a fair result of the test.

In order to have been more accurate several composite samples should have been taken on each plot, each day, and the average taken as the result. As our time was limited we took only one composite sample of four holes each on the plots from day to day and tabulated the results. The samples were taken in the four corners of a square whose dimensions was from four to six feet. By practical demonstrations by the various experimental stations this seems to be the method conducive of the best results.

A brief description of the soils in these plots may not be out of order: The class of soils in these three plots is the same as silt loam, but there are two different series of soils, that on the wheat plot being the Oswego silt loam and

that of the corn and alfalfa the Marshall silt loam. While the texture of the first two feet of each was fairly similar, there was a marked difference in the third and fourth feet, especially the fourth foot of the Oswego silt loam. The Oswego silt loam seems to have been derived from the weathering of the underlying cherty limestone. This is accounted for from the fact that in the third and fourth feet are found small, irregular lime concretions or unweathered limestone. The texture of the subsoil is that of a heavy clay while it is that of a silty clay. It was very compact, and hard, during the earlier part of the experiment when the fourth foot contained only an average of sixteen per cent of water; it was a difficult matter to drive the tube, but when the soil became moister from succeeding rains it was quite tenacious. In color the subsoil is of a grayish brown, that of the surface soil varying in color from a dark brown under ordinary moisture conditions to black when wet.

Below is shown the mechanical analysis of the Oswego silt loam:

	Fine gravel	Coarse gravel	Medium sand	Fine Sand	Very fine sand	Silt	Clay
Soil	0.0	0.6	0.3	1.5	6.9	71.8	17.8
Subsoil	0.0	0.4	0.5	4.4	3.2	61.3	30.4

The soil of the Marshall silt loam consists of from 10 to fourteen inches of a brown to a dark brown silt loam. The subsoil is of a reddish brown silt loam. The second foot is more of a heavy clay and often in taking the samples, especial-

ly on the corn plot the soil stuck in the tube, indicating a more plastic nature at this depth than at any other depth taken.

Both the soil and the subsoil contain a considerable quantity of sand. The Marshall silt loam is undoubtedly an alluvial formation, the result of the deposition of a material from water which was dammed by the southern extension of the glacial waters of this country.

The corn plot is situated on a slope and from its very position there is large surface runoff with more or less surface washing, though withal this the soil readily absorbs a large amount of the rainfall. The alfalfa plot showed less total moisture throughout the experiment. This may be accounted for from the fact that the deep penetration of the alfalfa roots permitted the water to percolate to a greater depth than in the corn plot. Again, alfalfa requires a larger amount of water for its proper growth, and development.

Below is shown the mechanical analysis of Marshall silt loam:

	Fine gravel	Coarse gravel	Medium sand	Fine sand	Very fine sand	Silt	Clay
Soil	0.0	0.6	0.4	3.7	13.6	61.3	19.9
Subsoil	0.0	0.5	0.4	4.7	16.1	57.5	20.4

The mechanical analysis of the two above soils was taken from the United States Soil Survey of Riley County.

In carrying on this work we used the King soil tube for taking the samples. However, immediately after heavy rains the soil tube was found to clog so the soil auger was used instead.

This is a slower and less accurate method, however. The samples were taken compositely, one foot at a time and placed in soil trays which had been previously weighed. These trays were made of sheet iron with close fitting lids so as to prevent as much evaporation as possible. As soon as the composite samples were taken the trays were put inside of carrying chests, where further evaporation was prevented.

Upon returning from the field the trays were weighed on a torsion balance, after which they were opened and placed in a drying oven. This part of the apparatus was heated with gas up to 110 degrees C. for ten hours or until all traces of water had been driven off. The trays were then weighed while hot and the operation performed as quickly as possible to prevent the taking up of hygroscopic moisture from the air by the soil. From this point the remainder of the work consisted in figuring the results from the data. To do this the following method was used: -- The weight of the tray was subtracted from the gross weight of the dry soil. This gave the weight of the dry soil. The gross weight of the dry soil was then subtracted from the gross weight of the wet soil; the remainder being the weight of the water. Then, by dividing the weight of the dry soil into the weight of the water, the percentage of water in the soil figured on a dry basis was the result.

To determine the number of inches of water in each foot of soil the following method was used:-- It has been determined by sampling that the weight of a cubic foot of soil from the four feet on the plots used were respectively; 1st foot 78 pounds,

2nd foot 84.8 pounds, 3d foot 93.2 pounds, and the fourth foot 97.9 pounds. One inch of water covering one square foot of surface water weighs, approximately, 5.2 pounds, hence by multiplying the percentage of water in the soil by the weight of the soil and dividing the quotient by 5.2, the number of inches of water in the soil will be approximated.

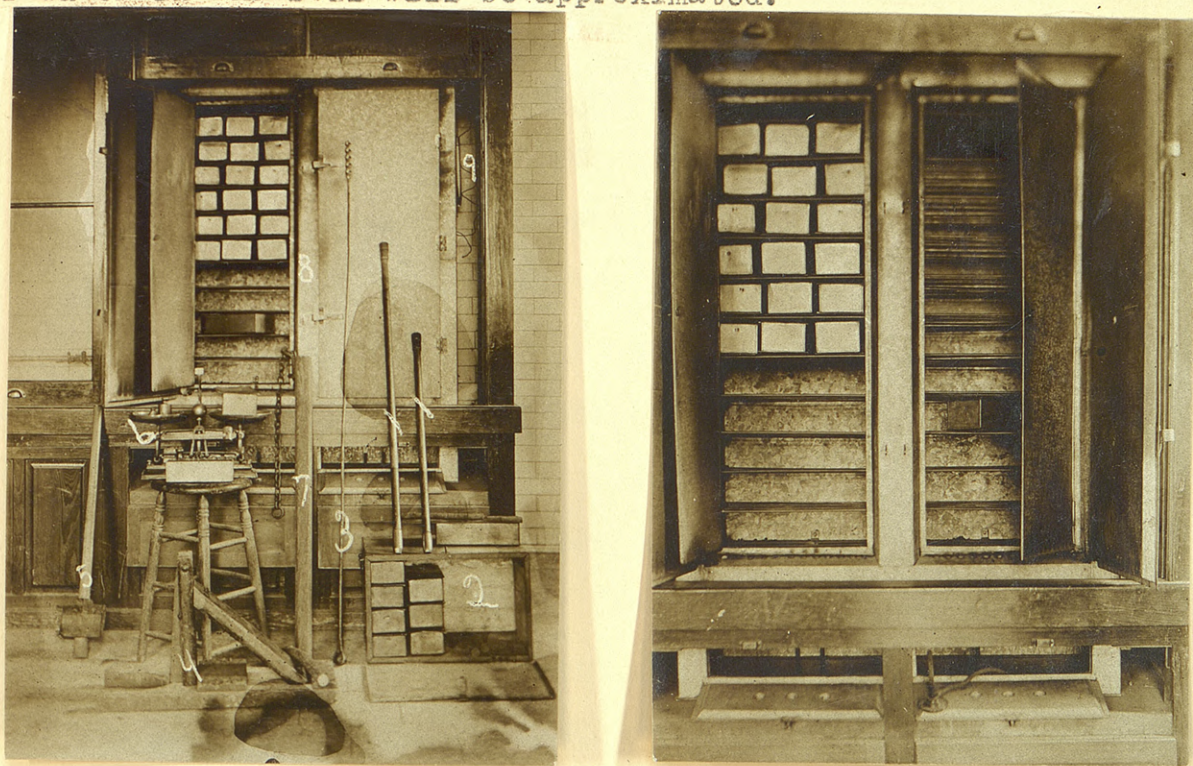


Figure I shows the entire apparatus used in taking the samples and in determining the percentage of moisture.

1. King's Soil Tube
2. Chest for carrying soil trays.
3. Soil auger
- 4-7 Jack and lever used in pulling tubes from the soil; also auger.
5. Mall used in driving the soil tubes.
6. Torsion balance and weights.
8. Oven in which trays were dried.
9. Centigrade thermometer.

Figure II is a nearer view of the drying oven, showing the double doors, the Bunsen burners beneath; also racks on which the trays were placed while drying.

