STATE OF ILLINOIS

INFILTRATION OF SOILS IN THE PEORIA AREA

R. S. STAUFFER

In Cooperation With
ILLINOIS AGRICULTURAL EXPERIMENT STATION

DEPARTMENT OF REGISTRATION AND EDUCATION

NOBLE J. PUFFER, Director

STATE WATER SURVEY DIVISION

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URBANA. ILLINOIS

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INFILTRATION OF SOILS IN THE PEORIA AREA[1]

By R. S. Stauffer[2]

It was the purpose of this investigation to determine at what rates the major soil types in the area north and northwest of the city of Peoria, in Peoria, Marshall, and Stark Counties, would absorb water and to make a map of the territory based on the permeabilities of the soils.

Plan

A representative of the Soil Physics Division of the Illinois Agricultural Experiment Station organized the project and supervised the preparation of the necessary equipment. Two units were set up. The Illinois Station furnished the equipment, which it already possessed, for one unit. The Water Survey paid for the equipment for the other unit. After the field work was started, in June 1942, the Soil Physics representative spent about half the time in the field, selecting sites, writing up profile descriptions, and directing the work. Four men, paid by the Water Survey, made the actual field determinations.

The Water Survey furnished a truck and a panel truck for the fieldmen. The Illinois Station furnished a truck and a passenger car for the field men and a passenger car for the

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1/ This is a report of a study carried on cooperatively by the Illinois State Water Survey and the Soil Physics Division of the Illinois Agricultural Experiment Station.

2/ Assistant Professor of Soil Physics, Illinois Agricultural Experiment Station, in charge of the investigation.

man in charge of the work. All expenses of operating the trucks and cars for the fieldmen were paid by the Water Survey. All expenses of operating the car used by the man supervising the work were paid by the Illinois Station.

Methods and Procedure

Sites for the tests were selected on all the major soil types throughout the area. Most of the sites were located on permanent bluegrass pastures. It was not always possible to secure sites on bluegrass pastures, particularly on the more productive soil types, because no large areas were left in permanent pasture. Hence, some determinations were made on areas which had a grass cover but which were in a regular crop rotatation.

On some major soil types, determinations were made at as many as six locations. On other types fewer determinations were made, and on some minor types no determinations were made.

The apparatus used and the procedure followed were similar to that described in various publications.1/ 2/ The method has been called the cylinder method. When the exact location for a test was selected, the surface vegetation was removed by cutting it off flush with the surface of the soil with

1/ Musgrave, G. W. The infiltration capacity of soils in relation to control surface runoff and erosion. Jour. Amer. Soc. Agron. 27:336-345.

2/ Stauffer, R. S. Infiltration capacity of some Illinois soils. Jour. Amer. Soc. Apron. 30:493-500. 1938.

a sharp knife. Cylinders, usually ten in number, 8 inches in diameter and long enough to reach into the B horizon, or subsoil, were forced vertically into the soil to the desired depth by means of a hydraulic jack. A truck loaded with sand bags was used to supply the necessary weight to jack against (See Fig. 1). Perforated metal disks, which fit inside the cylinders, were placed on the surface of the soil. These disks prevent the water from hitting the soil directly and thus avoided turbidity of the water and puddling of the surface soil. A tent, large enough to cover the cylinders in the soil, was set up so the determination could proceed in case of rain. The burettes, described below, were then placed in position as shown in Fig. 2, filled with water, and measurements were started. Readings were taken at 10-minute intervals for one hour, at 15-minute intervals for one hour, and at 30-minute intervals for two hours. Thereafter readings were taken hourly for three hours, making a seven-hour period during which readings were taken.

Before the cylinders were forced into the soil they were covered both inside and outside with. a thin coat of ordinary cup grease. This permitted the cylinders to penetrate the soil more easily and also lessened the likelihood of water passing down between the core of soil and the cylinder. In addition, the soil inside the cylinders is not likely to be depressed if the cylinders are greased. The grease does not penetrate the soil mass, hence 5.oes not interfere with the downward movement of water through the soil.

Fig. 1.--Forcing the Cylinders into the Soil.

