A S T U D Y

of the

MOVEMENT OF MOISTURE IN SOILS

Based on data collected by

the Bureau of Irrigation Investigations

of the

UNITED STATES DEPARTMENT OF AGRICULTURE

Co-operating with

THE TEXAS BOARD OF WATER ENGINEERS

By

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INTRODUCTION

A study of the duty of water in irrigation necessarily includes a determination of what becomes of soil moisture, including both rainfall and that applied artificially.

An investigation was begun early in 1915 near Mercedes, Texas, the purpose being to learn the rate of movement of applied moisture, both laterally and vertically, as well as the limits of these movements. Also an attempt was made to learn the extent of the losses from soils by evaporation, and the quantity retained by the soils.

This investigation was planned and the work begun by the Irrigation Division, U. S. Department of Agriculture and later carried on under the cooperation agreement between the Irrigation Division, U. S. Department of Agriculture, and the Board of Water Engineers of the State of Texas. As in the duty of water, so in this investigation the grounds of the Rio Grande Station were furnished and other assistance rendered by the American Rio Grande Land & Irrigation Company to whom the hearty thanks of the cooperators are tendered.

In the preparation of this report the use of the data gathered during the progress of the work has been freely furnished by Mr. R. G. Hemphill, Irrigation Engineer now in charge of Irrigation Division, U. S. Department of Agriculture, in Texas, to whom the Board of Water Engineers and the writer desire to express their sincere appreciation.

SOIL TYPES STUDIED

Experiments were conducted in four types of soil: Laredo clay loam, Brennan fine sandy loam, Laredo clay and Laredo silty clay. Insofar as the movement of moisture in soils is concerned, these four types represent fairly well the soils of semi-arid Texas.

Laredo Loam and Laredo Clay Loam

The Laredo loam or Laredo clay loam is a dark gray silty sandy loam in which the quantity of sand increases downward from 37 percent at the surface to about 50 percent at six feet. The silt and clay contents are about equal, each averaging for six feet about 27 or from 31 percent at the surface to 26 percent at six feet.

This soil contains a considerable quantity of vegetable matter, is friable and easily cultivated, retains moisture well, and has free drainage. The downward movement of gravity water is rapid, but capillarity only average. Considering fertility and cultivation, this is, perhaps, the most desirable soil type in the Valley. It is typical of the silty loams of the Rio Grande Valley and of the State.

Brennan Fine Sandy Loam

Brennan fine sandy loam is a dark reddish brown, fine sandy loam, which when moist pulverizes readily, but if allowed to dry without thorough cultivation

cements and solidifies and in plowing breaks up in large, hard chunks that only a heavy sledge will break. A mechanical analysis for a six foot depth shows the following: sand, 69 per cent; silt, 12 per cent; clay, 19 per cent. The sand increases from 62 per cent at the surface to 75 per cent at six feet. The silt decreases from 14 per cent at the surface to 9 per cent at six feet. The clay decreases from 24 per cent at the surface to 16 per cent at six feet.

The downward movement of moisture is quite free, the lateral movement slight. There is not a large quantity of nitrogenous matter in this type, but it may be improved by rotation of crops and green soiling.

In the Rio Grande Valley this type is found over a large area north of the St. Louis, Brownsville and Mexico Railway and west of Mercedes, Texas. It is very similar in texture and moisture requirements to Webb fine sandy loam, and Duval fine sandy loam, of which there are large areas in Southwest Texas.

Laredo Clay

Laredo clay is a dark gray, black when wet, sticky, tenacious soil which when dry contracts, cracks extending several feet in depth, rendering a uniform distribution of applied water difficult. Though the surface foot takes water quite readily, through the second, third and fourth feet, the movement is slow.

A mechanical analysis of this soil type gave the following results: For a six foot depth, the average content of sand is 3 per cent; silt, 37 per cent; and clay, 60 per cent. The sand remains nearly constant in quantity from surface to six feet. The silt increases from 34 to 43 per cent, while the clay decreases from 61 to 54 per cent. From six to ten feet, the sand increases, the ninth and tenth feet consisting of a very fine sand.

The nitrogen content of this type of soil is low and may be increased by the production of catch crops which will improve the fertility and physical condition of the soil. Large areas of it are found in all West and Southwest Texas valleys. So far as movement of moisture is concerned, it is very similar to Cameron clay and the Houston and Duval clay series.

Laredo Silt Loam

Laredo silt loam is a light colored, reddish gray, silty loam, a heavy type of the soil upon which Bermuda onions are grown at Laredo. When wet, it is sticky, but in drying breaks up and mulches readily. At depth it becomes spongy in texture. At five feet it feels ashy, and if taken in the hand moist, falls apart like ashes. Moisture movement near the surface is quite free in all directions, a four inch application moving laterally as much as ten feet.

A mechanical analysis shows for six feet depth an average of 12 per cent sand, 41 per cent silt, and 47 per cent clay. Most of the sand is in the first, fifth, and sixth feet. The silt increases from 36 per cent at the surface to 41 per cent at six feet. The clay decreases from 54 per cent at the surface to 26 per cent at six feet.

PROCEDURE

Soil uniform in type and topography was selected, upon which plats twenty to fifty feet square were prepared. Water was applied in furrows and by flooding, the furrows being spaced two, three, four, and six feet, center to center. In a few of the first experiments, the furrows were made three inches deep and six inches wide at the surface, semi-circular in form, but in the larger number of experiments, they were made uniformly three inches deep and twelve inches wide, nearly semi-circular in form.

Soil Sampling

The samples were taken with a soil tube which cut and extracted a core sample extending entirely through the foot being tested. The whole sample of from one hundred to two hundred grams was used, thus insuring an average of the entire foot. In the heavy clays following irrigation, it was not possible on account of the stickiness of the soil to use the soil tube and an auger was used instead. A hole was located in the bottom of each furrow and at each foot laterally. At each daily test from seven to nineteen holes were put down, the number depending upon the spacing of the furrows. For the purpose of overcoming the influence of the drier soils adjoining, water was applied in two to four furrows outside the tested plot.

Preceding irrigation, usually by twenty-four hours, a set of samples extending across the plot was taken. Sample holes were put down at each foot laterally before irrigation to a depth of eight feet, then following irrigation, to a depth of six to twelve feet at the following time intervals: at twenty-four, forty-eight, seventy-two, ninety-six, and one hundred and twenty hours, ten, twenty, and thirty days, excepting that no regular work was performed on Sunday.

Measurement of Water

The quantity of water applied was measured very accurately over a specially calibrated "V" notch weir. Water was not allowed to overflow the furrows. Two, three, four, five, and six inch irrigations were used. The flooded plots were surrounded by a border levee and divided into two by a light guide levee. In beginning the application of water to a plot, an increased head was used until the area was flooded or the furrows were wet, when the stream was reduced to the size which just maintained a uniform supply at every point.

Soil Laboratory Techniques

Each sample as taken was placed in a can with a closely fitting cover, taken to the laboratory, weighed, the cover removed, the sample placed in the soil oven, where it remained for twelve to fourteen hours in a temperature of 100 to 110 degrees centigrade, then reweighed while hot and the moisture content determined. All percentages were based upon the absolutely dry weight of soils.

Soil Evaporation Losses in Tanks

During the progress of this work, it was sought to learn the rate of evaporation from soil surfaces. Eight water tight metallic tanks were secured, each about

13 inches in diameter, and 12 inches deep. Holes of the form of the tanks, but slightly larger, were dug in the earth, and a tank placed in each hole. The tanks were set level, extending about two inches above the ground surface. Soil was brought around the tank, raising it to within an inch of the top of the tank. Strips of burlap were drawn about the top of the tank to prevent circulation of air about it.

Soil Moisture Losses from Tank Experiments

Soil of the type in which study of moisture movement was being conducted was selected, samples of it taken, and the moisture content determined, filling the tanks at the same time and weighing them. While determining the moisture content of these samples, the tanks were closely covered. This learned, the percentage of moisture in the tanks was raised by the addition of water to four uniformly graded quantities, from that near the wilting point of plants to soil saturation. These tanks were carefully weighed every twenty-four hours until the soil approached the limit of free moisture, when they were again raised to the former moisture percentages and the work repeated.

Soil Moisture Graphs

The graphs of each experiment show the moisture condition of the soil before water was applied and at each sampling thereafter during the period of the experiment.

The graph at the upper left hand corner of each platted experiment shows the extent of the moisture movement for each twenty-four hours during the first five days, and in a number of the experiments, the tenth, twentieth, and thirtieth day after was was applied. The graph at the upper right hand corner shows the quantity of moisture in the soil before irrigation, by lines of equal percentage. Likewise in the following graphs the moisture percentage at each date is similarly indicated. Thus the quantity of moisture and its movement in the soil are shown day by day.

MOVEMENT OF MOISTURE IN SOILS

Laredo Loam

Experiments Nos. 1 to 9, inclusive, were conducted at Mercedes, Texas, and made in Laredo loam soil.

Experiment No. 1

In Experiment No. 1, figure 1, two inches of water was applied in furrows three inches deep and six inches wide, spaced two feet apart, center to center. There was 19.6 percent of moisture in the surface foot, the average moisture content of the upper six feet being 17.4 percent. Eighteen minutes was taken in the application, and in twenty-six minutes after the water was shut off, it disappeared from the surface. In twenty-four hours water had moved downward five and one-half feet, and had united between the furrows on the surface. Twenty-four hours after irrigation, horizontal strata of soil had practically attained

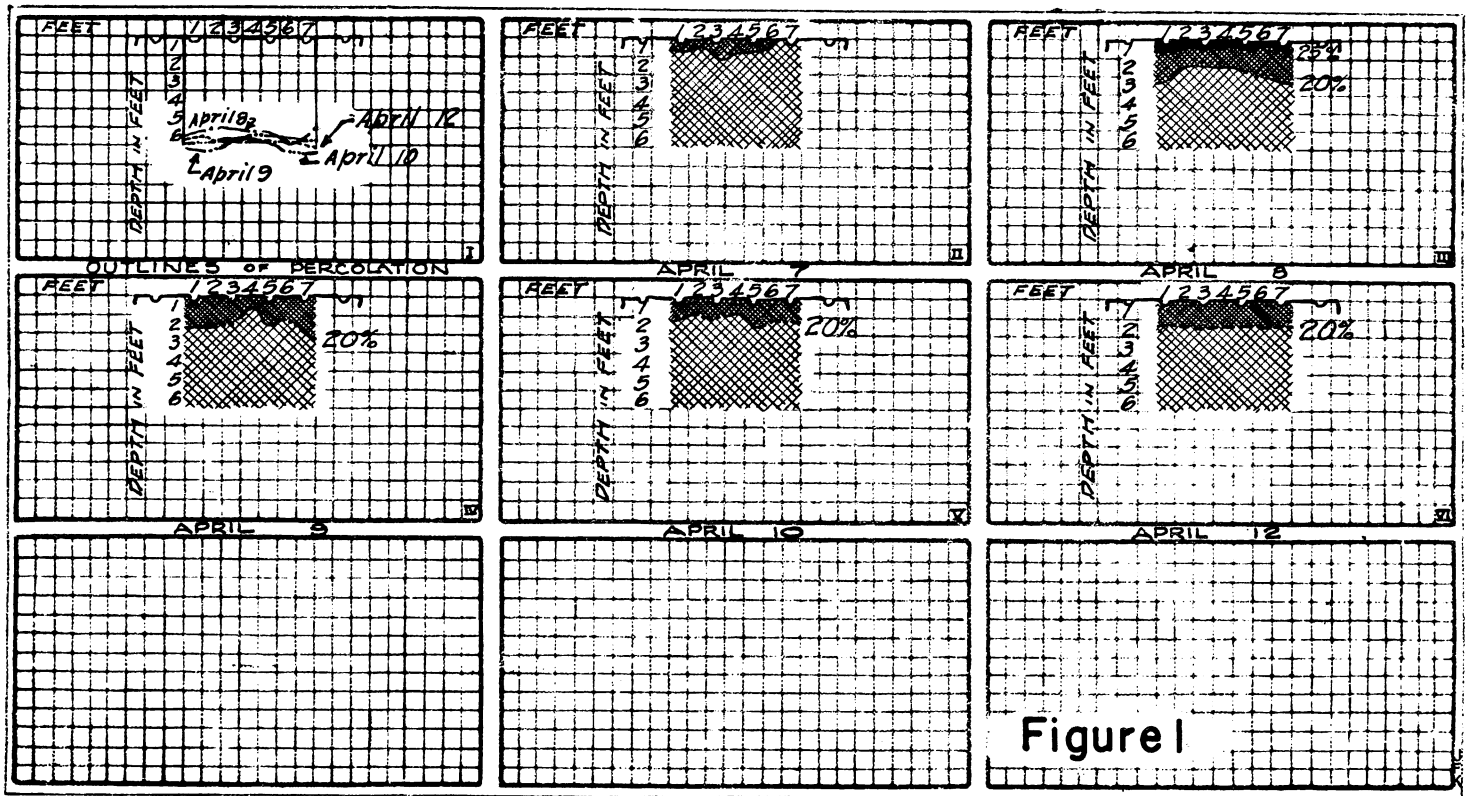


Figure I

Experiment No. I :- Percolation of 2-Inch Irrigation in Laredo Clay Loam; applied in 3"×6" Furrows. 2' c. to c. in ¼ Hour. Effect of Rainfall - High Initial Percentages; also, .64" and .03" Precipitation on April 11th and 12 respectively.

equilibrium of moisture content. Following the first day, the moisture movement was slow. On the third day after irrigation, there occurred a rain of 0.64 inch. At the end of the fifth day, there was an average of 1.8 percent or 1.54 inches more moisture in the soil than before irrigation. In this soil, seven percent of moisture represents one inch depth of water.