In examining the data it is seen that after each rain the total inches of water in the soil was noted to have increased far beyond the number of inches of rainfall. Professor King, in this "Physics of Agriculture" shows that the addition of two pounds or 0.38 inches of water per square foot after 26 hours, there had been an increase of 3.5 pounds or 0.67 inches in the first foot while in the second and third and fourth feet, there had been a decrease in the water content. The same phenomena was noticed during the experiment that after each rain there was an increase in total moisture far exceeding the amount of rain that had fallen. This increase was not only in the first foot of soil but also in the remaining feet also. This increase may be accounted for from the fact that wetting the surface acts as an attraction to the water below, causing it to move upward in order that the equilibrium of the surface tension around each soil particle would again be established.

In arranging the data we have let the lowest tray number stand for the first foot, the next higher the second foot, and so on to the fourth foot on each plot. This data is as follows:

April 22.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat

35	755 5	711 3	469 3	242	44 2	18 26	2 73
83	850 5	786 5	473 8	312 7	64	20 43	3 33
92	932 2	866 8	503 3	363 5	65 4	17 99	3 22
172	899 3	842 3	496 9	345 4	57	16 5	3 12
					Av.	18.24	12.40

Total.....

Corn.

71	977 5	877 8	518	359 8	99 7	27 7	4 15
80	1198 3	1060 1	474 3	385 8	138 2	23 59	3 84
108	1388 2	1236 6	491 1	745 5	151 6	20 33	3 64
115	1303 5	1174 2	483 2	691 5	129 3	18 71	3 9

Total.....

Av. 22.58 15 53

Alfalfa.

8	1190 2	1098 5	484 5	614	91 7	14 93	2 24
47	1189 7	1103 8	492 8	611	85 9	14 05	2 29
64	1217 5	1133 1	490 5	642 6	84 4	13 13	2 35
91	1218	1135	508 2	628 8	83	13 24	2 49

Total.....

13.83 9.37

April 23, 1908.

Tray No.	Gross wet Wt.	Gross dry Wt.	Wt. of trays	Wt of dry soil	Weight of water	Per cent water	Inches of Water.

1							
1	1104.1	1026.9	492.8	534.1	77.2	12.25	2.12
8	1273.8	1151	484.5	666.5	122.8	18.40	2.98
78	1342.7	1217.2	496.2	821	125.5	15.16	2.71
124	1309.6	1197.2	500.8	696.4	112.4	<u>16.12</u>	<u>3.03</u>
					Average	<u>16.04</u>	<u>10.86</u>
Total.....							

Corn

56	1001.9	895.8	494.3	401.5	106.1	26.42	4.06
118	1231.8	1090.7	497	593.7	141.1	23.9	3.70
132	1330	1214.4	495.2	719.2	115.6	16.05	2.87
150	1106.3	1028.2	496.9	531.3	78.1	14.71	2.75
Total.....					Av.	<u>17.77</u>	<u>13.38</u>

Alfalfa

67	1035.9	960	480.2	499.8	75.9	15.38	2.30
103	1119.5	1039.7	469.8	569.9	79.8	14.00	2.27
162	1206.8	1123.1	472.7	650.4	83.7	12.86	2.30
195	1233.4	1144.9	490.7	654.2	88.5	13.68	2.57
Total.....					Av.	<u>13.48</u>	<u>9.44</u>

April 24.

Tray No.	Gross wet weight	Gross dry weight	Weight of trays	Weight of dry soil	Weight of water	Per cent of water	Inches of water.
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Wheat.

8	1091.2	1019.5	484.5	535.	71.7	13.4	2.01
47	1186 3	1076 2	492 8	583 4	110 1	18 87	3 07
64	1315 9	1195 2	490 5	704 7	120 7	17 12	3 06
71	1344	1232 1	518	714 1	111 9	15 67	2 95
Total.....						16.24	11.09

Corn

35	792.2	730.1	469.3	260.8	62 1	23 81	3 57
91	123666	1098 2	508 2	590	138 4	23 45	3 82
92	1334 6	1214 7	503 3	711 4	119 9	15 85	3 02
108	1183	1094	491 1	602 9	89	14 76	2 73
Total.....						19.71	13.14

Alfalfa

80	958.4	819.7	474.3	417 4	66 7	15.98	2.39
83	1186 4	1098	472 8	624 2	88 4	14 16	2 30
115	1157 2	1080 7	483 2	597 5	76 5	12 8	2 29
172	1204 5	1118 3	496 9	621 4	86 3	13 87	2 61
Total.....						14.18	9.59

April 25.

Tray No.	Gross wet weight	Gross dry weight	Weight of trays	Weight of dry soil	Weight of water	Per cent water	Inches water.
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Wheat

25	1097 5	1016 7	486	530 7	80 8	14 84	2 22
49	1172 7	1055	474 6	580 4	117 7	20 27	3 30
127	1316 7	1192 9	513	679 9	123 8	18 35	3 28
154	1298 9						
		1182 7	497	685 7	116 2	16 94	3 16
Total.....					Av.	17.60	11.96

12	1019 5	913 5	492 1	421 4	106 0	25 15	3 77
86	1211 3	1066 1	489 5	576 6	145 2	25 16	4 29
131	1278 7	1176 2	495	681 2	102 5	15 63	2 80
174	1280 4	1188 1	509	679 1	92 1	13 56	2 55
Total.....						19.87	13.41

55	1115 1	1037	476 8	560 2	78 1	13 76	2 06
69	1197 2	1108	500 9	607 1	89 2	14 69	2 39
84	1233 4	1145 7	528 2	617 5	87 1	14 20	2 56
136	1272 2	1174 9	490 2	683 7	97 3	14 34	2 69
Total.....						14.27	9.70

April 27. 1914.

Tray No.	Gross wet weight	Gross dry weight	Weight of tray	Weight of dry soil	Weight of water	Per cent of water	Inches of water.
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Wheat.

35	1069 5	999 7	469 3	530 4	69 8	13 14	1.97
118	1108	1011 5	497	514 5	86 5	16 81	2 74
124	1335	1211 3	500 8	710 5	123 7	17 21	3 12
162	1248 5	1140 8	472 7	668 1	107 7	16 12	3 03
Total.....					Av.	15.87	10.86

Corn

565	789 9	732 7	494 3	238 4	51 2	23 99	3 56
78	1125 3	996 3	496 2	500 1	129	20 57	3 34
132	1343 8	1224 9	495 2	729 7	118 9	16 43	2 94
195	1224 5	1130 6	490 7	639 9	93 9	14 67	2 75
Total.....					Av.	18.91	12.59

Alfalfa

3	965 5	909 4	502 2	407 2	56 1	13 77	2 06
67	1183	1091 8	480 2	611 6	91 2	14 91	2 43
103	1131 9	1049 8	469 8	580	82 1	14 10	2 54
150	1221 7	1135 2	496 9	638 3	85 5	13 55	2 55
Total.....					Av.	14.08	9.58

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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April 28.

Wheat.

8	1073	1006	7	484	5	521	2	66	3	12	72	1	90	
64	1196	1	1086	490	5	595	5	110	1	18	48	3	01	
108	1289	1	1176	491	1	648	9	113	1	16	51	2	95	
172	1326	3	1208	7	496	9	711	8	117	6	16	52	3	10

Total.....

 16 05 10.96

Corn.

47	910	6	828	3	492	8	335	5	82	3	24	53	3	67	
71	1100	9	984		518		466		116	9	25	08	4	08	
													2	15	
83	1289	3	1180	7	473	8	706	9	108	6	13	56		2	50
115	1243	5	1154	3	483	2	671	1	89	2	13	29			

Total.....

Av.

 19.56

13.00

Alfalfa

1	1109	3	1043		492	8	550	2	66	3	12	05	1	80
80	1184	3	1097	2	474	3	602	9	87	1	13	98	2	28
91	1195	3	1112	7	508	2	604	5	82	6	13	66	2	44
92	1214	5	1130	4	503	3	627	1	84	1	13	41	2	48

Total.....

Av.