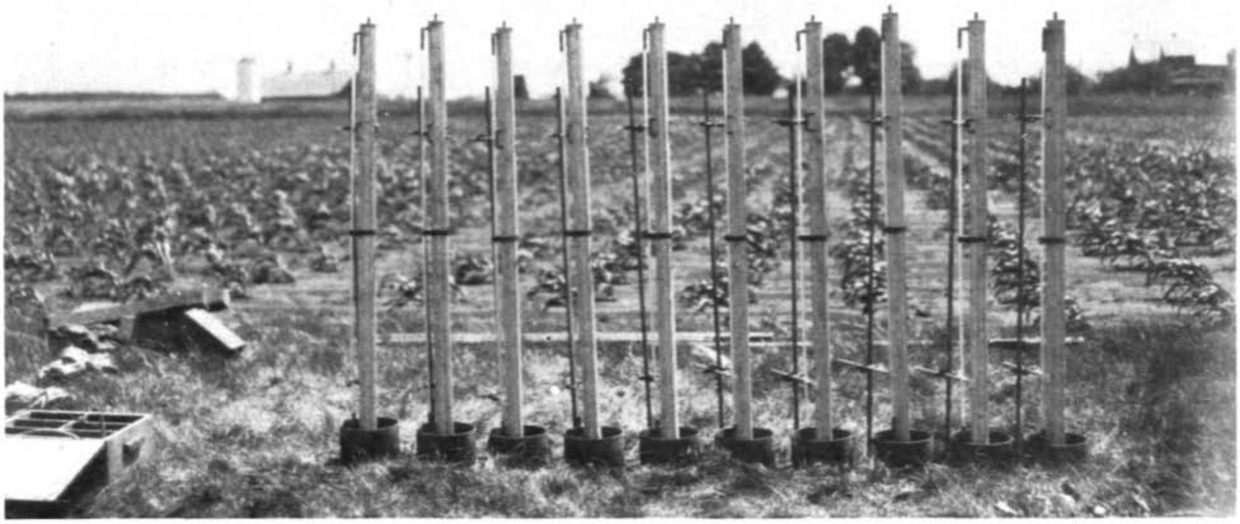

Fig. 2.--Cylinders in Soil and Burettes in Place
Ready to Make a Run.

The burettes, some of which have a capacity of 3600 c.c. and others a capacity of 2700 c.c, were made of galvanized iron downspouting. The downspouting was cut into desired lengths; the seams were soldered so as to make them air-tight; and short metal tubes for inlets and outlets were soldered on the ends. A glass tube for making the readings was calibrated at 10 c.c.-intervals and was connected to each piece of downspouting near the ends.

The amount of evaporation was determined by putting a measured amount of water at the beginning of the test into a container of the same diameter as the cylinders. At the end of the test the water in the container was measured again and the difference was considered the amount of water evaporated.

Since the viscosity of water is affected by changes in temperature, temperatures were taken of the air, the water, and the soil. At the start of a determination, samples of soil were taken near the cylinders for moisture determinations.

Two runs were made at each location, an initial run and a wet run. The initial run was made on the soil with the field moisture content just what it happened to be at the time. The cylinders were left in the soil and the wet run was made the next day on the same soil that had been soaked with water the previous day.

From the data secured a map showing the infiltration capacities by areas was made. (Fig. 4).

Description of the Solis

Fourteen soil types were included in the tests. These included both prairie soils and timber soils. Based on parent material they included loessial soils, glacial till soils, soils formed from outwash material, bottom land soils, and terrace soils.

The most extensive prairie soils in this area are Muscatine silt loam, Tama silt loam, and Saybrook silt loam. The most extensive timber types are Clinton silt loam and Berwick silt loam. The common outwash soils are Proctor silt loam, Karpster clay loam, Osceola silt loam, Thorp silt loam, and Drummer clay loam. Most of the bottomland soil is classed as Huntsville loam. The largest area of silt loam terrace soils is in northern Marshall County along the west side of the Illinois River. Another area of considerable extent occurs in northeastern Peoria County and borders the large sandy terrace on the west. The largest area of sandy loam soils occurs in northeastern Peoria County west of the Illinois River. There is considerable variation in the soils of this sandy terrace area. The tops of the low ridges are very sandy becoming less so as one descends the slope. The area has not been typed by the Soil Survey but Sumner sandy loam is probably the most extensive tyoe.

Muscatine silt loam is one of the best agricultural soils of Illinois. It was formed from loess and occurs on undulating topography. The surface soil is dark brown in color and is usually in a granular condition. The subsoil is a brownish yellow color and is only slightly plastic. Water passes through it readily. Tama silt loam is associated with Muscatine but occurs on more rolling topography. The surface soil is lighter in color and the subsoil is even less plastic than that of Muscatine. Saybrook silt loam occurs on undulating to rolling topography where the loess overlying the Wisconsin till is thin enough that the till has affected the soil profile. Where the tests were made on this soil type, the silty material on too of the till was 30 to 35 inches thick.

The timber soils, Clinton silt loam and Berwick silt loam, have a lighter colored surface than the prairie soils. This is due largely to the lower content of organic matter. The chief difference between these two types is that Berwick occurs on flatter topography and has a less pervious subsoil than Clinton.