Experiment No. 2

In Experiment No. 2, figure 2, as in No. 1, two inches of water was applied in the same dimensioned furrows, but spaced three feet apart. Prior to irrigation, there was present in the surface foot of soil 19.8 percent of moisture, the average of six feet depth being 17.1 percent. Fifteen minutes was taken in applying and in forty-five minutes after the supply was cut off, water disappeared from the surface.

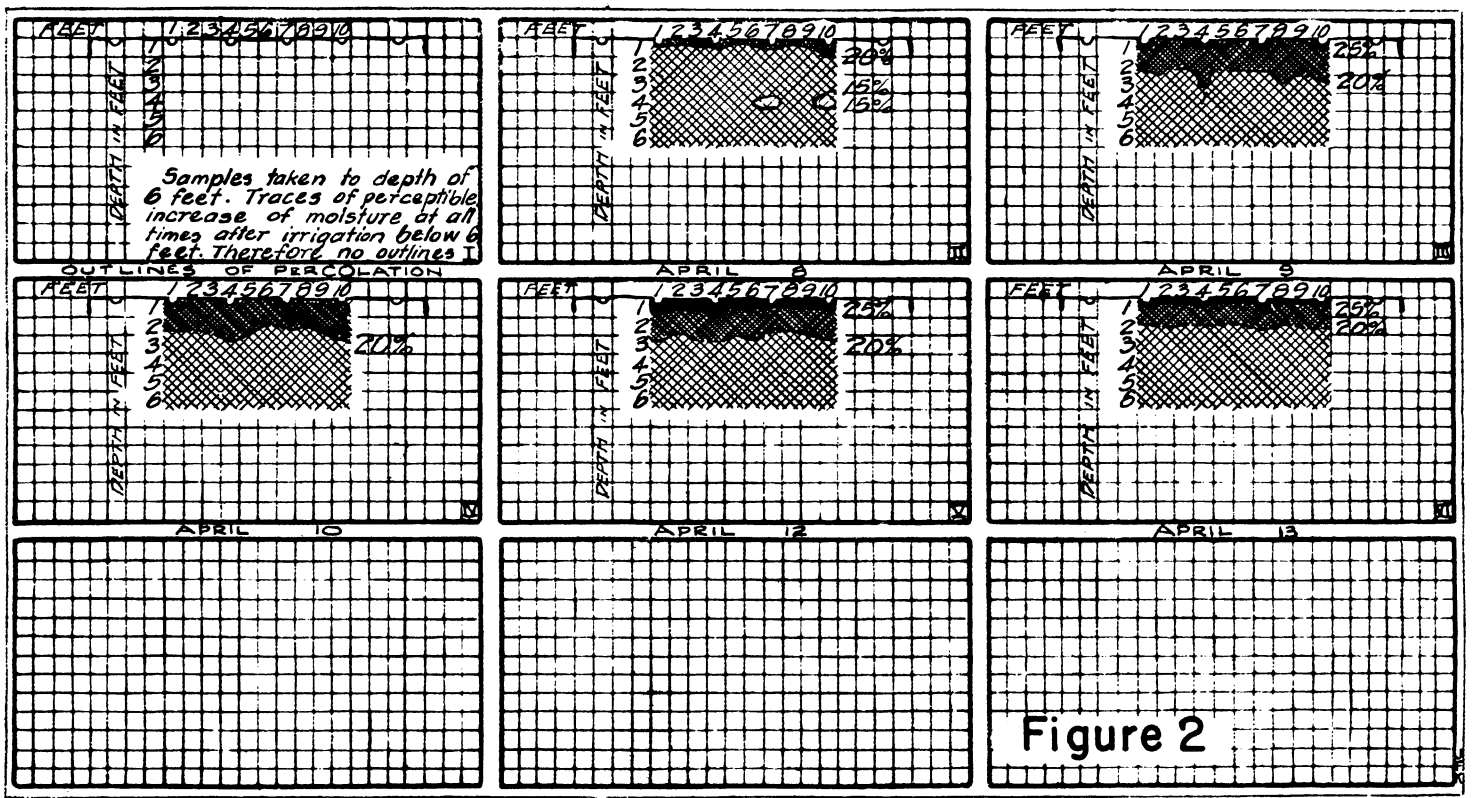
During the first twenty-four hours, water moved downward five and one-half feet and met on the surface between the furrows. At the end of the first twenty-four hours, there was two to three percent more moisture in the surface foot beneath the furrows than in the two intermediate surface feet, but at the end of the second day, this difference had practically disappeared, horizontal depths being in virtual equilibrium. On the third day after irrigation. 0.64 inch rain fell, and at the end of the fifth day, there was 2.2 percent or 1.89 inches more moisture in the upper six feet of soil than before irrigation. Evaporation experiments indicate that, under average conditions, during the five days of the test, there would be a loss of moisture by that means from the surface foot of about 2.80 percent, or 0.40 inch in depth of water. Though the depth of penetration was not sufficient to produce appreciable loss of moisture to deep rooting field crops, the penetration was too deep and rapid for truck and grass crops to which there would be a distinct loss of as much as one-half inch of water. The conditions in Experiments Nos. 1 and 2 were very similar, and the results practically identical.

Experiment No. 3.

In Experiment No. 3, figure 3, two inches in depth of water was applied, and during the second day after irrigation, 0.13 inch of rain fell. The water was applied in furrows 3 by 6 inches, spaced 4 feet apart. Three hours and fifteen minutes was consumed in making the application, and in twenty-two minutes after the supply was cut off, water disappeared from the surface. Before irrigation, 22.4 percent of moisture was present in the surface foot and an average of 18.0 percent in the upper six feet.

During the first twenty-four hours, the moisture did not meet in the surface foot, and between two of the furrows not in the second and third feet. Throughout the period of the experiment, the percentage of moisture decreased from beneath the furrow laterally to a point midway between furrows, there being a variation of from one to three percent. At the end of the fifth day, there was 0.8 percent or 0.70 inch more moisture in the upper six feet of soil than before irrigation.

The vertical penetration was about five feet, one foot less than in the preceding experiment, indicating that when at irrigation such a soil contains a similar quantity of water, two inches is about the proper quantity to apply in



Experiment No. 2:- Percolation of 2" Irrigation in Laredo Clay Loam: applied in 3"×6" Furrows 3' c. to c. in ½ Hour. Effect of Rainfall - High Initial Percentages: also, .64" & .03" Precipitation on April 11" & 12 respectively.

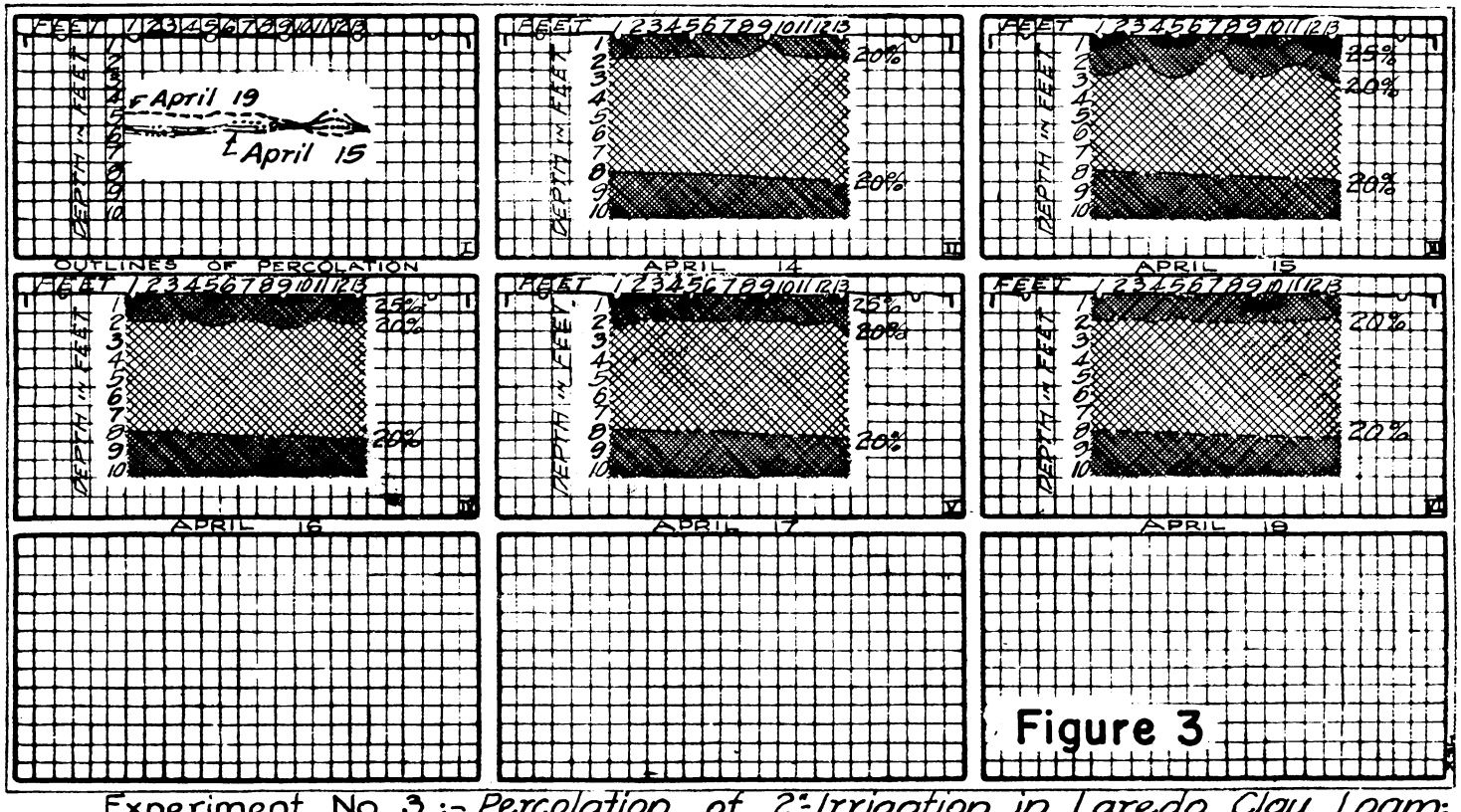


Figure 3

Experiment No. 3 :- Percolation of 2"-Irrigation in Laredo Clay Loam; applied in 3" × 6" Furrows. 4' c. to c.; in 3¼ Hours: Rainfall :- .64"; .03"; and .13" on April 11, 12. and 16 respectively.

producing deep rooting field crops and that at least one-half inch will be lost by gravity below the beneficial range of truck crops. About eight percent or 1.08 inch of the moisture in the surface foot escaped into the air. The results of this experiment are similar to those of one and two, with the added indication that the limit of lateral surface movement in this soil was very nearly reached.

Experiment No. 4

In Experiment No. 4, figure 4, two inches of water was applied in furrows 3 by 6 inches, spaced six feet apart, center to center. Three hours was consumed in making the application. Before irrigation, the surface foot of soil contained 15.3 percent moisture, the upper six feet 15.6 percent. At the end of the fifth day, the soil still contained 1.5 percent or 1.30 inch more moisture than previous to irrigation. At the expiration of the first twenty-four hours, the moisture in the surface foot had moved laterally from one to two feet, average about one and one-half feet. Between two furrows it had united laterally in the fourth and fifth feet; elsewhere it lacked two feet of meeting at any depth. The vertical movement during the first twenty-four hours was about sixty-six inches. At the end of the second day, it had met between all furrows at from three to six feet depth, and had moved downward to about six feet depth. At the end of the fifth day, it still lacked two feet of joining at one and two foot depths, and it is not likely that there was any further appreciable lateral movement. Excepting along the border of the limit of penetration, the moisture percentage attained very nearly equilibrium. At the end of one hundred and twenty hours, the vertical movement extended beyond nine feet.

At the end of the fifth day, there was still 17.1 percent moisture in the six feet of soil, which in considering the experimental data on evaporation indicates that about 0.90 inches of the added moisture was lost into the air, very little, if any, had passed below the six foot depth, and 1.30 inches remained.

It appears that in this type of soil two feet is near the limit of lateral movement in the upper two feet of soil. That in applying water to shallow rooting plants, the supply in the furrow should approach laterally within two feet of the plant; also that there is a waste by percolation if, under the conditions, as much as two inches in depth is applied.

Experiment No. 5

In Experiment No. 5, the same quantity was applied, two inches, and the same spacing of furrows, six feet, as in the preceding experiment. There was before irrigation 16.5 percent moisture contained in the surface foot of soil and 15.8 percent in the upper six feet. After 120 hours, there was 17.1 percent of moisture present, or an average of 1.3 percent more than before irrigation.