 13.27 9.00

April 29.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
11	802 4	765 9	484 7	Wheat. 281 2	34 5	12 26	1 82
95	834 5	785 5	492 1	293 4	49	16 70	2 72
141	929 5	865 7	500 2	365 5	63 8	17 45	3 12
160	880	827 3	488 7	338 6	52 7	15 56	2 92
Total.....					Av.	15 49	10.58
74	812 2	779 6	506	Wheat (Duplicate) 275 6	32 6	11 91	1 78
128	843 9	787 6	483 5	304 1	56 3	18 51	3 01
152	878 4	818 7	468 6	350 1	59 7	17 05	3 03
170	871	820 2	497 5	322 7	50 8	15 71	2 95
Total.....					Av.	15 54	10.77
76	842 3	771 6	477 8	Corn. 2 93 8	70 7	24 06	3 41
99	1163 9	1033 2	498	535 2	130 7	24 42	3 98
133	1274 4	1162 5	455 8	706 7	119 9	15 83	2 83
155	1261 7	1170 8	504 5	660 3	90 9	13 64	2 56
Total.....					Av.	19 48	12 78
30	1096 5	1027 7	480 2	Alfalfa. 547 5	68 8	12 56	1 88
33	1176 8	1091 5	497 2	594 3	85 3	14 36	2 34
102	1193 2	1109 1	497 7	611 4	84 1	13 73	2 46
163	1167 6	1086 9	485 3	601 6	80 7	13 41	2 48
Total.....					Av.	13.51	9.16

April 30.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
Wheat.							
14	805 2	729 6	502 5	267 1	35 6	13 32	1 99
38	839 7	784 5	493	291 5	55 2	18 93	3 08
129	880	823 1	489	334 1	56 9	17 03	3 05
165	876 6	822 4	483	339 4	54 1	16 26	3 04
Total					Av.	16.38	11.16
Wheat (Duplicate)							
31	780 7	746 4	478 3	268 1	34 3	12 75	1 91
121	770 8	726 7	489 4	237 3	44 1	18 58	3 02
140	932 6	869 2	490 7	378 5	63 5	16 75	2 99
175	888 3	833 8	503 2	330 6	54 5	16 28	3 10
Total					Av.	16.10	11.02
Corn.							
19	1132 7	1006 4	496 2	510 2	126 3	24 15	3 71
23	1219	1077 7	487 5	590 2	141 3	23 94	3 90
54	1350 8	1228 5	504 3	724 2	122 3	16 88	3 02
167	1235 7	1143 1	512 2	630 9	92 6	14 66	2 76
Total					Av.	20.05	13.39
Alfalfa.							
85	1024 6	968 3	476	592 3	56 3	11 19	1 67
88	1250 7	1155 2	497 6	657 6	95 5	14 52	2 36
139	1213 5	1125 4	493 1	632 3	88 1	13 83	2 49
164	1169 4	1087 5	488 6	598 9	81 9	13 69	2 50
Total.					Av.	13 33	9.02

May 1.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
Wheat							
25	820 7	782 6	485 1 494 3	297 5	38 1	12 80	1 72
26	771	726 1	5203	231 8	44 9	19 37	3 13
84	960	897 2	496 9	366 9	62 8	17 93	3 21
150	876 1	822 4		335 5	43 7	13 02	2 35
Total.....					Av.	15.78	10.41
Wheat (Duplicate.)							
35	774 2	738 2	469 3 496 2	268 9	36	13 39	2.00
78	854 4	798 8	511 2	362 6	55 6	18 36	2 99
127	878	823 2	508 6	311 5	44 8	14 38	2 67
174	891 2	836 5		327 9	54 7	16 68	3 14
Total.....					Av.	15.10	10.80
Corn.							
3	877 2	808 1	502 2	305 9	69 1	22 58	3 39
12	900	817 2	492 5	324 7	82 8	25 50	4 21
67	1133 5	1036 5	480 2	556 3	97	17 25	3 09
138	1028 7	957 1	489 8	467 3	71 6	15 32	2 88
Total.....					Av.	20.16	13 47
Alfalfa.							
49	1021 7	969 7	474 3	485 4	52	10 71	1 60
55	1127	1045 5	472 8	572 7	81 5	12 23	2 32
118	1214 5	1129 5	497	632 5	85	13 23	2 79
141	812 6	776 5	500 2	276 3	38 1	12 14	2 66
Total.....					Av.	13 12	9.37.

May 2.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

8	784 6	751	484 5	266 5	33 6	12 60	1 88
74	871 9	815 3	506	309 3	56 6	18 62	3 05
91	930 3	869 7	508 2	361 5	60 6	16 76	3 00
132	884 4	830 9	495 2	335 7	53 5	15 96	3 00
Total.....					Av.	15.98	10.93

Wheat (Duplicate)

47	923	785 4	492 8	292 6	37 6	12 85	1 93
83	763 8	717 4	473 8	243 6	46 4	19 04	3 10
124	924 5	862 7	500 8	361 9	61 8	16 79	3 00
154	961 5	811 2	498 4	312 8	50 3	16 08	3 02
Total.....					Av.	16 19	11.05

Corn.

30	1124 3	997 5	480 12	517 3	126 8	24 51	3 67
86	816 1	748 2	489 5	258 7	67 9	26 25	4 28
162	1092 7	997 5	472 7	524 8	95 2	18 14	3 24
195	987 5	926 1	490 7	435 4	61 4	14 33	2 69
Total.....					Av.	20.80	13 88

Alfalfa.

69	947 9	900.5	500 2	400 3	47 4	11 84	1 77
92	990 3	931 7	503 3	428 4	58 6	13 93	2 28
95	1129 3	1055 7	492 1	563 6	63 6	11 28	2 02
131	1047 1	981 9	495 7	486 2	65 2	13 41	2 52
Total.....					Av.	12 61	8.59

May 4.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

71	838 3	772 5	518	254 5	65 8	25 85	3 87
102	812 2	747 3	497 7	249 6	64 9	26 00	4 24
133	883 2	813 4	455 8	357 6	69 8	19 51	3 52
163	862 4	807 7	485 3	322 4	54 7	16 96	3 19
Total.....					Av.	22.08	14 82

Wheat (Duplicate)

76	779.8	717 9	477 8	240 1	61 9	25 78	3 86
103	839	767 1	469 8	297 3	71 9	24 18	3 94
155	929 8	852 2	504 5	347 7	77 6	22 32	3 98
172	774 3	734	496 9	237 1	40 3	16 99	3 19
Total.....					Av.	22.31	14 97

Corn.

64	974 2	854 9	490 5	364 4	119 3	32 71	5 00
99	919 5	872	498	374	107 5	28 74	4 68
152	908 7	822 2	468 6	353 6	86 5	24 46	4 38
170	1008 4	934 2	497 5	436 7	74 2	16 99	3 19
Total.....					Av.	25 72	17.25

Alfalfa.

33	922 7	832 1	497 2	334 9	90 6	27 05	4 05
80	878 2	926 3	474 3	352	51 9	14 77	2 40
115	814 7	775 9	483 2	292 7	38 8	13 25	2 37
160	847 7	799 8	488 7	311 1	48 9	15 75	2 96
Total.					Av.	17.70	11.78

May 5, 1908.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
Wheat.							
41	1131 7	977 8	484	493 8	153 9	30 96	4 60
77	1273 7	1101 5	498	603 5	172 2	28 54	4 80
90	1232	1096	497	605	136	22 46	4 02
178	1260	1133 5	458 9	684 6	126 5	18 47	3 47
Total.....					Av.	25.10	16 89
Corn.							
1	1005 5	881	492 8	388 2	124 5	32 07	4 77
52	1215 2	1061 6	505 7	555 9	144 6	26 01	4 24
108	1225 2	1088 6	491 1	597 5	136 6	23 86	4 27
149	1257 9	1135 5	486 4	649 1	122 4	18 85	3 54
Total.....					Av.	25.16	16.82
Alfalfa.							
6	748 8	688 4	467 4	221	60.2	27.23	4 08
11	875 2	812	484 7	327 3	63.2	19 31	3 14
21	1042 2	972 8	506 2	466 6	69 4	14 87	2 66
44	1017 5	950 1	495	455 1	67 4	14 59	2 74
Total.					Av.	19.00	12.62.

May 6.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

3	840 2	755 7	502 2	253 5	84 5	33 33	5 01
55	809 3	736 2	472 8	263 4	73 1	27 70	4 51
127	955 5	869 5	511 7	357 8	86	24 03	4 30
138	923 2	857 8	489 8	368	65 4	17 77	3 34
Total.....					Av.	25 70	17.16

Corn.