The soils occuring in the outwash area of southern Stark and northern Peoria Counties are extremely varied and spotty even within short distances. A relatively greater number of determinations were made in this outwash area. The rate of water absorption in this area varies from very slow to quite rapid. Proctor silt loam is one of the more extensive and one of the more porous of the outwash types. It has a dark colored surface soil and absorbs water readily. Where the determinations were made, the soil profile becomes decidely sandy at 35 to 40 inches, Harpster, Pella, and Drummer soils are somewhat similar to each other. The surface soil is very dark brown or black in color and usually quite deep. They occur on nearly level or even depressional areas. The sub-surface drainage is slow. Thorp silt loam and Osceola silt loam are similar. The surface soil is dark colored but contains considerable gray. The subsoil is very-plastic and water passes through it very slowly. Thorp drains more readily than Osceola. Brenton silt loam has a dark colored surface and occurs on gently sloping areas. It is similar to Proctor but occurs on more gentle slopes and has a darker colored surface soil.

Huntsville loam, the bottomland soil on which determinations were made, occurs along the larger streams on nearly level topography. It has a dark colored surface and contains considerable sand throughout the profile. Being formed from recent alluvial sediments, this type shows very little profile development- that is there is no distinct line of demarcation between the horizons or layers of the profile.

O'Neill silt loam, a terrace soil, has a brown to light brown surface soil. Coarse sand and pebbles are usually found at a depth of 25 to 35 inches. Considerable sand is usually found throughout the profile. Littleton silt loam has a darker colored surface than O'Neill silt loam and while quite variable contains a smaller amount of sand throughout the profile than does O'Neill. A sandy, pebbly, stratum usually occurs at about 50 inches below the surface. No determinations were made on these types. The infiltration capacity was estimated.

The soils of the sandy terrace area have not been classified by the Illinois Soil Survey. They are very sandy and at a depth of 30 to 40 inches they are nearly pure sand of medium size.. These soils, therefore, permit water to pass through them at a rapid rate.

Results and Discussion

Several methods have been used to determine the infiltration capacities of soils. None of these methods can exactly duplicate nature. Each method has some advantages and each has some disadvantages. The cylinder method was used in this project because it seemed to be the best method available for getting at fundamental or inherent soil differences. It was felt that the first step should be to try to get some idea of the permeability of the different soil profiles. Additional studies by some other method could determine the variation due to cover and surface conditions of the soil.

Table 1 gives a summary of all the results, showing the amount of infiltration in inches per hour for each soil. The results on Muscatine silt loam are the average of determinations at five locations of 10 cylinders each or 50 individual determinations. The number of individual determinations for the other soils is shown in Column 2 of Table 1. Table 2 shows the extreme ranges in results from individual cylinders for each soil type for the seven-hour period. Table 3 shows the range in results within the 10 individual determinations at each locetion.

From results obtained previously it was found that 10 or more cylinders were required to secure significant results.

Since in this project it was planned to include determinations on more than one location on each soil type it was considered that 10 cylinders at each location would be sufficient. However, the results are so variable that soils which might have been expected to differ significantly in permeability did not do so. On the other hand, each soil type should not be expected to differ in permeability from every other soil type since permeability is only a minor one of a number of characteristics taken into consideration in classifying soils.

Because of the extremely wide variation in the results it was hoped that a complete statistical analysis of them could be made. This has not been done. However, after a brief check Mr. H. W. Bean, of the Illinois Agricultural Experiment Station, made the following statements:

> "The mean difference between the brown sandy loam and any other soil type is great enough to be called significant. The difference between Muscatine and Saybrook is significant. The differences between Muscatine, Proctor and Tama are not significant. The difference between Proctor and Clinton is significant, while the intervening differences are not. The difference between Tama and Pella is not significant nor are any of the differences between two intervening pairs. Berwick differs significantly from Thorp and also from Polla and Brenton."

Seven hours were taken as a satisfactory length of time to continue a run because in practically all cases the rate per hour at which the soils take up water becomes reasonably constant before that time. The graphs in Fig. 3 for a Muscatine and a Clinton soil bring out this point. Seven hours are probably longer than is necessary for the wet run because there is usually only slight change in the rate of infiltration after the first couple of hours.

Table 4 shows the amount of evaporation during each run on the various soils. In most cases the amount of water evaporated is insignificant compared to the amount absorbed by the soil. But with soils having such low infiltration rates as Osceola, Karpster, and Drummer, the amount of water evaporated does make up a considerable portion of the water absorbed. For example, the average amount of water removed from each cylinder during the initial run on Osceola soil was 0.85 inches. The average amount of evaporation was 0.023 inches or nearly 2.4 percent of the total water disappearing from each cylinder. One surface inch of water on each cylinder is enuivalent to 823.7 c.c. The highest amount evaporated during any run was 70 c.c. or 0.085 inches.