Four hours and fifteen minutes was taken to add the water. The lateral movement in the surface foot averaged between eighteen and twenty-four inches. However, the moisture met during the first twenty-four hours at depths of two to five feet, and became distributed throughout the subsoil, not uniformly however, until the end of the fifth day, when the moisture content underneath the ditches and between them did not vary to exceed two percent. There were a few areas in the

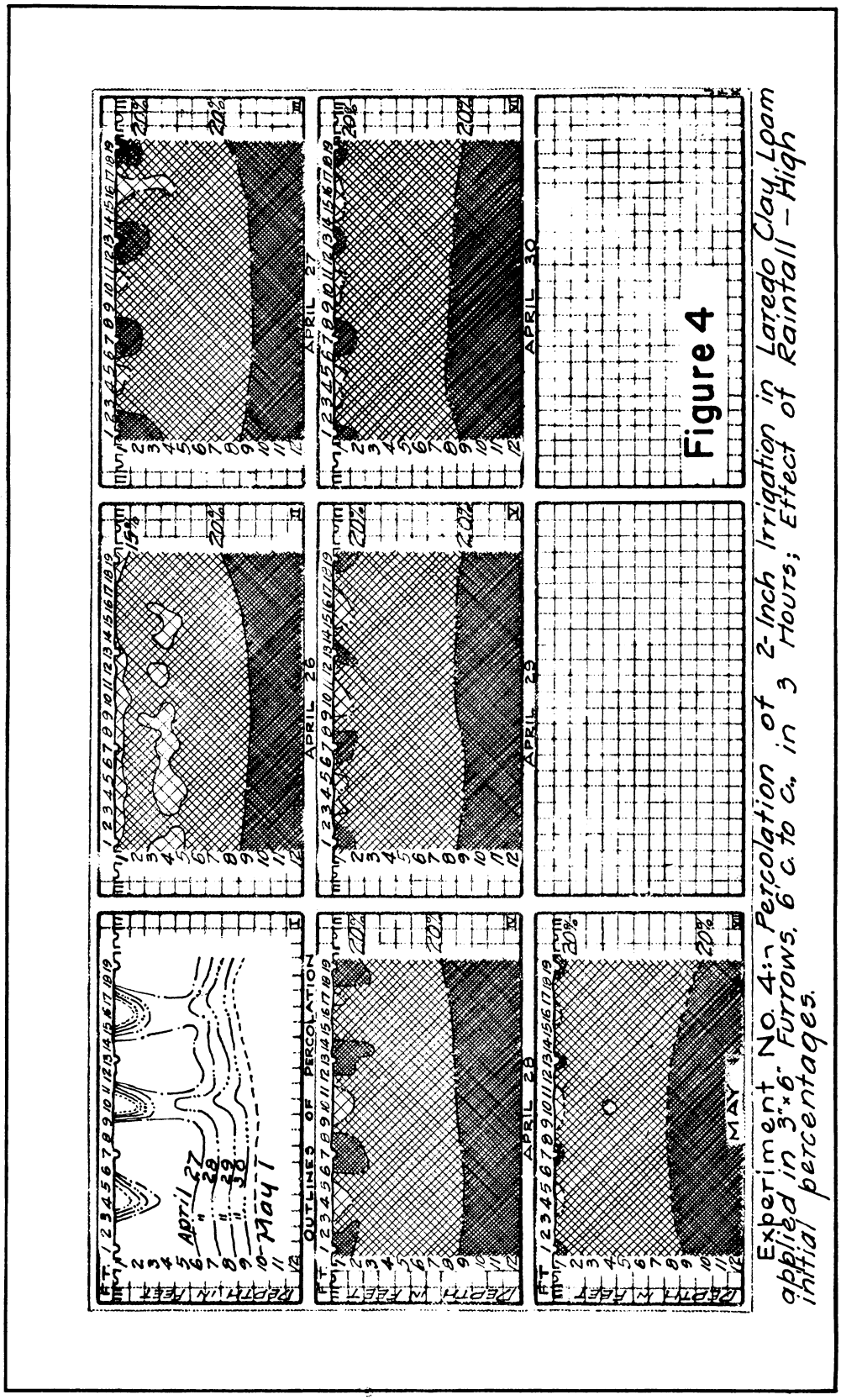


Figure 4

Experiment No. 4:- Percolation of 2-Inch Irrigation in Laredo Clay Loam applied in 3"×6" Furrows, 6 c. to c., in 3 Hours; Effect of Rainfall – High initial percentages.

subsoil which the added water did not reach, they continuing quite dry. This is likely due to a variation in soil texture.

At the close of the experiment, the disposition of the irrigation water appears, from the experimental data, to have been as follows: Of the 2.00 inches applied, 1.3 percent, or 1.11 inches, remained in the upper six feet of soil, and 0.89 inch had evaporated, very little, if any, having percolated to the deeper subsoil.

Experiment No. 6

In Experiment No. 6, figure 5, four inches of water was applied in 3 by 6 inch furrows, spaced two feet apart. The application continued for one hour and thirty-seven minutes. Before irrigation, the surface foot of soil contained 14.0 percent moisture, the upper six feet an average of 16.9 percent. At the end of the fifth day, the upper six feet contained 2.2 percent more moisture than before irrigation. During the first twenty-four hours, the moisture spread through the soil and subsoil, distributing itself over the area quite uniformly and to a depth of a little more than five feet, the percentages varying from 23.0 percent in the surface soil to 17.0 percent in the fifth foot. At the end of the fifth day, the disposition of the added water appears approximately as follows: Evaporated, 1.1 inches; retained in the upper six feet, 1.9 inches; percolated below the six foot limit, 1.0 inch.

Experiment No. 7

In Experiment No. 7, four inches of water was applied in 3 by 6 inch furrows, spaced three feet apart. Time of application, one hour and fifty minutes. Before irrigation, the upper foot of soil contained 12.5 percent of moisture, the upper six feet an average of 15.3 percent of moisture. At the end of the fifth day, the upper six feet contained 2.2 percent more moisture than before the application, which had become quite evenly distributed through the soil, decreasing gradually with depth. The disposition of the water was approximately 1.9 inches retained, 1.0 evaporated, and 1.1 inches percolated below the six feet.

Experiment No. 8

In Experiment No. 8, figure 6, four inches was applied in 3 by 6 inch furrows, spaced six feet apart. The time of application three hours and twenty-seven minutes. Before irrigation the surface foot contained 13.2 percent moisture, and the upper six feet an average of 15.7 percent. During the first twenty-four hours, water moved downward through the upper six feet of soil, a considerable quantity reaching deeper strata. Laterally, the movement in the upper two feet did not penetrate to exceed eighteen inches, the limit of lateral movement at that depth being two feet. Below three feet depth, the moisture united laterally, the percentage decreasing quite rapidly from points directly under the ditches. Rapid vertical movement with correspondingly small horizontal movement of water in this soil is very plainly indicated.

Five days after irrigation, the upper six feet still retained 2.0 percent or 1.7 inches of the added water, 0.9 percent or 0.8 having evaporated, and 1.8 percent

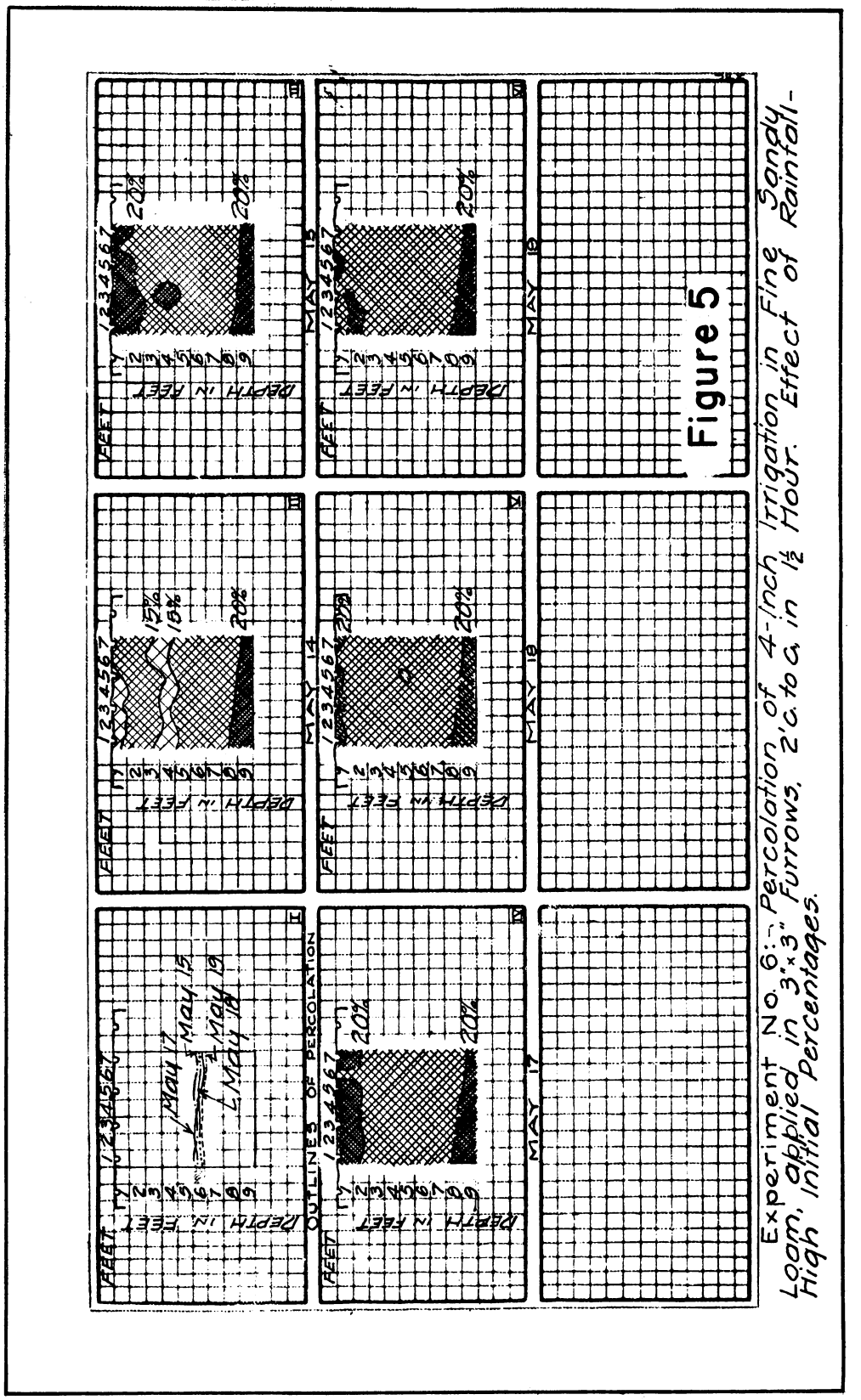
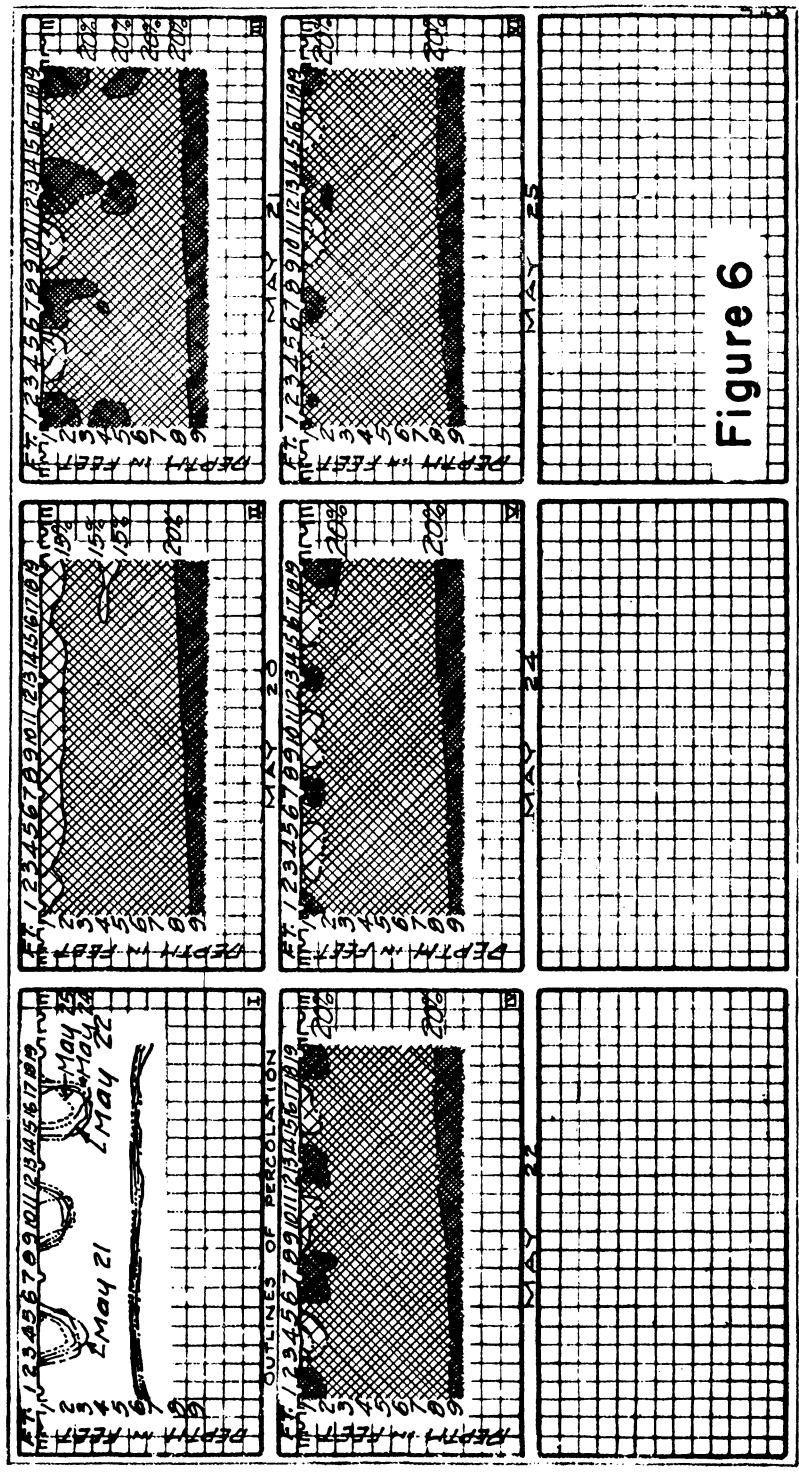


Figure 5

Experiment No. 6:- Percolation of 4-inch Irrigation in Fine Sandy Loam, applied in 3"x3" Furrows, 2'c to c, in ½ Hour. Effect of Rainfall-High Initial Percentages.