49	774 8	700 1	474 3	225 8	74 7	33 08	4 96
56	738 4	682 8	492 3	188 5	55 6	29 49	4 80
67	930 2	846 7	480 2	366 5	83 5	22 78	4 08
78	721 7	684 8	496 2	188 6	36 9	19 56	3 67
Total.....					Av.	26.22	17.51

Alfalfa.

12	872 6	784 7	492 5	292 2	87 9	30.08	4 51
35	784 8	739 8	469 3	270 5	45	16 63	2 71
84	869 4	828 2	520 2	308	40 8	13 24	2 37
118	859 5	816 6	497 0	319 6	42 9	13 42	2 52
Total.....					Av.	18 36	12.11

May 7.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

132	1220 5	1055	495 2	559 8	165 5	29 56	4 43
152	1206 7	1045 4	468 6	576 8	161 3	27 96	4 55
162	1300 4	1148 5	472 7	675 8	151 9	22 47	4 02
174	1239 7	1131	508 6	622 4	108 7	17 46	3 28
Total.					Av.	24 36	16 28

Corn.

71	813 5	744 2	518	226 2	69 3	30 90	4 63
103	755 2	694 2	469 8	224 4	61	27 18	4 43
141	940 8	876 7	500 2	376 5	64 1	17 02	3 05
172	855 7	814 5	496 9	317 6	41 2	12 97	2 44
Total.....					Av.	24 01	14.55

Alfalfa

25	985	892 8	485 1	307 7	92 2	29 96	4 49
115	1065 5	961 2	483 2	478 5	104 3	21 82	3 55
150	1225 5	1137 4	496 9	640 5	88 1	13 75	2 46
189	1143 2	1066 2	491	575 2	77	13 38	2 52
Total.					Av.	19 72	13.02

May 8.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

14	1133 5	984 1	502 5	481 6	149 4	31 02	4 64
38	1195 4	1040 5	493	547 5	154 9	28 43	4 82
54	1314 2	1161 4	504 3	657 1	152 8	23 26	4 16
160	1243 3	1138 7	488 7	650	104 6	16 09	2 83

Total.....

Av.

24.70

16.45

Corn.

102	777 5	715 5	497 7	217 8	62	28 97	4 17
163	711 9	665 3	485 3	180	45 6	25 33	4 13
154	941 6	865 9	488 6	377 3	75 7	20 09	3 60
170	702 7	677 1	497 5	179 6	25 6	14 25	3 75

Total.....

Av.

22.16

14.65

901 5

Alfalfa.

140	1016 4	1127 7	490 7	4410 8	114 9	27 96	4 19
155	1265 1	1134 9	504 5	623 2	137 4	20 44	3 32
165	1222	1104 2	483	651 9	87 1	13 34	2 39
167	1185 7		512 2	592	81 5	13 75	2 59

Total.

Av.

18.87

12.49

May 9.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

8	1170 6	1016 3	484 5	531 8	154 3	29 01	4 33
74	1337 5	1165	506	659	172 5	26 17	4 24
76	1299 5	1157 4	477 8	679 6	142 1	20 90	3 74
86	1226 6	1123 2	498 5	633 7	103 4	16 31	3 07
Total.....					Av.	23.09	15.38

Corn.

30	743 7	685	480 2	204 8	58 7	28 66	4 29
95	881 5	797	492 1	304 9	85 5	27 71	4 51
124	901	830 2	500 8	329 4	70 8	21 19	3 79
154	885 1	810	498 4	311 6	48 1	15 43	2 90
Total.....					Av.	23 24	15.49

Alfalfa.

69	904 7	818 4	500 2	318 2	86 3	27 12	4 06
83	1040 2	846 8	473 8	470	93 4	19 85	3 17
91	1206 2	1125 3	508 2	617 1	80 9	13 10	2 34
133	1160 7	1078 3	455 8	622 5	82 4	13 23	2 49
Total.....					Av.	18.42	12.06

May 11.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

152	803 5	722	468 6	253 4	81 5	32 16	4 84
155	917 5	828	504 5	323 5	89 5	28 90	4 90
160	902 8	834	488 7	345 3	68 8	19 92	3 57
167	866 9	813 5	512 2	301 3	53 4	17 72	3 33
Total.....					Av.	24 67	16 64

Corn.

35	656 3	612 3	469 3	143	44 1	30 76	4 61
56	765 4	706 3	494 3	212	59 1	27 87	4 50
127	695 5	660	511 7	148 3	35 5	23 93	4 28
150	854 1	800	496 9	303 6	53 6	17 65	3 32
Total.....					Av.	25 05	16 71

Alfalfa.

25	837 2	756 5	485 1	271 4	80 7	29 73	4 45
140	818 5	763 2	490 7	272 5	55 3	20 29	3 30
165	836 2	793 5	483	330 5	42 7	12 29	3 30
172	848 2	806 2	496 9	309 3	42 0	13 57	2 55
Total.....					Av.	19 15	12 63

May 12.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

78	1211	103 75	496 2	541 6	173 2	31 97	4 95
84	13314	1167	520 3	646 7	164 4	25 42	4 14
162	1252 4	1141	472 7	668 3	111 5	16 68	2 98
138	1333 3	1199 8	489 8	710	113 5	18 8	3 57
Total.					Av.	23 21	15 64

Corn.

52	903 5	812 2	505 7	306 5	91 3	29 78	4 46
55	801 7	732 5	472 8	259 7	69 2	26 69	4 35
67	805	744 5	480 2	264 3	60 5	22 88	4 27
174	817 9	772	508 6	263 4	45 9	17 42	3 28
Total.					Av.	24 44	16 36

Alfalfa.

3	1152 9	1011 2	502 2	509	141 7	27 83	4 17
12	1212 5	1102	492 5	609 5	110 5	18 16	2 94
118	1132 7	1058	497	561	74 7	13 31	2 38
189	1184	1099 5	491	608 5	85 5	13 90	2 61
Total.					Av.	18.30	12.10

May 13.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

103	832 2	748 4	469 8	278 6	83 8	30 08	4 51
141	833	760 2	500 2	260	72 8	28	4 56
149	952 1	875 9	486 4	269 5	76 2	20 64	3 69
178	797 9	750 6	458 9	291 7	47 3	16 21	3 03
Total.....					Av.	23 73	15.79

Corn.

11	776	711 2	484 7	226 5	64 8	28 61	4 29
44	875 8	795 4	495	300 4	80 4	26 76	4 19
77	925 2	846 9	498	348 9	78 3	22 2	3 96
164	878 3	822 8	488 6	334 2	55 5	16 6	3 1
Total.....					Av.	23 27	15 54

Alfalfa.

38	813 3	743 2	493	250 2	70 1	27 61	4 14
49	786 8	735	474 3	260 7	51 8	19 48	3 17
115	844 9	799 7	483 2	316 5	45 2	14 21	2 54
163	837 3	795 6	485 3	310 3	41 7	13 43	2 52
Total.					Av.	18 93	12.37

May 14.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

92	875 1	793	503 3	289 7	82 1	28 34	4 25
102	766 3	713 7	497 7	216	41 6	24 36	3 98
131	993 7	913 3	495 7	418	80	19 13	3 42
170	718 7	687 9	497 5	190 4	30 9	16 13	3 03
Total.....					Av.	21 99	14 68

Corn.

54	841 3	765	504 3	260 6	76 3	29 27	4 00
80	854 8	776	474 3	301 6	78 8	26 12	4 25
99	953 5	871 4	498	373 4	82 1	21 71	3 87
132	945 7	868 9	495 2	373 7	76 8	20 55	3 89
Total.....					Av.	24 41	16.01

Alfalfa.

1	776 8	715	492 8	222 2	61 8	27 81	4 17
21	743 5	703 4	506 2	197 2	40 1	20 33	3 31
90	875 1	828 9	497	331 9	46 2	13 91	2 52
108	832 5	795 2	491 1	304 1	37 2	12 26	2 30
Total.....					Av.	20.82	12.30

May 15.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

55	1044 5	925 9	472 8	453 1	118 6	26 17	3 92
152	923 5	827	468 6	358 4	96 5	26 78	4 36
157	1204	1069 2	500 3	568 9	134 8	23 69	4 24
167	1319 5	1199 8	572 2	627 6	119 7	19 07	3 59
Total.....				Av.	Av.	23 92	16.01

Corn.