In Table 5 are shown temperatures of soil, air, and water. Undoubtedly wide variations in temperature, particularly of the water, would affect the rate at which water would enter the soil. If the temperature could be controlled or held constant the effect of temperature could be calculated. This is

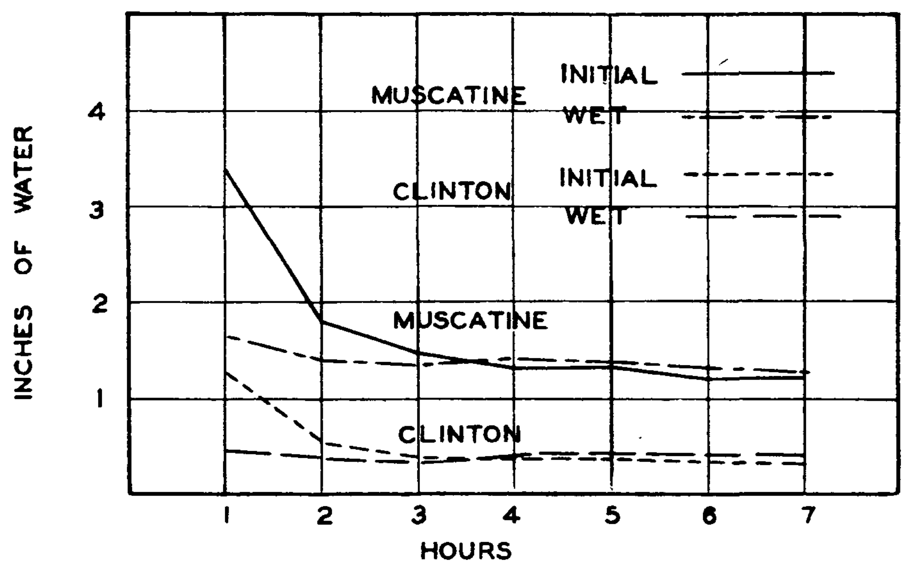

Fig. 3.--Infiltration Capacity in Inches per Hour of Muscatine and Clinton Soils.

impossible since the temperature of the water may vary considerably during a run, and the soil temperature, which is likely to be different from that of the water, varies with depth. Probably the best one can do is to carry on such work at a time when temperature variations are as small as possible and not to compare results obtained when the temperatures are widely different.

Another factor that would affect the rate at which a soil will take up water is the amount of water it contains at the time the determination is made. This would be particularly true with the initial run. Table 6 shows the moisture contents of the soils from samples taken near the cylinders at the beginning of the initial run. These results are expressed as percentages of water by weight based on the weight of oven-dry soil.

Since the water holding capacity of soils varies widely even within the same soil class, the percentage of water in a soil does not convey very definite information. For example, a soil may contain 15 percent water but unless one knows what percentage of the total water holding capacity of the soil that 15 percent is he still does not know how nearly saturated the soil is. Therefore, the results in Table 6 should be used only in a very general way.

The map, Fig. 4, shows the wide variation in the permeability of the soils in this area. In most of the are? the soils are fairly permeable. However, in north-central Peoria county and south-eastern Stark county there are several areas of slowly permeable soils.