Experiment No. 8 :- Percolation of 4-inch Irrigation in Laredo Clay Loam: applied in 3×6" Furrows. 6 a to c, in 3½ Hours. Effect of Rainfall-Moderate Initial Percentages.

or 1.5 inches having been lost in the subsoil below the six foot level.

Experiment No. 9

In Experiment No. 9, figure 7, four inches of water was applied in 3 by 6 furrows, spaced four feet apart, center to center. The time of application, one hour and fifty-six minutes. Before irrigation, the surface foot contained 11.6 percent moisture and the upper six feet, 14.9 percent. During the first twenty-four hours, a considerable quantity of water passed beyond six feet depth by moving vertically from the ditches. After five days, there was retained in the six feet of surface soil, 3.4 percent, or 2.9 inches; 0.9 inch evaporated; and 0.2 inch was lost in the deeper subsoil.

This experiment concludes the work conducted in Laredo loam soil. From a comparison of results, it is believed that the following conclusions are justified:

To this type of soil for shallow rooting crops, such as truck and ordinary grasses, two inches is near the maximum limit of application, and for general field crops, three inches is near the maximum economic quantity per application. Within the limits, the quantity applied will depend upon the crop, the percent of moisture contained in the soil, and the stage of development of the crop.

If at planting shallow rooting crops, as lettuce, spinach, cabbage, tomatoes, beets, the soil is not sufficiently moist, an irrigation of 1.50 to 2.00 inches may be applied to raise the three or four feet of surface soil to a moist condition. Following this at proper intervals, depending largely on climatic conditions, an application of three-quarters to one inch of water near the plant row will serve the purpose better than a larger quantity. It will not water-log the soil, and will permit it to become warm and well-aerated, optimum conditions for young and tender plants.

The lateral movement of moisture in a two foot depth of surface soil is little affected by the duration of the application, or the quantity applied, and if a uniform distribution in the surface soil is necessary, the water must be applied on or near the surface within a lateral distance of six to eighteen inches.

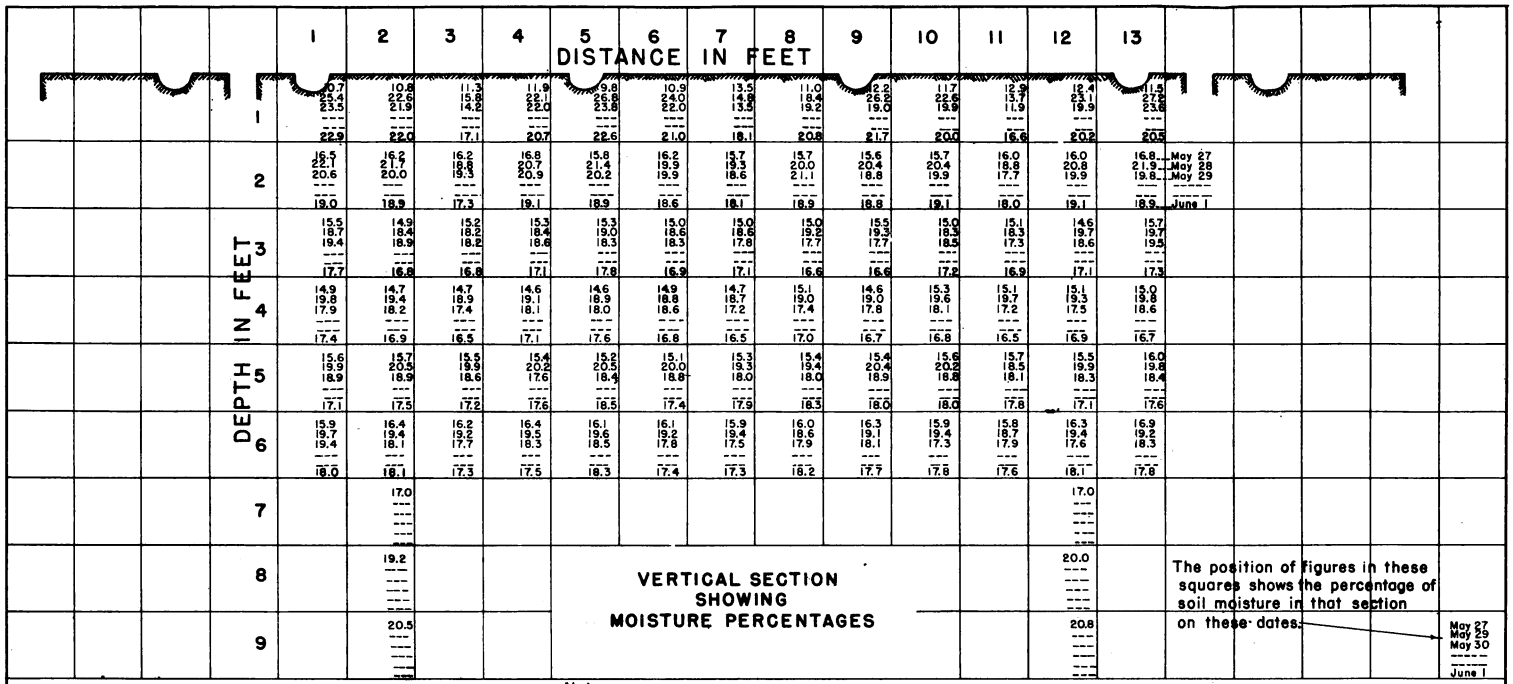
Brennan Fine Sandy Loam

Experiments Nos. 10 to 23 were conducted during June, July, and early August, 1915, near Mercedes, Texas, in Brennan fine sandy loam soil. A time limit on the use of the ground prevented extending the experiments over more than five day periods. In these experiments, the water was confined to the furrows, and no cultivation was practiced.

Experiment No. 10

In Experiment No. 10 two inches of water was applied in 3 by 6 inch furrows, spaced two feet apart. Twenty minutes was used in the application. The soil was very dry and the weather warm.

Before irrigation there was 5.1 percent moisture in the surface foot of soil

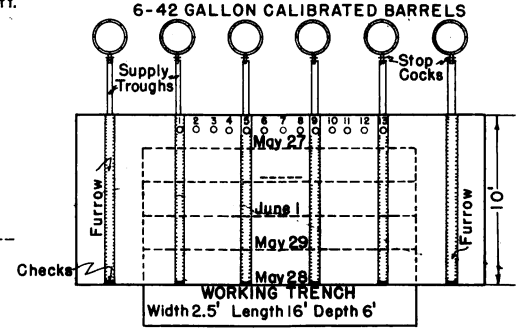


Note:
Irrigation water percolated below 6 feet. Generally, the percentage was highest at end of 24 hours; then gradually decreased.

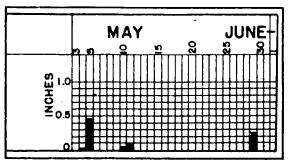
Type of Soil ____ Laredo Clay Loam
Depth of Irrigation ____ 4 Inches
Method of Application ____ In Furrows 3" X 6"
Average Time of Application ____ 1 Hour and 56 Minutes
Spacing of Furrows ____ 4 feet c. to c.
Area Irrigated ____ 10' X 24' = 240 sq. ft.
Location ____ Station Field

Movement of Moisture in Soil in:
24 Hours
48 Hours
72 Hours
96 Hours
120 Hours

SCALE
0 1 2 3 4 Feet



PLAN OF EXPERIMENT



RAINFALL RECORD

TEXAS BOARD OF WATER ENGINEERS COOPERATING WITH U. S. DEPARTMENT OF AGRICULTURE IRRIGATION INVESTIGATIONS 1915 MOVEMENT OF MOISTURE IN SOILS

Mercedes, Texas
W. L. Rockwell - J.F.K.

EXPERIMENT No. 9
Figure 7

Traced and revised by A.C.C. - 1944

and an average of 8.8 percent in the upper three feet. Within the first twenty-four hours after irrigation, moisture met between the furrows, and at the end of five days had become quite evenly distributed throughout the upper three feet with a slightly higher percentage in the third than in the surface foot, with an average in the three surface feet of 2.54 percent, or 1.09 inches more water than before irrigation. There having been no downward movement below the third foot, no loss by percolation resulted, the evaporation amounting to 0.91 inch, nearly one-half the water added.

Experiment No. 11

In Experiment No. 11, figure 8, two inches of water was applied in 3 by 6 inch furrows, spaced 4.0 feet apart, center to center. Forty minutes was used in the application.

Before irrigation, 5.6 percent moisture was present in the surface foot of soil and an average of 9.7 percent in the upper six feet of soil.

During the first twenty-four hours after water was applied, directly underneath the ditches it moved vertically five feet, which was very nearly the limit of downward movement, none passing below six feet.

Laterally in the surface foot, the moisture moved about eighteen inches from the center of the ditches, there being left between ditches an area of dry soil from twelve to fifteen inches in width. The dry areas extended downward, connecting with the dry soil at depth; in fact, these in most instances broadening with depth, the moistened areas being in the form of pockets contracting toward the bottom. At the end of the fifth day, there remained in the upper six feet of soil an average of 1.4 percent, or 1.2 inches, of irrigation water. Eight-tenths of an inch had escaped by evaporation.

This experiment indicates that a little more than two inches of water may be added to and retained by a very dry sandy soil, and to obtain a uniform surface distribution, the furrows must be spaced less than three feet, center to center.

Experiment No. 12

In Experiment No. 12, figure 9, two inches was applied in 3 by 6 inch furrows, spaced six feet apart. Time of application, 32 minutes. Before water was applied, the surface foot contained 5.3 percent moisture, the average of the upper six feet being 10.4 percent.

During the first twenty-four hours, the water traveled vertically from three and one-half to six feet. Laterally, in the surface foot, from eighteen to twenty-four inches. At places in the third and fourth vertical foot, the moisture united from furrow to furrow. Directly underneath the ditches, water passed below six feet depth. At the end of the fifth day, the upper six feet of soil still retained 1.45 inches of the 2.00 applied, approximately 0.40 inch was lost by evaporation, and 0.15 by deep percolation.