22	766	709 4	503 7	205 7	56 5	27 51	4 12
95	820 5	750	492 1	257 9	70 5	27 33	4 41
118	926	847	497	350	79	22 57	4 06
124	868 4	813 5	500 8	312 7	54 9	17 55	3 30
Total.....					Av.	23 74	15.93

Alfalfa.

25	629 2	598 9	485 1	113 8	29 3	25 74	3 86
53	668 9	637 4	499 9	137 5	31 5	22 90	3 73
78	851 8	810 5	496 2	313 3	41 3	13 21	2 36
140	868 2	822 4	490 7	332	45 5	13 70	2 57
Total.....					Av.	18 88	12.52

May 16.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

1	848 7	784 5	492 8	291 7	64 2	22	3 1
80	799 3	732 4	474 3	258 1	66 9	25 92	4 22
102	982 7	899 9	497 7	402 2	82 8	20 58	3 68
108	877	819 9	491 1	327 6	56 3	17 48	3 48
Total.....					Av.	21 48	14.48

Corn.

54	775 2	718	504 3	219 7	57 2	26 76	4 01
99	877 5	795	498	297	82 5	27 77	4 52
131	969 2	883 4	495 7	387 7	85 8	22 13	3 98
170	884 8	819 9	497 5	322 4	64 9	20 13	3 78
Total.....					Av.	24.18	16.29

Alfalfa.

21	841 4	766 2	506 2	270	65 2	24 14	3 62
90	761 3	719 7	497	222 7	41 6	18 67	3 02
92	864 7	818 7	503 3	315 4	56	14 58	2 61
132	868	821 8	495 2	336 3	46 2	13 76	2 59
Total.....					Av.	17.78	11.77

May 18.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

11	812 5	732 5	484 7	247 8	80	32 28	4 84
49	869 7	785 7	474 3	311 4	84	26 97	4 39
141	920 3	852 5	500 2	352 3	67 8	19 24	3 44
149	924 7	861 7	486 4	375 3	63	<u>16 75</u>	<u>3 56</u>
Total.....					Av.	23 81	16.17

Corn.

37	727 2	668 5	477 8	190 7	58 7	30 78	4 61
38	919 7	826 4	493	333 4	93 3	27 98	4 54
48	922 7	826 4	498 8	356 6	76 3	21 39	3 83
145	760 2	718	498	220	42 2	<u>19 18</u>	<u>3 61</u>
Total.....					Av.	24 81	16.59

Alfalfa.

40	783 3	714 7	481 5	233 2	68 6	29 41	4 41
42	702 2	659 2	488 9	170 3	43	25 24	4 11
97	714	684 4	495	189 4	29 6	15 61	2 79
199	868 7	818 7	470	348 7	50	<u>14 33</u>	<u>2 77</u>
Total.....					Av.	21.17	14.08

May 19.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
Wheat.							
77	863 5	770 2	498	272 2	93 3	34 27	5 14
115	859	775 7	483 2	292 5	73 3	25 06	4 08
164	948 7	871 4	488 6	362 8	77 3	21 33	3 82
178	811 9	762 2	458 9	303 3	49 7	16 38	3 08
Total.....					Av.	24.26	16.12
Corn.							
44	840 9	764	495	269	76 9	28 55	4 28
63	950	856	493 4	352 6	94	26 64	4 34
70	881 5	808 4	486	322 4	73 1	22 67	4 02
163	865	796 8	485 3	311 5	68 2	21 89	4 12
Total.....					Av.	24 93	16.76
Alfalfa.							
15	744 7	685 5	469 5	216	79 2	36 66	5 69
103	774 7	718 7	469 8	248 9	56	22 49	3 67
123	849 9	803 9	494 7	309 2	46	14 87	2 66
180	886 8	837 1	486 3	350 8	49 7	14 16	2 66
					Av.	22 54	14.68

May 20.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

50	944 2	851	480 3	370 7	93 2	25 14	3 76
95	1080 5	979 2	492 1	487 1	101 3	20 80	3 39
187	1211 5	1127 5	490 1	637 4	84	13 18	2 36
196	1150 8	1072 7	493 5	578 2	78 1	13 50	2 54
Total.....					Av.	18.15	12.05

Corn.

45	1173	1024 5	498 5	526	148 5	26 32	3 94
79	1337	1168 2	522 1	646 1	168 8	26 12	4 25
96	1300 5	1163 7	498 8	664	136 8	20 57	3 68
113	1349 8	1220 4	486 5	733 9	129 4	17 63	3 31
Total.					Av.	22 66	15 18

3 47

Alfalfa.

24	1170 8	1038 7	473 5	565 2	132 1	23 19	3 47
117	1217 3	1093 9	499 3	594 6	123 4	20 74	3 38
125	1291	1159 7	505	654 7	131 3	20.05	3 59
137	1259	1147 7	467 5	680 2	112 3	16 50	3 10
Total.					Av.	20 12	13.54

May 21.

Tray No.	Gross wet weight.	Gross dry weight.	Weight of tray.	Weight of dry soil.	Weight of water.	Per cent of water.	Inches of water.
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Wheat.

3	854 8	776	502 2	273 8	78 8	28 77	4 31
5	898 3	805 5	489 8	315 7	92 8	29 37	4 79
171	885 9	812 9	470 1	342 8	73	21 29	3 83
174	896 2	843 4	508 6	334 8	52 8	15 77	2 96
Total.....					Av.	23.80	15.89

Corn.

13	723 9	675 5	511 7	163 8	48 4	29 48	4 42
59	899 2	814 4	494 1	320 3	84 8	26 16	4 25
84	968 5	889 5	520 3	369 2	79	21 39	3 83
166	854 2	787 9	489 5	298 4	66 3	22 21	4 18
Total.....					Av.	24 81	16.69

Alfalfa.

27	807 5	740 9	491 8	219 1	66 6	26 73	3 99
36	887 7	811 5	479 8	331 7	76 2	22 97	3 74
67	802	761 5	480 2	281 3	40 5	14 39	2 55
144	829 7	787	504 8	282 3	42 7	15 13	2 84
Total.....					Av.	19.80	13.12.

A condensed table showing the average percentages of water in the four feet of soil; also the number of inches of water in the same soil plots.

Date.	Av. % H ₂ O wheat.	Total H ₂ O in inches	Av. % H ₂ O Corn.	Total H ₂ O in in.	Av. % H ₂ O alfalfa.	Total H ₂ O inches. ²	P. *
4-22	18.24	12.40	22.58	15.53	13.83	9.37	.13
23	16.04	10.86	17.77	13.38	13.48	9.44	
24	16.24	11.09	19.71	13.14	14.18	9.59	1.05
25	17.60	11.96	19.87	13.41	14.27	9.70	
26			SUNDAY				
27	15.87	10.86	18.91	12.59	14.08	9.58	
28	16.05	10.96	19.56	13.00	13.27	9.00	
29	15.51	10.67	19.48	12.78	13.51	9.16	
30	16.24	11.08	20.05	13.39	13.33	9.02	
5-1	15.44	10.60	20.16	13.47	13.12	9.37	
2	16.08	10.89	20.80	13.88	12.61	9.59	
3			SUNDAY				
4	22.19	14.89	25.72	17.25	17.70	11.78	2.91
5	25.10	16.89	25.16	16.82	19.00	12.62	.13
6	25.70	17.16	26.22	17.51	18.36	12.11	.56
7	24.36	16.28	24.01	17.55	19.72	13.02	
8	24.70	16.45	22.16	14.65	18.87	12.49	
9	23.09	15.38	23.24	15.49	18.42	12.06	
10			SUNDAY				
11	24.67	16.64	25.05	16.71	19.15	12.60	.61
12	23.21	15.64	24.44	16.36	18.30	12.10	.64
13	23.73	15.79	23.27	15.54	18.93	12.37	.12
14	21.99	14.68	24.41	16.01	20.82	12.30	
15	23.92	16.01	23.74	15.93	18.88	12.52	
16	21.48	14.48	24.18	16.29	17.78	11.77	
17			SUNDAY				
18	23.81	16.17	24.81	16.59	21.17	14.08	2.05
19	24.26	16.12	24.93	16.76	22.54	14.68	
20	18.15	12.05	22.66	15.18	20.12	13.54	
21	23.80	15.89	24.81	16.69	19.80	13.12	.35
22							
Total-----							8.62