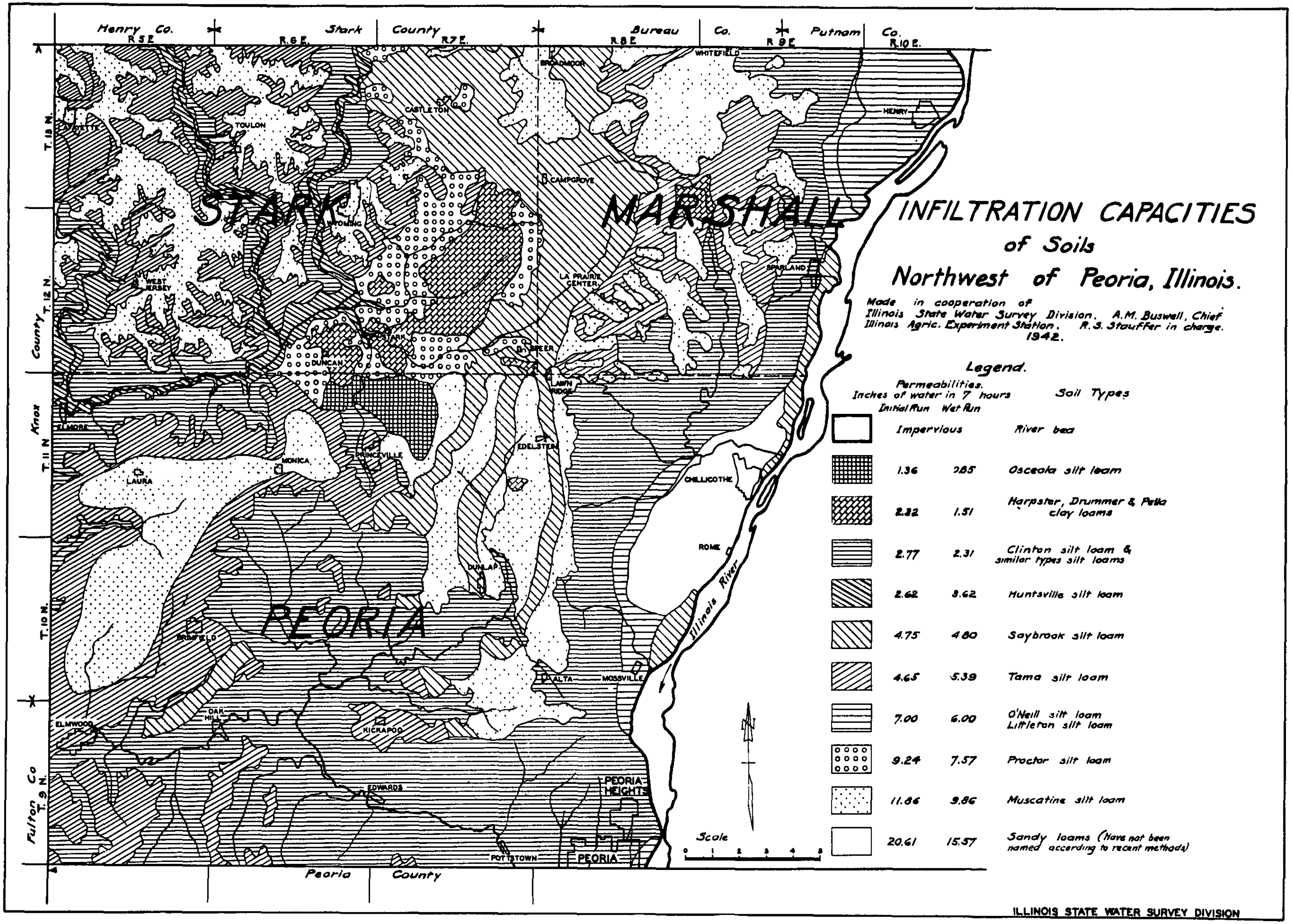

Fig. 4.--INFILTRATION CAPACITIES
of Soils Northwest of Peoria, Illinois

Table 1. Infiltration Capacity of Soils

Soil	No. of Determinations	Hour	Initial Run In./Hr.	Initial Run Accumulated Inches/Hour	Wet Run In./Hr.	Wet Run Accumulated Inches/Hour
Sandy loam	20	1	4.15	4.15	2.61	2.61
		2	3.05	7.20	2.21	4.82
		3	2.77	9.97	2.14	6.96
		4	2.63	12.60	2.05	9.01
		5	2.65	15.25	2.23	11.24
		6	2.68	17.93	2.22	13.46
		7	2.68	20.61	2.11	15.57
Muscatine silt loam	50	1	3.44	3.44	1.64	1.64
		2	1.79	5.23	1.46	3.10
		3	1.49	6.72	1.39	4.49
		4	1.34	8.06	1.42	5.91
		5	1.36	9.42	1.29	7.20
		6	1.21	10.63	1.34	8.54
		7	1.23	11.86	1.32	9.86
Proctor silt loam	20	1	2.84	2.84	1.34	1.34
		2	1.41	4.25	1.17	2.51
		3	1.17	5.42	1.11	3.62
		4	1.06	6.48	1.04	4.66
		5	0.94	7.42	1.03	5.69
		6	0.96	8.38	0.93	6.62
		7	0.86	9.24	0.95	7.57
Tama silt loam	60	1	1.81	1.81	1.09	1.09
		2	0.65	2.46	0.83	1.92
		3	0.50	2.96	0.74	2.66
		4	0.46	3.42	0.72	3.38
		5	0.42	3.84	0.68	4.06
		6	0.4l	4.25	0.67	4.73
		7	0.40	4.65	0.66	5.39
Saybrook silt loam	30	1	1.66	1.66	0.84	0.84
		2	0.63	2.29	0.71	1.55
		3	0.52	2.81	0.67	2.22
		4	0.48	3.29	0.65	2.87
		5	0.45	3.74	0.66	3.53
		6	0.52	4.26	0.62	4.15
		7	0.49	4.75	0.65	4.80

Table 1. (Continued)