The results of Experiments 10, 11, and 12 indicate that the method of appli-

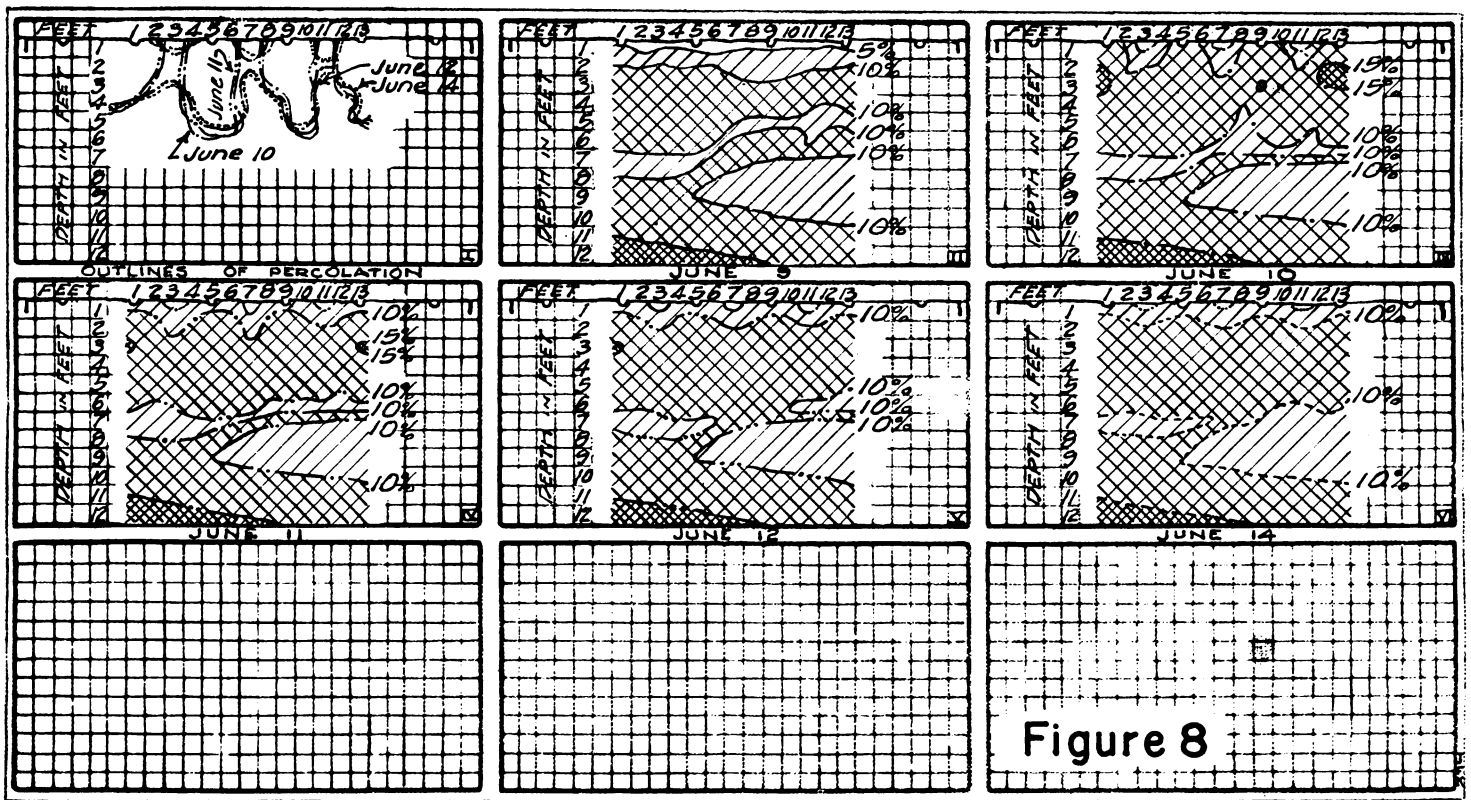
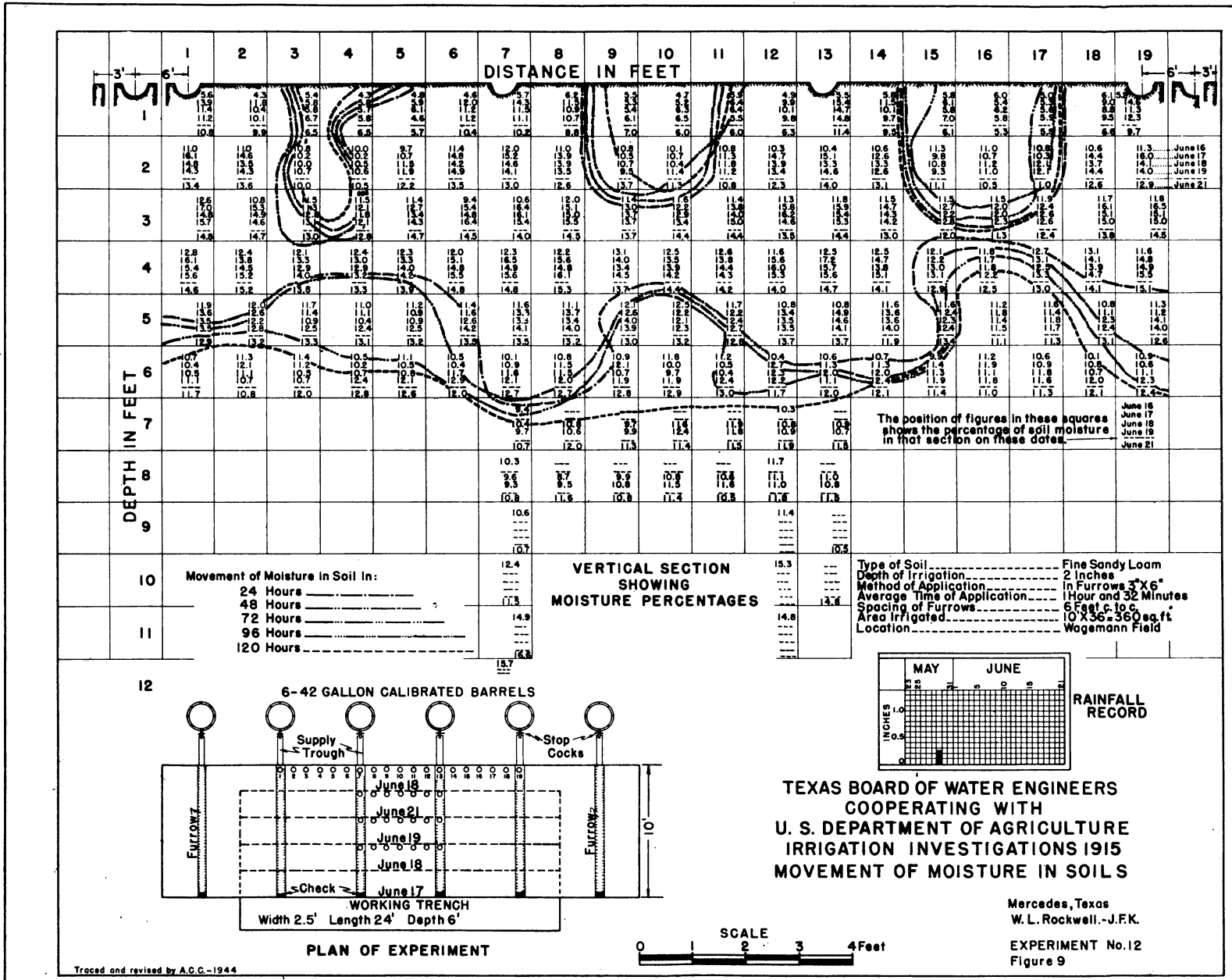


Figure 8

Experiment No. 11:— Percolation of 2-Inch Irrigation in Fine Sandy Loam, applied in 3"×6" Furrows, 4' c. to c. in ¾ Hour. No Influencing Rainfall.


DISTANCE IN FEET
DEPTH IN FEET
3'
6'
Movement of Moisture in Soil In:
24 Hours
48 Hours
72 Hours
96 Hours
120 Hours
VERTICAL SECTION
SHOWING
MOISTURE PERCENTAGES
The position of figures in these squares shows the percentage of soil moisture in that section on these dates.
June 16
June 17
June 18
June 19
June 21
Type of Soil Fine Sandy Loam
Depth of Irrigation 2 Inches
Method of Application In Furrows 3"X6"
Average Time of Application 1 Hour and 32 Minutes
Spacing of Furrows 6 Feet c to c.
Area Irrigated 10'X360 sq.ft.
Location Wagemann Field
6-42 GALLON CALIBRATED BARRELS
Supply Trough
Stop Cocks
Furrow 7
Furrow 1
June 18
June 21
June 19
June 18
Check
June 17
10'
WORKING TRENCH
Width 2.5' Length 24' Depth 6'
PLAN OF EXPERIMENT
SCALE
0 1 2 3 4 Feet
MAY
JUNE
INCHES
1.0
0.5
0
RAINFALL RECORD
TEXAS BOARD OF WATER ENGINEERS
COOPERATING WITH
U. S. DEPARTMENT OF AGRICULTURE
IRRIGATION INVESTIGATIONS 1915
MOVEMENT OF MOISTURE IN SOILS
Mercedes, Texas
W. L. Rockwell.-J.F.K.
EXPERIMENT No.12
Figure 9
Traced and revised by A.C.C.-1944

cation, as well as the quantity applied, directly influence the vertical movement of the water. The longer the time of application, though the quantity applied is the same, the greater is the vertical penetration and the more likely a loss by gravity.

Experiment No. 13

In Experiment No. 13, two inches of water was applied by flooding, the time of application requiring nineteen minutes. At the time of irrigation, the surface foot of soil contained 4.8 percent of moisture, the average of the upper three feet being 9.1 percent. At the end of five days, the average of the upper three feet was 10.6 percent, indicating that 1.5 percent of added moisture remained in this soil. Very little water reached the third foot. At the end of the experiment, 0.65 inch of irrigation water remained, and 1.35 inches was lost by evaporation. The surface was not cultivated.

Experiment No. 14

Four inches of water was applied in Experiment No. 14, figure 10, in furrows 3 by 12 inches, spaced two feet apart. Thirty-eight minutes was taken in the application. Before irrigation, the surface foot contained 4.7 percent of moisture, the average of the upper six feet being 9.7 percent. Twenty-four hours after irrigation, the water had moved downward about three feet. At the end of the second day, it had moved downward one foot farther, and at the end of the fifth day had reached the sixth foot, which was the limit of vertical movement.

The furrows being twelve inches wide and there being only one foot between them permitted a very uniform distribution of the water. At the end of the experiment, 2.25 of the 4.00 inches applied remained, and 1.75 inches was lost by evaporation. There was no loss beyond six feet depth.

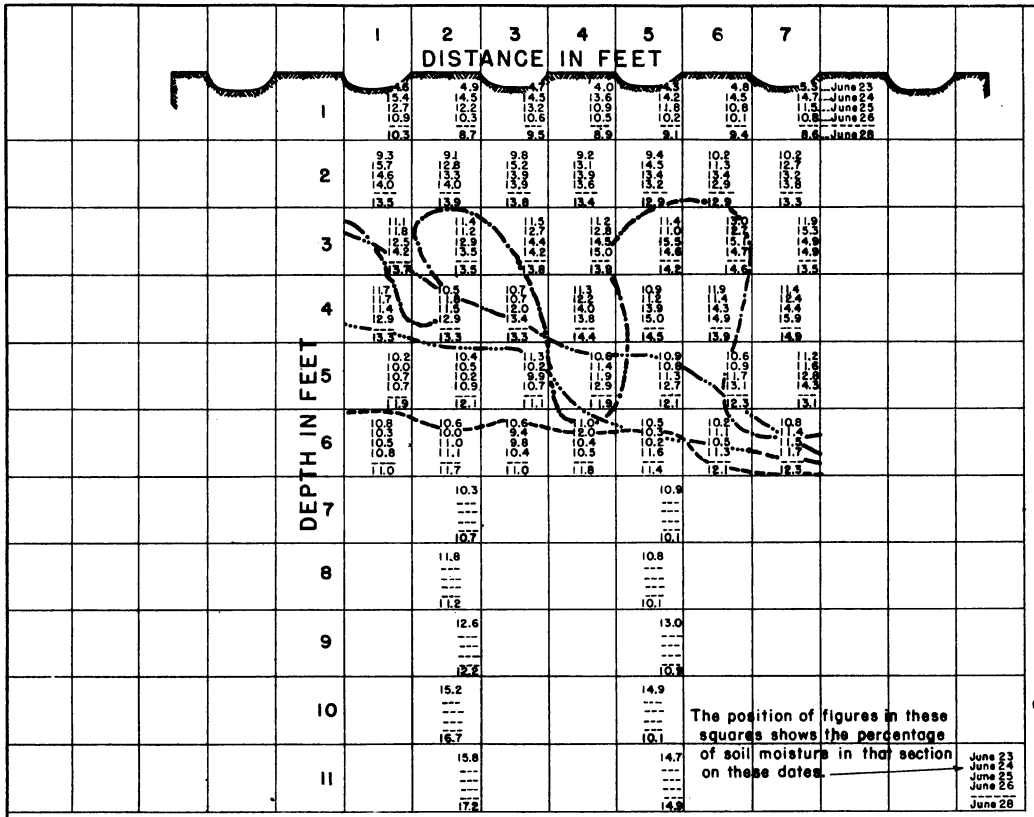
Experiment No. 15

In Experiment No. 15, figure 11, four inches of water was applied in furrows 3 by 12 inches, spaced four feet, center to center. Time of application, one hour and thirty-one minutes.

Before irrigation, the surface foot contained 3.8 percent of moisture, the upper six feet an average of 9.6 percent. The twelve inch furrows brought their borders to a three foot spacing and after the first day, the moisture united on the surface between furrows. At the end of the third day, the water had reached the six foot level, and a small percentage continued to move downward. At the end of the experiment, the larger portion of the water was in the third, fourth and fifth feet, or an average of about 13 percent, as compared with 10 percent in the two surface feet. Two inches of the irrigation water remained, 0.95 inch escaped into the air, and 1.05 inch passed below six feet depth.

Experiment No. 16

In Experiment No. 16, figure 12, four inches was applied in 3 by 12 inch furrows, spaced four feet apart. Time of application, one hour and thirty-one minutes.



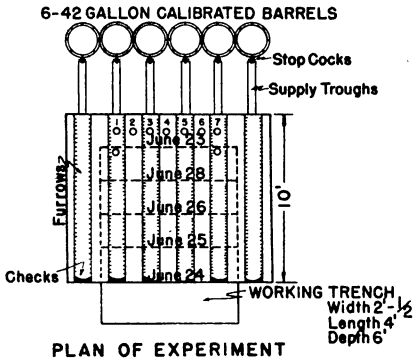
VERTICAL SECTION
SHOWING
MOISTURE PERCENTAGES

The position of figures in these squares shows the percentage of soil moisture in that section on these dates.

Movement of Moisture in Soil in:
- 24 Hours
- 48 Hours
- 72 Hours
- 96 Hours
- 120 Hours

Type of Soil ..... Fine Sandy Loam
Depth of Irrigation ..... 4 Inches
Method of Application ..... In Furrows 3" deep 12" wide
Average Time of Application ..... 36 Minutes
Spacing of Furrows ..... 2 feet c. to c.
Area Irrigated ..... 10'X 12' = 120 sq. ft.
Location ..... Wagemann Field

No Rainfall During June



PLAN OF EXPERIMENT

SCALE
0 1 2 3 4 Feet

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IRRIGATION INVESTIGATIONS 1915
MOVEMENT OF MOISTURE IN SOILS

Mercedes, Texas.
W. L. Rockwell.-J.F.K.