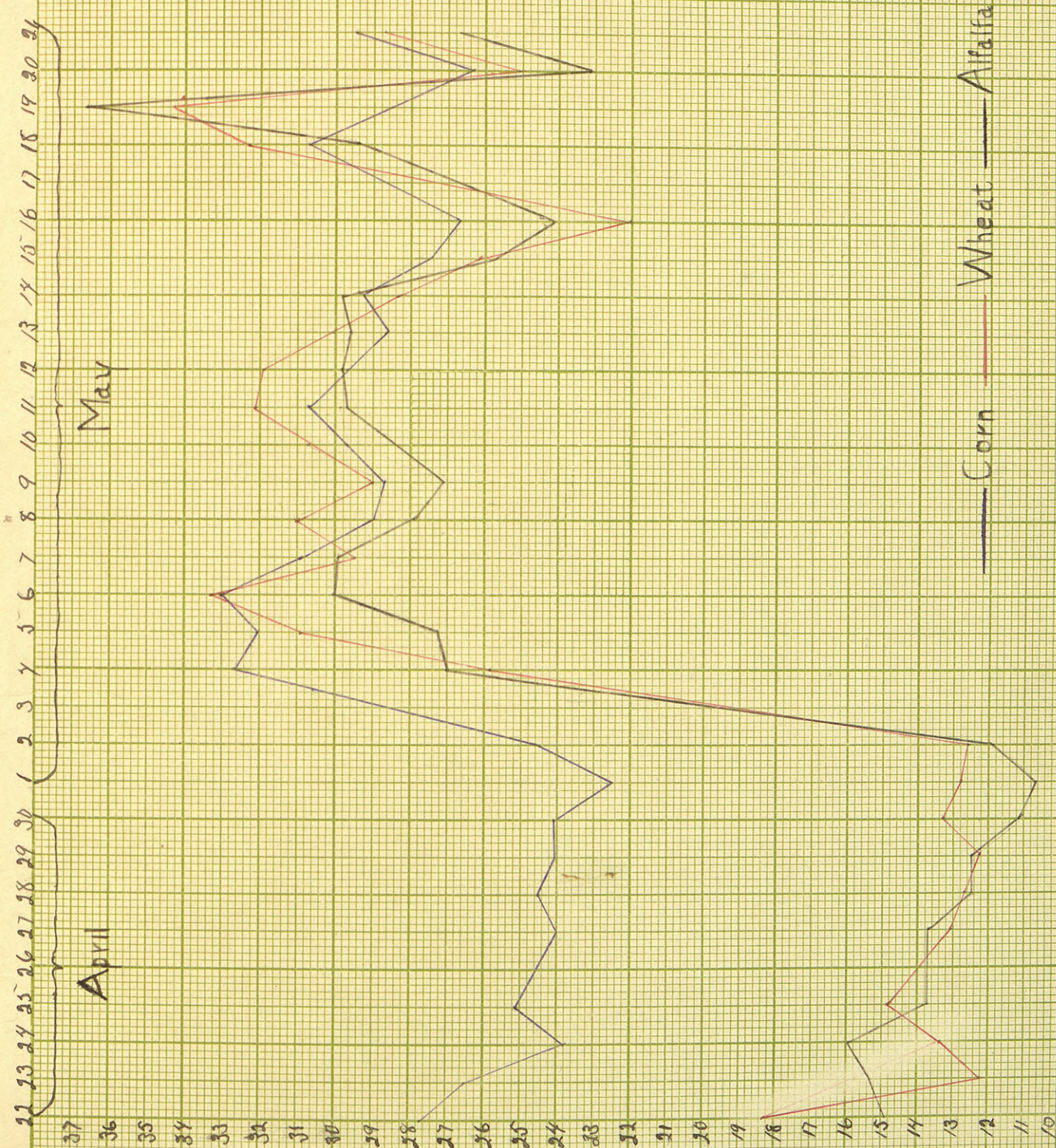
* P = Amount of precipitation.

Weather Report
April 22 to May 22, '08.

Date	Temperature		Rainfall, inches.	Weather	
	Max.	Min.		7 A. M.	7 P. M.
4/22	81	55	.13	Partly cloudy	Partly cloudy
23	83	68	T	Cloudy	Cloudy
24	75	53	1.05	Partly cloudy	Partly cloudy
25	73	43		" "	" "
26	59	43	T	Cloudy	Cloudy
27	53	34	T	Partly cloudy	Partly cloudy
28	51	32		" "	" "
29	53	36		Clear	Clear
30	62	27		Clear	Clear
5/1	73	37		"	"
2	62	35		Cloudy	Cloudy
3	53	47	T	Cloudy	Cloudy
4	70	45	2.91	"	"
5	52	46	.13	"	"
6	70	44	.56	"	"
7	58	38		"	"
8	64	33		Clear	Clear
9	70	37		"	"
10	80	44	.61	"	"
11	74	56	.64	Cloudy	Clear
12	83	67		Partly cloudy	Partly cloudy
13	75	56	.12	" "	" "
14	75	66	.07	Clear	Clear
15	85	48		"	"
16	86	63		Partly clear	"
17	75	61	2.05	Cloudy	Cloudy
18	78	53		Clear	Clear
19	87	56		"	Partly clear
20	88	52		"	Partly cloudy
21	80	48	.35	Cloudy	Clear
22	78	44		Clear	Cloudy

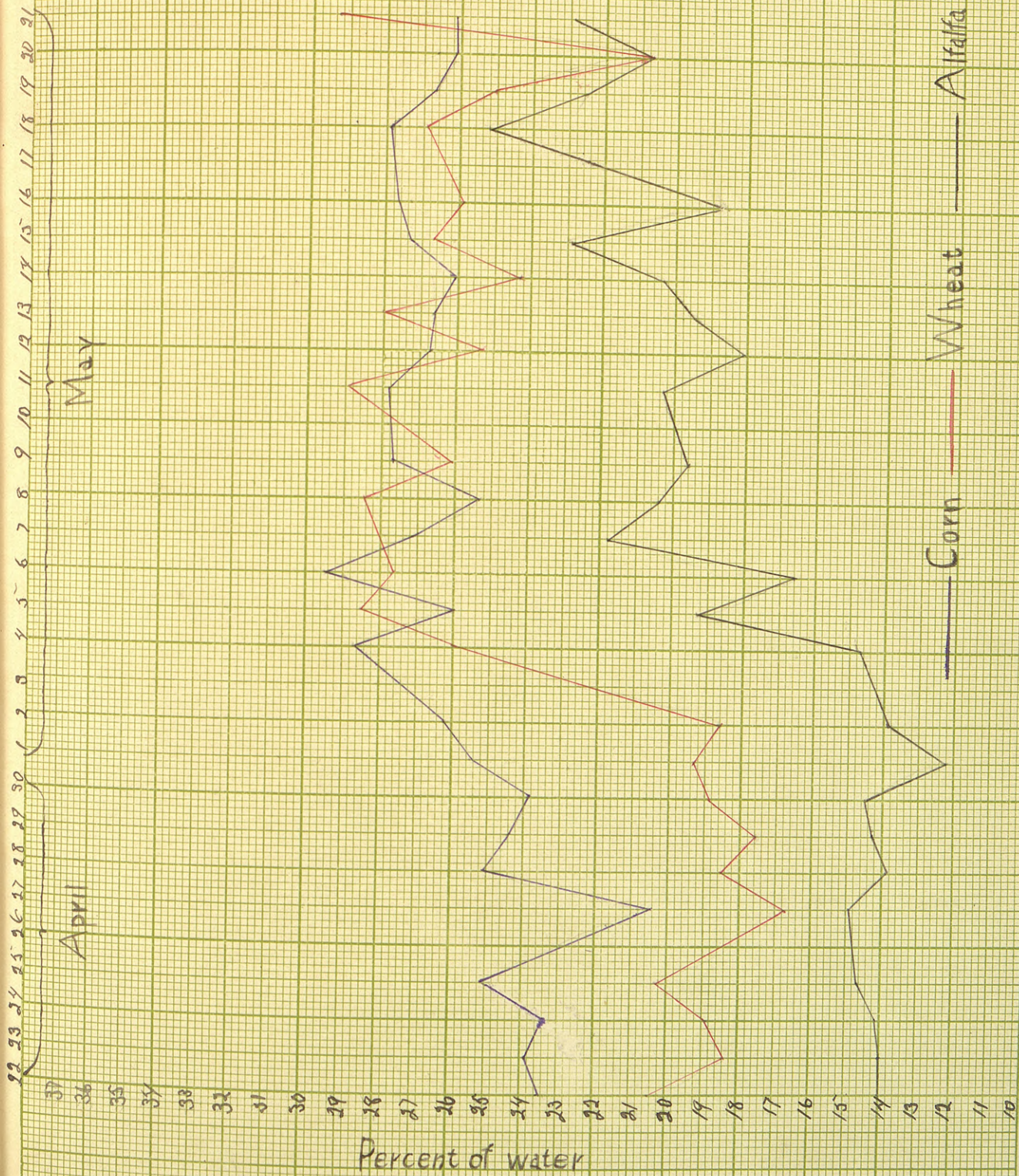
Following is plotted on coordinate paper the percentages of moisture for each foot of the different plots. On the fifth sheet is drawn the line of total inches. These lines are plotted so that one can read at a glance, the moisture condition of the soil for any one day.