Soil	No, of Deter-minations	Hour	Initial Run In./Er..	Initial Run Accumulated Inches/Hour	Wet Run In./Hr.	Wet Run Accumulated Inches/Hour
Huntsville	20	1	0.91	0.91	0.57	0.57
		2	0.38	1.29	0.55	1.12
		3	0.30	1.59	0.54	1.66
		4	0.28	1.87	0.50	2.16
		5	0.28	2.15	0.48	2.64
		6	0.23	2.38	0.50	3.14
		7	0.24	2.62	0.48	3.62
Clinton silt loam	50	1	1.26	1.26	0.48	0.48
		2	0.54	1.80	0.41	0.89
		3	0.40	2.20	0.42	1.31
		4	0.39	2.59	0.42	1.73
		5	0.36	2.95	0.44	2.17
		6	0.34	3.29	0.44	2.61
		7	0.35	3.64	0.44	3.05
Harpster clay loam	20	1	0.28	0.28	0.03	0.03
		2	0.09	0.37	0.03	0.06
		3	0.08	0.45	0.02	0.08
		4	0.08	0.53	0.03	0.11
		5	0.06	0.59	0.03	0.14
		6	0.06	0.65	0.03	0.17
		7	0.05	0.70	0.03	0.20
Osceola silt loam	40	1	0.57	0.57	0.14	0.14
		2	0.21	0.78	0.14	0.28
		3	0.14	0.92	0.12	0.40
		4	0.12	1.04	0.12	0.52
		5	0.11	1.15	0.12	0.64
		6	0.11	1.26	0.11	0.75
		7	0.10	1.36	0.10	0.85
Berwick silt loam	40	1	0.58	0.58	0.20	0.20
		2	0.25	0.83	0.20	0.40
		3	0.21	1.04	0.19	0.59
		4	0.19	1.23	0.21	0.80
		5	0.17	1.40	0.20	1.00
		6	0.16	1.56	0.17	1.17
		7	0.16	1.72	0.21	1.38

Table 1. (Concluded)

Soil	No. of Determinations	Hour	Initial Run In./Hr.	Initial Run Accumulated Inches/Hour	Wet Run In./Hr.	Wet Run Accumulated Inches/Hour
Thorp silt loam	20	1	1.83	1.83	0.64	0.64
		2	0.57	2.40	0.37	1.01
		3	0.43	2.83	0.36	1.37
		4	0.36	3.19	0.32	1.69
		5	0.35	3.54	0.35	2.04
		6	0.31	3.85	0.28	2.32
		7	0.27	4.12	0.31	2.63
Brenton silt loam	20	1	1.07	1.07	0.50	0.50
		2	0.50	1.57	0.39	0.89
		3	0.44	2.01	0.37	1.26
		4	0.35	2.36	0.37	1.63
		5	0.31	2.67	0.39	2.02
		6	0.34	3.01	0.39	2.41
		7	0.33	3.34	0.42	2.83
Drummer* clay loam	10	1	1.08	1.08	0.14	0.14
		2	0.63	1.71	0.11	0.25
		3	0.52	2.23	0.11	0.36
		4	0.53	2.76	0.10	0.46
		5	0.41	3.17	0.10	0.56
		6	0.40	3.57	0.10	0.66
		7	0.43	4.00	0.10	0.76
Pella silty clay loam	20	1	0.82	0.82	0.39	0.39
		2	0.45	1.27	0.34	0.73
		3	0.44	1.71	0.36	1.09
		4	0.37	2.08	0.33	1.42
		5	0.40	2.48	0.35	1.77
		6	0.46	2.94	0.29	2.06
		7	0.49	3.43	0.35	2.41

*The profiles of Drummer clay loam and of Harpster clay loam are more permeable than results in table indicate. Water table was high when determinations were made in early June.

Table 2. Range, Highest and Lowest Infiltration for Each Soil Type

Inches in seven hours

Soil	Initial Run		Wet Run	
	Highest	Lowest	Highest	Lowest
Sandy loam	44.81	3.08	30.77	1.37
Muscatine	36.71	2.38	39.95	0.4?
Proctor	32.36	1.30	23.58	0.49
Tama	17.56	0.73	39.58	0.23
Saybrook	15.60	0.76	20.08	0.10
Huntsville	9.52	0.78	19.26	0.19
Clinton	14.40	0.68	19.38	0.25
Karpster	4.04	0.06	0.23	0
Osceola	4.54	0.05	5.58	0.01
Berwick	14.97	0.23	8.48	0.06
Thorp	3.05	0.98	5.00	0.35
Brenton	8.55	0.93	11.32	0.04
Drummer	24.19	0.63	4.74	0.02
Pella	11.28	0.33	16.48	0.09