EXPERIMENT No. 14
Figure 10

Traced and revised by A.C.C. - 1944

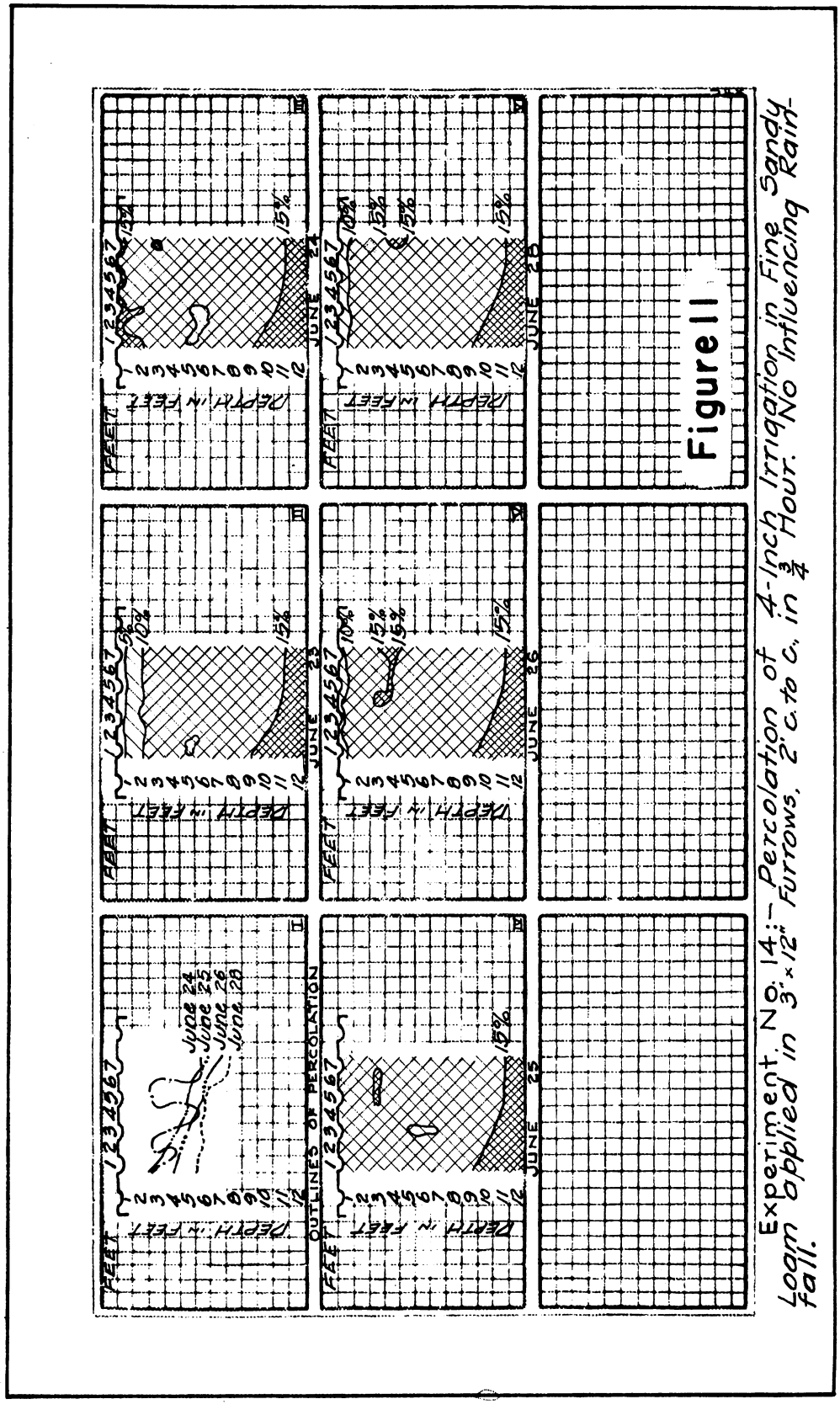
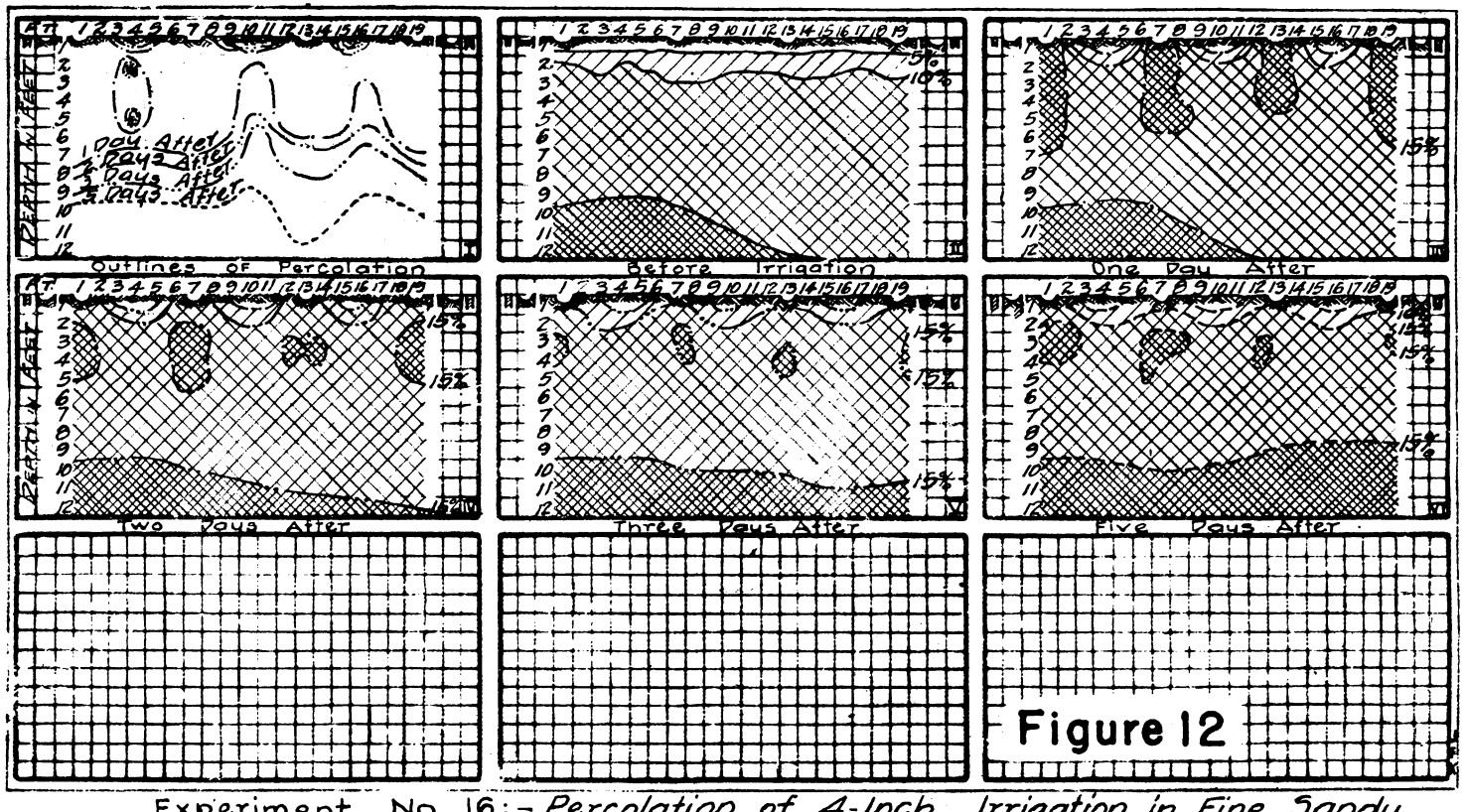


Figure II
Experiment No. 14:- Percolation of 4-inch Irrigation in Fine Sandy Loam Applied in 3"×12" Furrows, 2 c. to c., in ¾ Hour. No Influencing Rainfall.
OUTLINES OF PERCOLATION
June 24
June 25
June 26
June 28
DEPTH IN FEET
FEET
JUNE 24
JUNE 25
JUNE 26
JUNE 28
5%
10%
15%



Experiment No. 16:- Percolation of 4-Inch Irrigation in Fine Sandy Loam, applied in 3"×12" Furrows 6' c. to c. in 2¾ Hours; Effect of Rainfall Negligible.

Before irrigation, the surface foot of soil contained 3.8 percent of moisture, the average of the upper six feet being 9.6 percent. At the end of twenty-four hours, the moisture had moved vertically into the fifth and sixth feet, and laterally had united between the furrows with the exception that on the surface midway between furrows, a strip about two feet wide of dry soil remained. This surface foot between furrows continued to remain dry, but elsewhere throughout the area, the moisture gradually distributed itself. A few spots of dry subsoil between furrows indicate this to be near the limit of uniform lateral movement. At the end of the experiment, the larger portion of the retained moisture was in the third, fourth, and fifth feet. There remained 2.57 inches of irrigation water, 0.63 inch had evaporated, and 0.80 inch passed below the six foot depth.

Experiment No. 17

In Experiment No. 17, figure 13, four inches of water was applied by flooding, twenty-eight minutes being used to make the application. Before irrigation, the surface foot of soil contained 2.4 percent of moisture, and to six feet depth an average of 7.1 percent. During the first day, the vertical movement was not very uniform, moisture reaching from two to five feet depths. However, before the end of the experiment, it became more evenly distributed with the larger percentage in the second and third feet. Very little, if any, water passed below six feet in depth.

At the end of five days, there still remained of irrigation water an average of 3.1 percent, or 2.66 inches, and 1.34 inches escaped by evaporation.

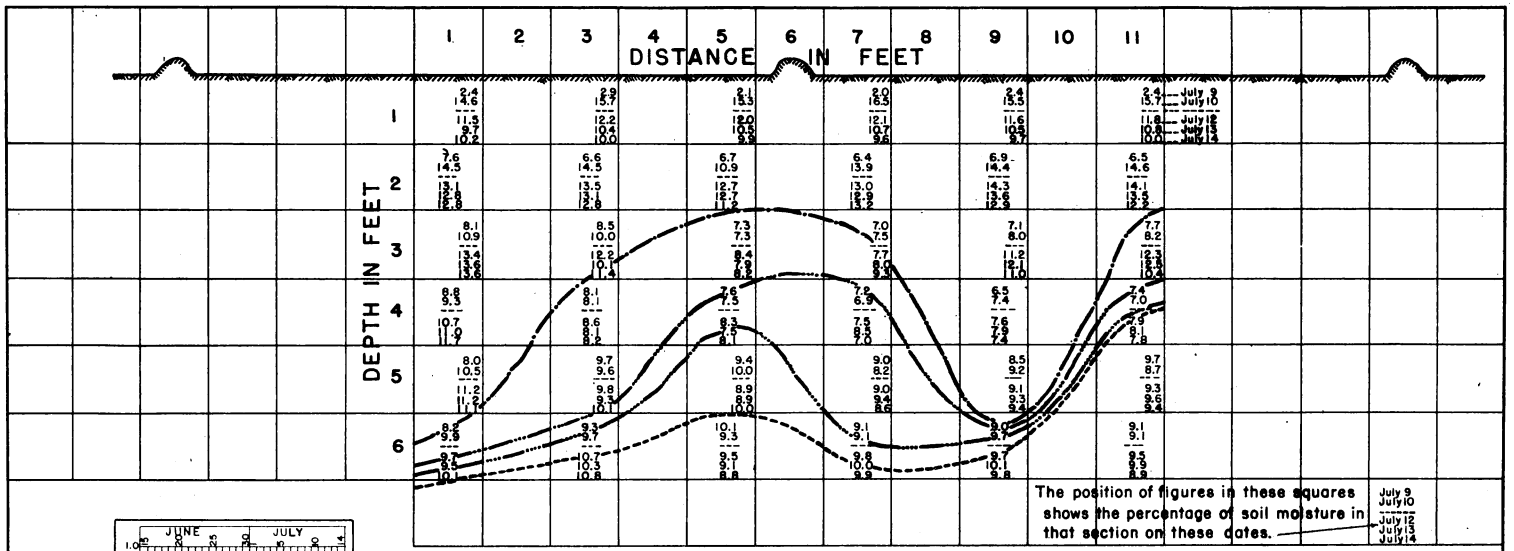
Experiment No. 18

In Experiment No. 18, figure 14, six inches of water was applied in 3 by 12 inch furrows, spaced four feet apart. The application continued for two hours and six minutes. Before irrigation, the surface foot contained 3.7 percent moisture, and the six surface foot contained an average of 7.5 percent.

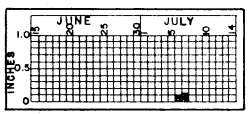
In this experiment, at the end of twenty-four hours the added moisture had met laterally between the furrows and had at a number of points reached the six foot level. At the end of the third day, the percentage of moisture had become very uniform throughout, or as follows: first foot, 10.5; second, 12.6; third, 12.8; fourth, 12.6; fifth, 12.6; and sixth, 11.5 percent, or least on the surface and highest at four feet. At the end of the experiment, the same variation existed with a larger difference in the surface and six foot depths, no doubt due largely to evaporation from the surface and percolation into deeper subsoils. However, the moisture percentages in the sixth foot did not vary but little from the quantity contained before irrigation, and it is not likely that there was much movement to greater depth. The loss from evaporation amounted to 1.10 inch, by percolation, 1.30 inches.

Experiment No. 19

In Experiment No. 19, figure 15, six inches of water was applied in furrows, spaced two feet apart, the time of application being fifty-one minutes. Before irrigation, the surface foot of soil contained 3.4 percent moisture, and the upper

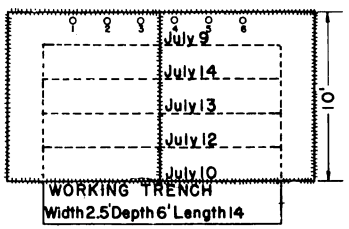


VERTICAL SECTION
SHOWING
MOISTURE PERCENTAGES



RAINFALL RECORD

Type of Soil ..... Fine Sandy Loam
Depth of Irrigation ..... 4 Inches
Method of Application ..... By Flooding
Average Time of Application ..... 28 Minutes
Spacing of Borders ..... 9 Feet c. to c.
Area Irrigated ..... 10'X18'=180 sq. ft.
Location ..... Wagemann Field



PLAN OF EXPERIMENT

Movement of Moisture in Soil in:
24 Hours
48 Hours
72 Hours
96 Hours
120 Hours

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IRRIGATION INVESTIGATIONS 1915
MOVEMENT OF MOISTURE IN SOILS

Mercedes, Texas
W. L. Rockwell - J.F.K.