First Foot

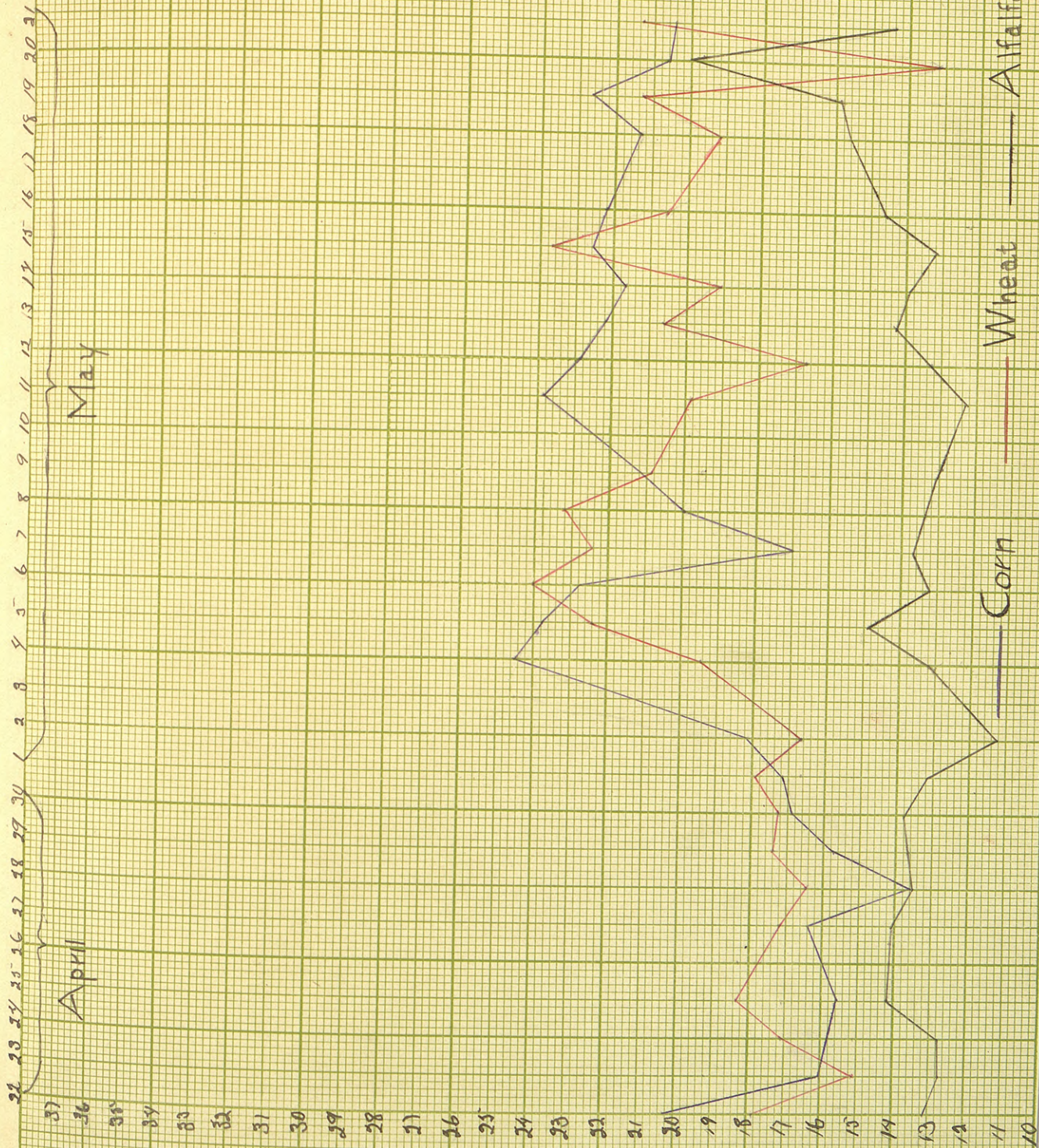


Percent of water

Second Foot

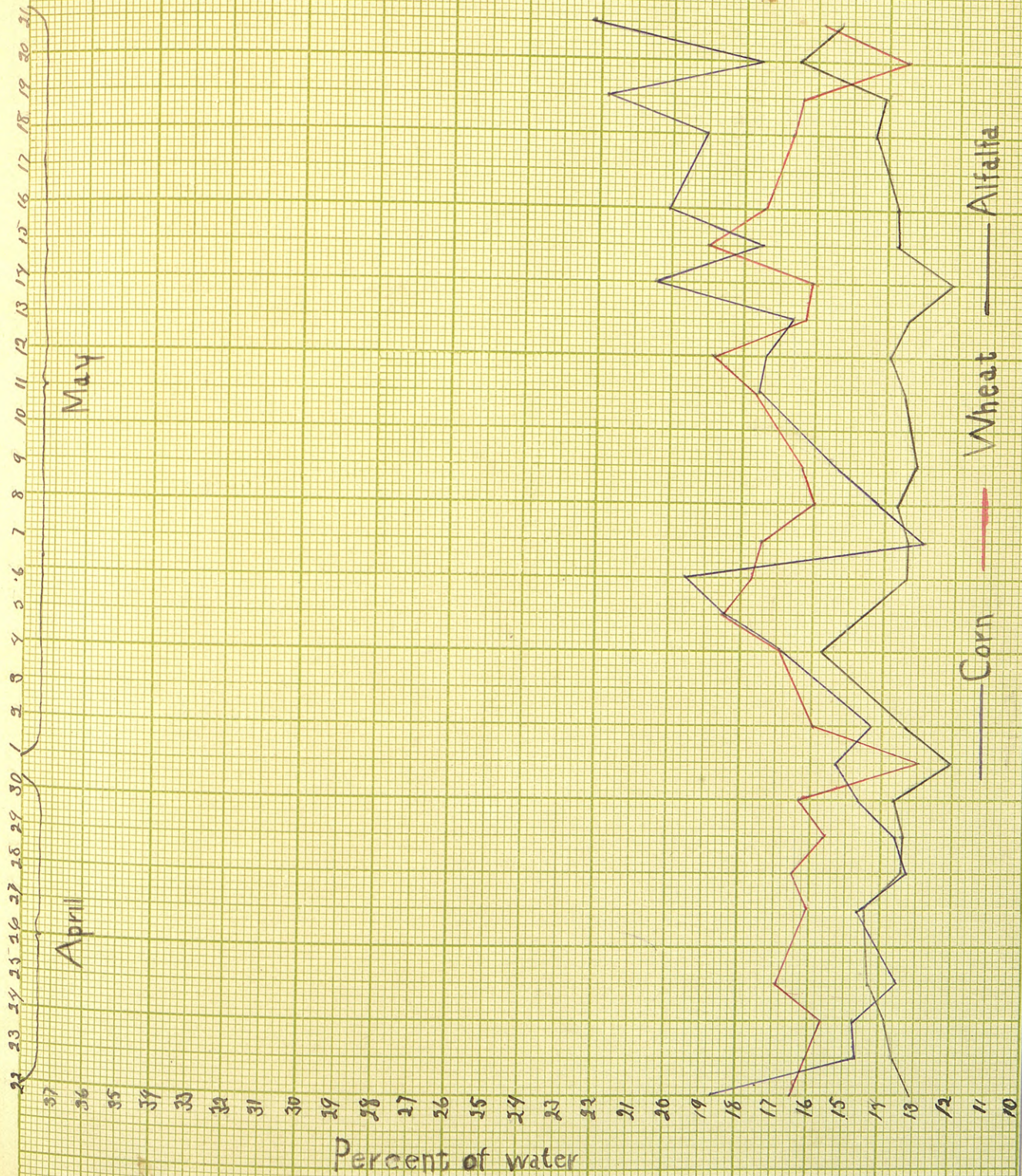


Third Foot

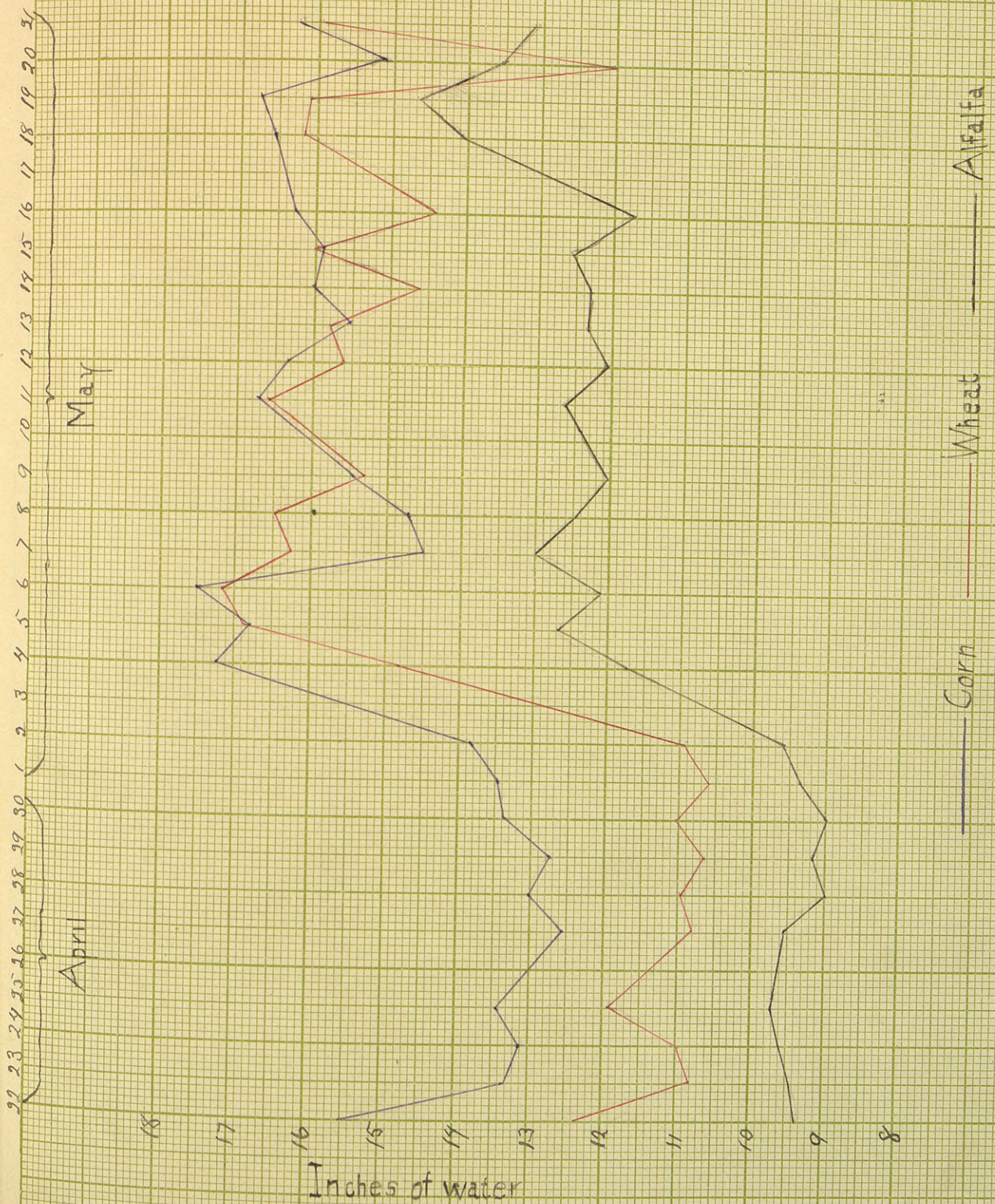


Percent of water

Fourth Foot



Total inches of water



A study of the moisture variations as it is plotted on the coordinate paper will give one a graphic idea of the fluctuation in the soil moisture of each foot or the separate plots. Studying these sheets in connection with the daily weather report, shows many interesting facts, some of which are apparently contrary to existing conditions. As for instance, a lower percentage of moisture on succeeding days when there had been a light rain and continual cloudy weather since the previous day.

The fifth of May, on the corn plot, illustrates this interesting fact. There was on this day .13 inches of rain. There had been cloudy weather since the third of the month, with a heavy rain, 2.91 inches on the fourth, but with these conditions favoring a higher moisture content, there was an actual decrease in the first three feet and a gain of moisture in the fourth foot of soil. A difference of .42 inches of water in the totals for May 4th and May 5th is noted. There are many other days that illustrate this point; some perhaps showing a greater difference as in the second foot of the alfalfa plot for May 6. The second foot on May 5 contained 19.31 per cent of water and on May 6, 16.63 per cent with a .56 inches rainfall on this day. On May 7 the moisture content again ran up to 21.82 per cent for this foot.

Just why these variations of the moisture would occur, can only be accounted for in the varying compactness of the soil. As the compactness of a soil directly influences its moisture retention power, and as it is impossible to have a soil that is compact uniformly, this fluctuation of the moisture line is

bound to occur from day to day even if other conditions do not favor a rise or fall of the soil moisture. This seems to be the only reasonable explanation as the samples were taken the same each day and only a few feet from where they were taken the previous day.

At the beginning of our work the corn ground had 27.7 per cent of water in the first foot, the wheat 18.26 per cent, and the alfalfa contained only 12.92 per cent. These differences continued until after the heavy rain of May 4, when the first foot of all plots ran approximately parallel. As a rule the alfalfa was a little lower in moisture than the other plots, but on May 19, for some unaccountable reason, the first foot of this plot sprang up to 36.66 per cent, which was the highest percentage of moisture recorded. In the second and third feet the alfalfa fell far below the wheat and corn, but in the last foot it again maintained a line close to that of the wheat and corn.