Table 3. Range Within Ten Cylinders at Each Location

Inches in seven hours

Soil	Location	Initial Run Highest	Initial Run Lowest	Wet Run Highest	Wet Run Lowest
Sandy loam	1	44.81	18.75	30.17	16.13
	2	16.92	3.08	17.38	1.37
Muscatine	1	36.71		22.05	3.74
	2	24.90	4.86	17.64	
	3	30.26	4.52	39.95	0.47
	4	20.48	3.13	10.55	0.63
	5	19.97	2.38	21.35	3.05
Proctor	1	32.36	3.87	15.88	1.84
	2	13.75	1.30	23.58	0.49
Tama	1	17.56	0.87	14.15	0.4l
	2	8.91	1.17	39.58	0.28
	3	9.6l	1.69	13.47	0.30
	4	9.37	2.04	11.18	0.40
	5	6.09	0.80	2.91	0.18
	6	10.78	2.49	10.45	0.64
Saybrook	1	17.36	0.76	20.08	0.10
	2	6.13	0.86	13.53	0.10
	3	6.00	1.13	10.7.7	
Kuntsville	1	4.48	0.95	19.26	0.91
	2	3.99	0.78	3.96	0.19
Clinton	1	13.18	2.40	13.81	0.72
	2	9.67	1.07	3.61	0.56
	3	14.40	2.38	19.38	1.27
	4	7.19	0.83	6.24	0.29
	5	1.87	0.68	2.89	0.22
Harpster	1	1.84	0.09	1.09	0
	2	1.37	0.06	0.42	0
Osceola	1	4.54	0.55	1.61	0.27
	2	2.39	0.67	0.52	3.01
	3	2.78	0.51	5.58	0.21
	4	1.87	0.05	0.39	0
Bert-rick	1	14.97	0.67	8.48	0.11
	2	5.80	1.25	3.67	0.22
	3	2.33	1.09	2.55	0.57
	4	1.21	0.23	0.42	0.06
Thorp	1	8.05	3.52	4.16	1.89
	2	4.71	0.98	5-79	0.38

Table 3. (Concluded)

Soil	Location	Initial Run		Wet Run	
		Highest	Lowest	Highest	Lowest
Brenton	1	8.55	1.89	9.94	1.08
	2	6.07	0.93	11.32	0.05
Drummer	1	24.19	0.63	4.74	0.02
Pella	1	11.28	1.01	16.48	0.21
	2	5.37	0.33	3.51	0.09

Table 4. Amount of Water Evaporated During Each Run
(Expressed as cubic centimeters and as surface inches)

		Evaporation During Each 7 Hours Run			
		Initial Run		Wet Run	
Soil	Location	Cubic centimeters	Surface inches	Cubic centimeters	Surface inches
		From 8-inch cylinder		From 8-inch cylinder	
Brown sandy loam	1	65	0.079	45	0.055
	2	65	0.079	45	0.055
Muscatine silt loam	1	6	0.007	50	0.06l
	2	70	0.085	50	0.06l
	3	57	0.069	20	0.024
	4	20	0.024	40	0.049
	5	55	0.067	20	0.024
Proctor silt loam	1	20	0.024	0	0
	2	48	0.058	40	0.049
Tama silt loam	1	6	0.007	50	0.061
	2	55	0.067	20	0.024
	3	46	0.056	46	0.056
	4	30	0.036	70	0.085
	5	60	0.073	45	0.055
	6	30	0.036	70	0.085
Saybrook silt loam	1	57	0.069	20	0.024
	2	50	0.061	45	0.055
	3	50	0.061	45	0.055
Huntsville loam	1	46	0.056	34	0.041
	2	48	0.058	40	0.049
Clinton silt loam	1	60	0.073	45	0.055
	2	45	0.055	25	0.030
	3	46	0.056	46	0.056
	4	55	0.067	70	0.085
	5	48	0.058	10	0.012
Harpster clay loam	1	57	0.069	42	0.051
	2	30	0.036	30	0.036
Osceola silt loam	1	15	0.018	40	0.049
	2	35	0.042	0	0
	3	15	0.018	40	0.049
	4	20	0.024	0	0

Table 4. (Concluded)

		Evaporation During Each 7 Hours Run			
		Initial Run		Wet Run	
Soil	Location	Cubic centimeters	Surface inches	Cubic centimeters	Surface inches
		From 8-inch cylinder		From 8-inch cylinder	
Berwick silt loam	1		0.055	25	0.030
	2	55	0.067	70	0.085
	3	48	0.058	10	0.012
	4	20	0.024	40	0.049
Thorp silt laom	1	60	0.073	0	0
	2	35	0.042	0	0
Brenton silt loam	1	46	0.056	34	0.041
	2	30	0.036	30	0.036
Drummer loam	1	51	0.069	42	0.051
Pella silt loam	1	54	0.066	40	0.049
	2	54	0.066	40	0.049