SCALE
0 1 2 3 4 Feet

EXPERIMENT No. 17
Figure 13

Traced and revised by A.G.C. - 1944

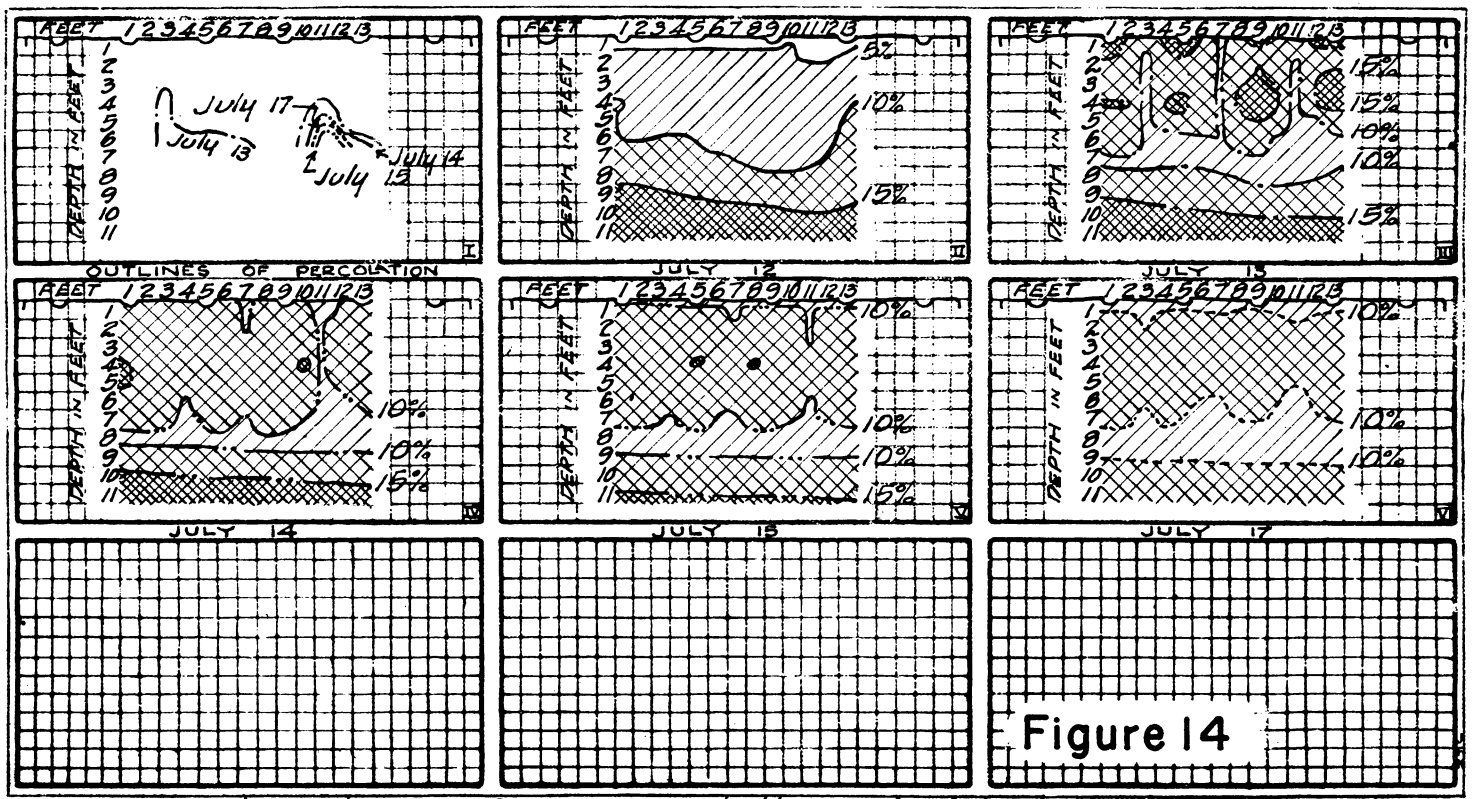
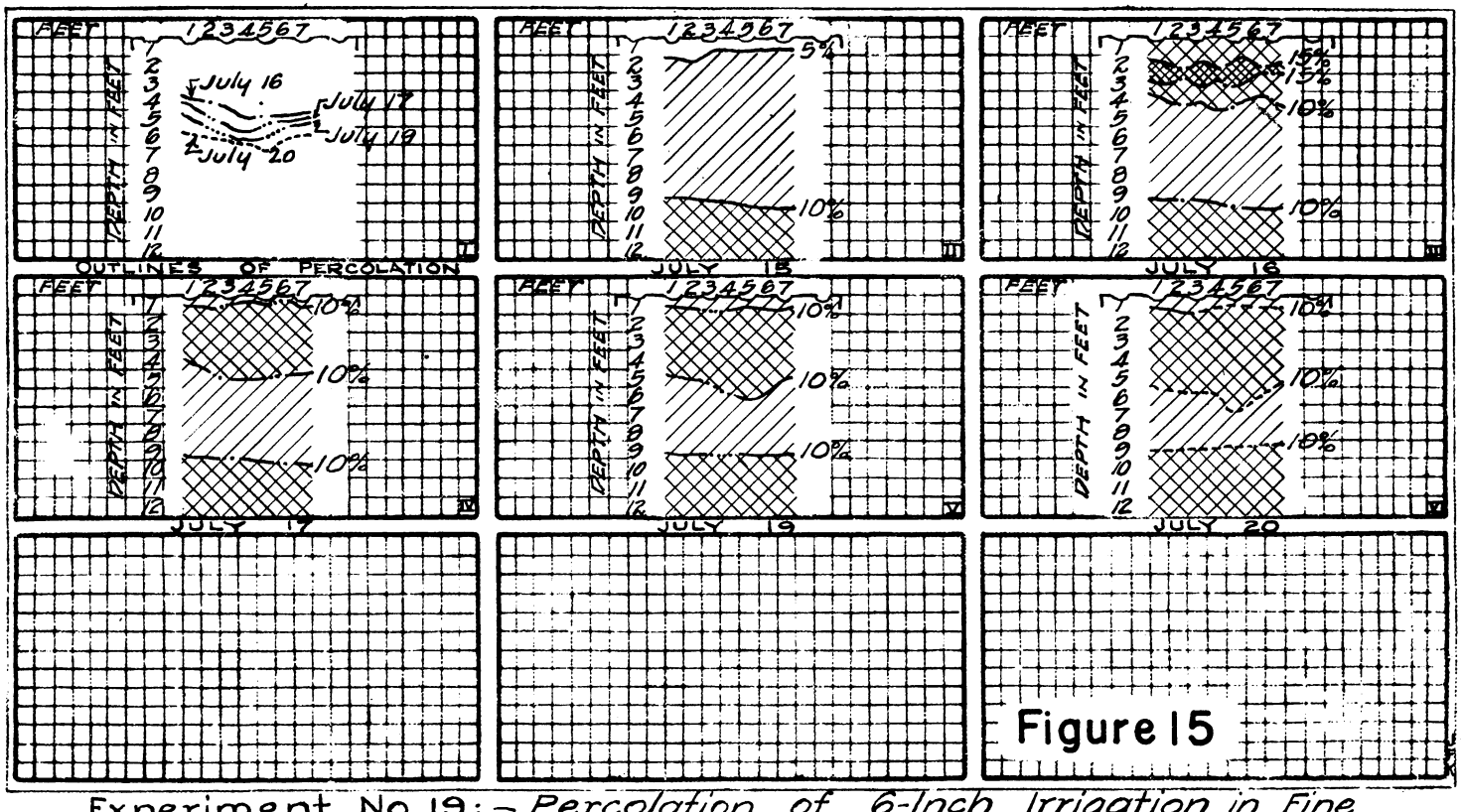


Figure 14

Experiment No. 18:— Percolation of 6-Inch Irrigation in Fine Sandy Loam, applied in 3" × 12" Furrows, 4' c. to c., in 2 Hours. No Influencing Rainfall.



Experiment No. 19:—Percolation of 6-Inch Irrigation in Fine Sandy Loam, applied in 3"×12" Furrows, 2' c. to c., in $\frac{3}{4}$ Hour Effect of Rainfall,—negligible.

six feet an average of 6.7 percent. In twenty-four hours, the water had spread quite uniformly over the area and had moved downward reaching the fourth and fifth foot. At the end of the experiment, the moisture had become distributed in horizontal strata, the higher percentages being in the second to fifth foot. The upper six feet still retained 4.25 inches of irrigation water, 1.00 inch had evaporated, and 0.75 inch moved below the six foot level.

Experiment No. 20

In Experiment No. 20, six inches of water was applied by flooding; the time used, fifty-three minutes. Before irrigation, the surface foot contained 2.1 percent moisture, the upper six feet an average of 6.5 percent.

On one portion of this plat at a depth of about five and one-half feet, there appears to be a rather impervious stratum of soil through which the moisture did not move freely. Elsewhere the moisture penetrated below the six foot level the first day. At the end of the experiment, the moisture had become quite evenly distributed, the surface foot retaining a larger percentage than in previous furrow applications. The surface foot retained 1.5 inches; the upper two feet, 2.7 inches; the upper six feet, 4.80 inches. Loss by evaporation, 1.12 inches; by deep percolation, 1.00 inch. Showers amounting to nearly an inch occurred during the period of the experiment.

Experiment No. 21

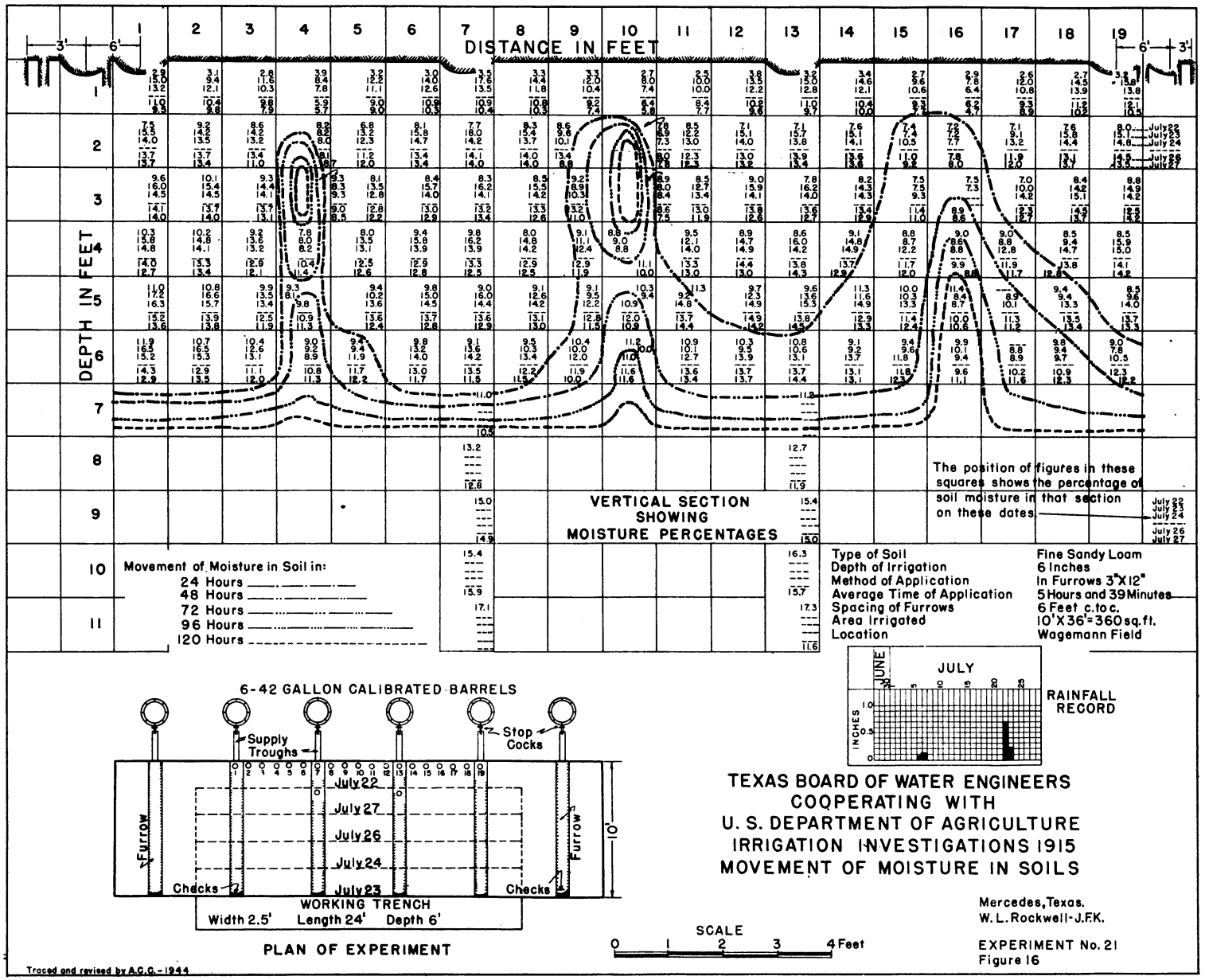
In Experiment No. 21, figure 16, six inches of water was applied in 3 by 12 inch furrows, spaced six feet apart, the irrigation continuing five hours and thirty-nine minutes. At 4:00 a.m. on July 22nd, preceding and during the irrigation, 0.92 inch of rain fell in two showers, which was deducted, only 5.08 inches being artificially applied. Before irrigation, the surface foot contained 3.1 percent of moisture, the upper six feet an average of 7.9 percent.

At the end of the first twenty-four hours after irrigation, moisture met between the furrows in the surface foot, but below this there were intermediate areas into which the added moisture failed at any time during the period of the experiment to penetrate. In the surface foot, intermediate between the furrows, there was a strip about two feet wide which received only about thirty percent as much moisture as that under the furrow, this condition continuing throughout the experiment. During the first day, the vertical movement was upwards of six feet, and moisture continued to move to lower levels.

The disposition of the moisture at the completion of the experiment was as follows: retained in the upper six feet, 3.26 inches; evaporated, 1.64 inches; and passed below the six foot level, 1.10 inches.