As a rule the moisture content for the fourth foot in the wheat plot was a little above that of the corn during the first part of the work, gradually falling below that of the corn toward the last. While the wheat had a growing crop, it contained on the average as much moisture in the subsoil as the corn plot. The corn plot was in a better condition for absorbing moisture; beside it had no growing crop. The difference in the physical texture of the two subsoils shows that the wheat plot is capable of retaining more moisture. The mechanical analyses of these soils show a difference of ten per cent of clay in favor of the wheat plot. As clay is one of the best soil con-

stituents for retaining water it perhaps accounts for the high percentage of moisture contained in the subsoil of the wheat.

Any of the coordinate sheets, either that for total inches of water, or the percentages of each foot, will reveal, at a glance, the variation of moisture in the several plots. Remembering that it is impossible to have the soil uniformly compact, these abrupt changes from day to day can be accounted for. The results show that the weather conditions, act only indirectly, or in some instances having no effect on the daily variation.

In performing this experiment there are several sources of error, the most notable of which are as follows: - In taking the soil samples in the field some loose dirt may become mixed in with the different feet of soil taken; for instance if the loose dirt from the first foot of moist soil should be intermingled with the dryer soil of the second foot. This would make the second foot appear to have more moisture than it really possessed. Again in weighing the trays of soil, great care and accuracy must be used or mistakes in counting the gram weights will result. If the scales are not handled very delicately, they are very apt to become unbalanced and hence throw one off from the desired results. Sources of error in the mathematical calculation are also possible, but this is hardly probable when duplicate results are figured.

Orville M. Kiser
Herman A. Praeger,
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