Table 5. Temperatures (Fahr.) of Soils, Air, and Water

Name	Location	Initial Run					Wet Run		
		Soil		Air		Water	Air		Water
		1" Deep	12" Deep	start	finish		start	finish	
Brown sandy loam	1	75	73	82	92	77	73	94	73
	2	80	80	87	92	77	--	--	--
Muscatine silt loam	1	78	72	82	67	72	--	--	--
	2	81	72	94	88	91	78	86	75
	3	66	65	75	--	--	--	--	--
	4	76	72	86	72	79	74	83	74
	5	80	75	81	--	--	--	--	--
Proctor silt loam	1	61	62	62	--	--	63	--	--
	2	69	70	76	69	71	73	80	67
Tama silt loam	1	82	74	78	67	72	61	79	63
	2	77	73	81	80	74	68	85	71
	3	77	73	80	--	--	--	--	--
	4	73	72	74	--	--	--	--	--
	5	82	74	92	--	--	--	--	--
	6	68	68	73	57	69	60	74	60
Saybrook silt loam	1	68	68	75	79	68	75	71	71
	2	79	76	80	--	74	--	--	--
	3	70	72	83	72	74	69	86	69
Huntsville loam	1	71	70	78	--	--	--	--	--
	2	76	74	80	--	--	--	--	--
Clinton silt loam	1	80	72	91	90	85	80	96	79
	2	75	73	77	80	76	71	84	72
	3	71	73	72	83	69	70	78	69
	4	83	73	81	59	80	59	82	--
	5	75	75	77	--	76	71	76	76
Harpster clay loam	1	66	65	73	--	75	59	75	60
	2	66	63	77	73	--	73	--	76
Osceola silt loam	1	79	75	82	72	79	79	82	77
	2	78	75	84	80	81	70	79	72
	3	79	75	82	--	72	--	--	--
	4	65	64	60	82	65	79	82	77
Berwick silt loam	1	76	74	76	80	76	71	84	72
	2	84	72	80	80	--	59	82	--
	3	75	72	79	74	76	71	76	76
	4	82	76	84	--	79	74	83	74

Table 5. (Concluded)

Name	Location	Initial Run: Soil 1" Deep	Initial Run: Soil 12" Deep	Initial Run: Air start	Initial Run: Air finish	Initial Run: Water	Wet Run: Air start	Wet Run: Air finish	Wet Run: Water
Thorp	1	67	65	73	—	69	61	65	61
silt loam	2	82	79	87	80	81	70	79	72
Brenton	1	73	66	75	74	73	69	85	80
silt loam	2	71	69	74	82	73	73	—	76
Drummer clay loam	1	70	67	79	59	75	59	75	60
Pella silt	1	76	74	76	71	76	69	79	69
loam	2	75	75	76	71	76	69	79	69

Table 6. Percent Moisture in Soil at Time of Making Run Based on Weight of Oven-Dry Soil

Name	Location	Percent Moisture at Various Depths 1-6 inches	12-18 inches	30-36 inches
Brown aandy loam	1	10.250	13.035	13.108
	2	6.501	8.836	5.486
Muscatine silt loam	1	20.364	21.258	25.658
	2	19.659	23.874	26.555
	3	25.740	23.902	25.475
	4	21.380	26.287	24.646
	5	19.145	24.639	28.084
Proctor silt loam	1	Not determined		
	2	21.317	18.354	23.566
Tama silt loam	1	15.261	17.952	25.555
	2	22.806	13.247	27.535
	3	14.028	27.981	24.666
	4	15.411	23.399	23.851
	5	17.363	19.672	22.455
		17.282	22.314	25.665
Saybrook	1	21.116	19.522	23.871
	2	15.130	19.929	14.730
	3	11.905	16.206	14.885
	4	.	.	.
Huntsville loam	1	16.109	21.809	21.850
	2	8.801	15.657	10.381
Clinton silt loam	1	22.926	23.127	18.880
	2	21.866	19.613	22.094
	3	8.164	15.763	23.262
		9.646	20.772	22.491
	5	10.245	19.379	22.367
Harpster clay loam	1	33.657	31.909	35.971
	2	39.147	38.481	38.127
Osceola silt loam	1	14.107	24.075	26.413
	2	21.948	24.870	29.343
	3	14.224	20.116	21.708
	4	Not determined		
Berwick silt loam	1	22.876	23.005	27.256
	2	9.013	20.349	23.758
	3	10.425	15.882	24.761
	4	25.829	25.745	24.268

Table 6 (Concluded)

Name	Location	Percent Moisture at Various Depths		
		1-6 inches	12-18 inches	30-36 inches
Thorp	1	25i068	22.523	26.991
silt loam	2	44.770	19.459	24.012
Brenton	1	23.714	23.916	28.471
silt loam	2	22.241	25.466	27.679
Drummer	1	32.570	27.294	25.927
clay loam				
		:	:	:
Pella	1	28.287	33.932	32.504
silt loam	2	25.952	25.698	23.982