Experiment No. 22

In Experiment No. 22, figure 17A and figure 17a, six inches of water was applied in 3 by 12 inch furrows, spaced four feet, center to center. Time of application continued over eight hours and twelve minutes. Before irrigation, the surface foot of soil contained 4.8 percent moisture, the upper six feet an average of 7.4 percent. During the first twenty-four hours, the moisture moved downward five feet and


DISTANCE IN FEET
DEPTH IN FEET
The position of figures in these squares shows the percentage of soil moisture in that section on these dates.
July 22
July 23
July 24
July 26
July 27
VERTICAL SECTION SHOWING MOISTURE PERCENTAGES
Movement of Moisture in Soil in:
24 Hours
48 Hours
72 Hours
96 Hours
120 Hours
Type of Soil — Fine Sandy Loam
Depth of Irrigation — 6 Inches
Method of Application — In Furrows 3"X12"
Average Time of Application — 5 Hours and 39 Minutes
Spacing of Furrows — 6 Feet c. to c.
Area Irrigated — 10'X36'=360 sq. ft.
Location — Wagemann Field
6-42 GALLON CALIBRATED BARRELS
Supply Troughs
Stop Cocks
Furrow
Furrow
Checks
Checks
July 22
July 27
July 26
July 24
July 23
10'
WORKING TRENCH
Width 2.5' Length 24' Depth 6'
PLAN OF EXPERIMENT
JUNE
JULY
INCHES
RAINFALL RECORD
SCALE
0 1 2 3 4 Feet
TEXAS BOARD OF WATER ENGINEERS
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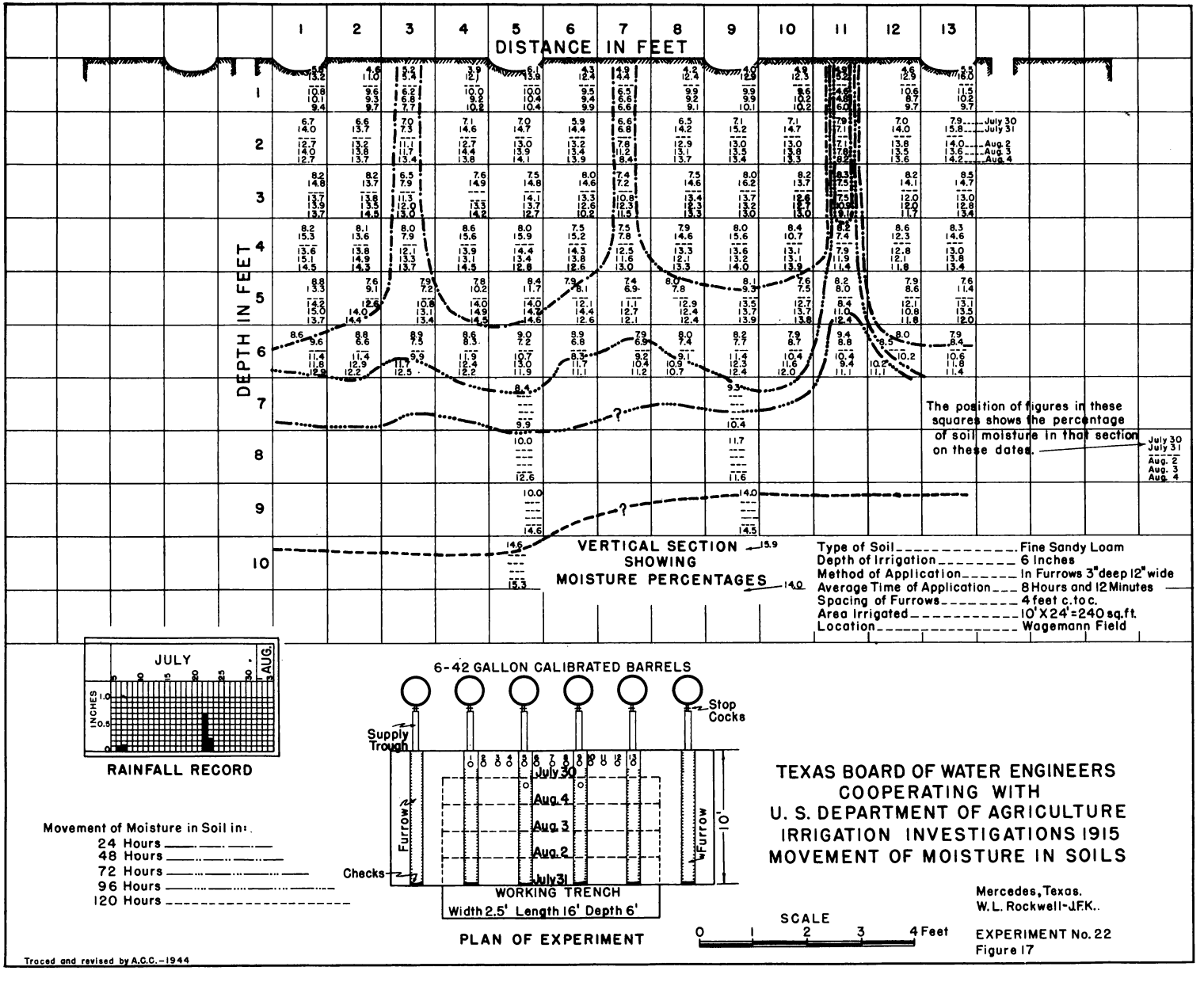
IRRIGATION INVESTIGATIONS 1915
MOVEMENT OF MOISTURE IN SOILS
Mercedes, Texas.
W. L. Rockwell-J.F.K.
EXPERIMENT No. 21
Figure 16
Traced and revised by A.G.C. - 1944


DISTANCE IN FEET
1 2 3 4 5 6 7 8 9 10 11 12 13
DEPTH IN FEET
1 2 3 4 5 6 7 8 9 10
July 30
July 31
Aug. 2
Aug. 3
Aug. 4
The position of figures in these squares shows the percentage of soil moisture in that section on these dates.
VERTICAL SECTION SHOWING MOISTURE PERCENTAGES
Type of Soil ..... Fine Sandy Loam
Depth of Irrigation ..... 6 Inches
Method of Application ..... In Furrows 3" deep 12" wide
Average Time of Application ..... 8 Hours and 12 Minutes
Spacing of Furrows ..... 4 feet c.to.c.
Area Irrigated ..... 10' X 24' = 240 sq. ft.
Location ..... Wagemann Field
JULY
AUG.
INCHES
RAINFALL RECORD
Movement of Moisture in Soil in:
24 Hours
48 Hours
72 Hours
96 Hours
120 Hours
6-42 GALLON CALIBRATED BARRELS
Stop Cocks
Supply Trough
Furrow
Furrow
10'
Checks
WORKING TRENCH
Width 2.5' Length 16' Depth 6'
PLAN OF EXPERIMENT
TEXAS BOARD OF WATER ENGINEERS
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IRRIGATION INVESTIGATIONS 1915
MOVEMENT OF MOISTURE IN SOILS
Mercedes, Texas.
W. L. Rockwell-J.F.K.
SCALE
0 1 2 3 4 Feet
EXPERIMENT No. 22
Figure 17
Traced and revised by A.G.C.-1944

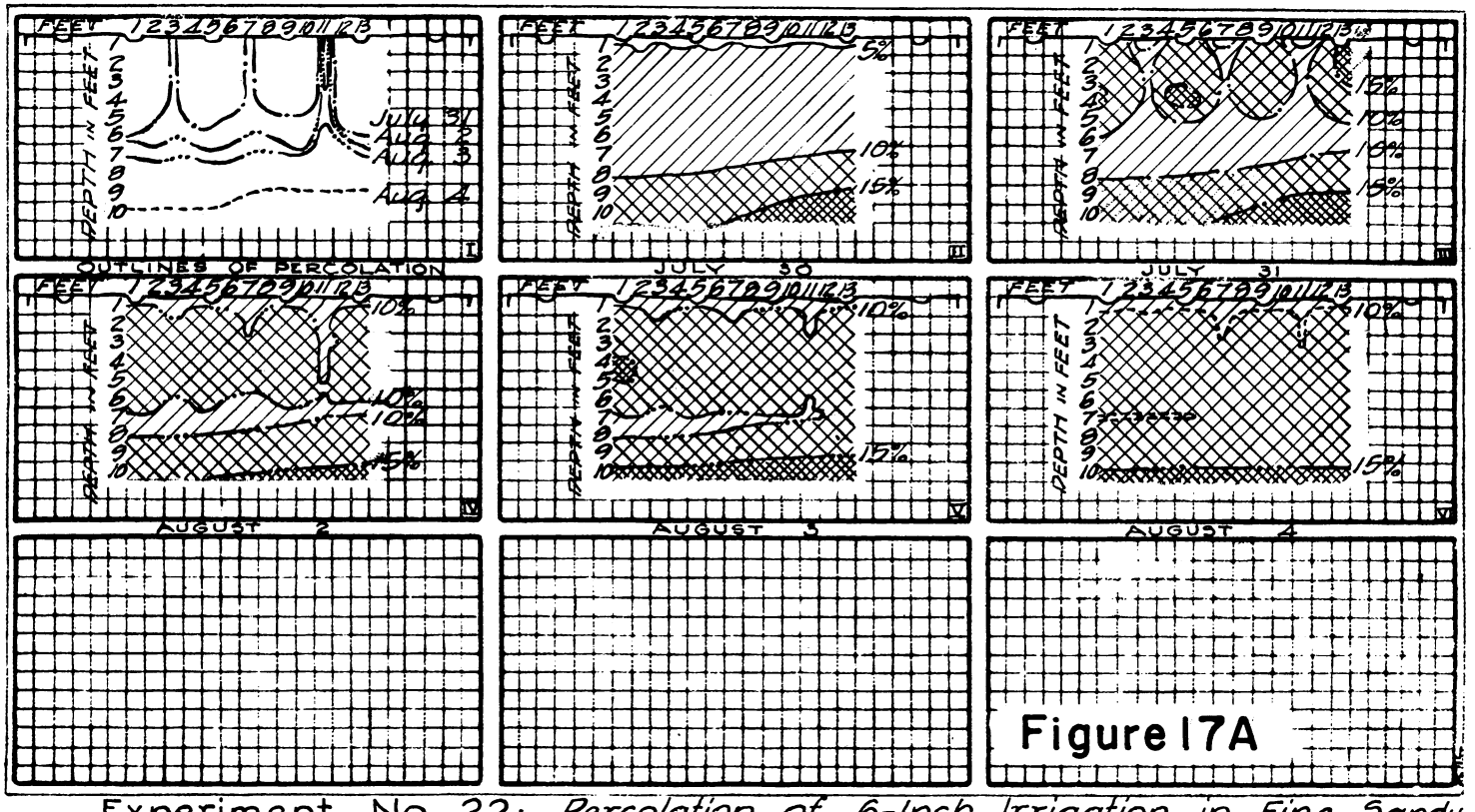

Figure 17A

Experiment, No. 22:- Percolation of 6-Inch Irrigation in Fine Sandy Loam; applied in 3"×12" Furrows 4' c. to c; in 8¼ Hours. No Influencing Rainfall.

laterally about two feet. During the following day, it began passing below the six foot level and laterally united between the furrows, with one exception where a strip of dry soil remained throughout the experiment. At the end of the experiment, the soil in the surface foot midway between furrows contained from sixty to seventy percent of the amount of moisture under the furrows. Below the surface foot, the lateral distribution was quite uniform. The vertical penetration was at least ten feet.

On the last day of the experiment, the percentages indicate there having occurred a light shower not recorded at the station. This is possible in this season of very local, light precipitations.

The moisture distribution was as follows: Retained in the upper six feet, 4.03 inches; evaporated, 1.10 inches; and moved below the six foot level, 0.87 inch.

Experiment No. 23

In Experiment No. 23, figure 18, six inches of water was applied in 3 by 12 inch furrows, spaced four feet apart, center to center. The irrigation continued for over nine hours and twenty-seven minutes. The purpose of the slow application being to learn particularly its affect on lateral movement. In all the experiments thus far conducted, the holding of water in the furrow for long periods had very small effect on lateral movement, particularly near the surface, but did materially increase the vertical penetration, which increased the loss into the subsoil.

Before irrigation, the surface foot contained 3.7 percent moisture and the upper six feet 7.8 percent. At the completion of the experiment, there was a strip of ground from one to two feet wide and from one to three feet deep into which the added water did not penetrate. The moisture percentage gradually decreased from immediately under the furrow to midway between furrows, there being a variation of from two to five percent. The disposal of added water at the end of the experiment was as follows: Retained in the upper six feet of soil, 3.17 inches; evaporated, 0.54 inch; and passed below the six foot level, 2.29 inches.

This experiment concludes the work at Mercedes, the station being moved to Rio Grande station. In the preceding experiments made in Brennan fine sandy loam, the soil was very dry, there being at least five percent less moisture than would be found where a crop is growing. On account of this condition, the loss by gravity was less per quantity applied than would ordinarily occur in practice.

Experiment No. 24

In Experiment No. 24, two inches was applied in furrows, spaced two feet apart, the only variation in methods and conditions from Experiment No. 10 being that the furrows in No. 24 were 3 by 12, instead of 3 by 6 inches, bringing the borders of the furrows six inches nearer together, and there was about one percent more moisture in the soil of No. 24. In this experiment during the first twenty-four hours, the applied moisture scarcely passed through the second foot, but by the third day it had reached the fifth foot and did not move much farther downward until following a rain of 0.62 inch on the sixteenth day, when quite a little passed beyond the six foot level. The percentage of moisture in the soil

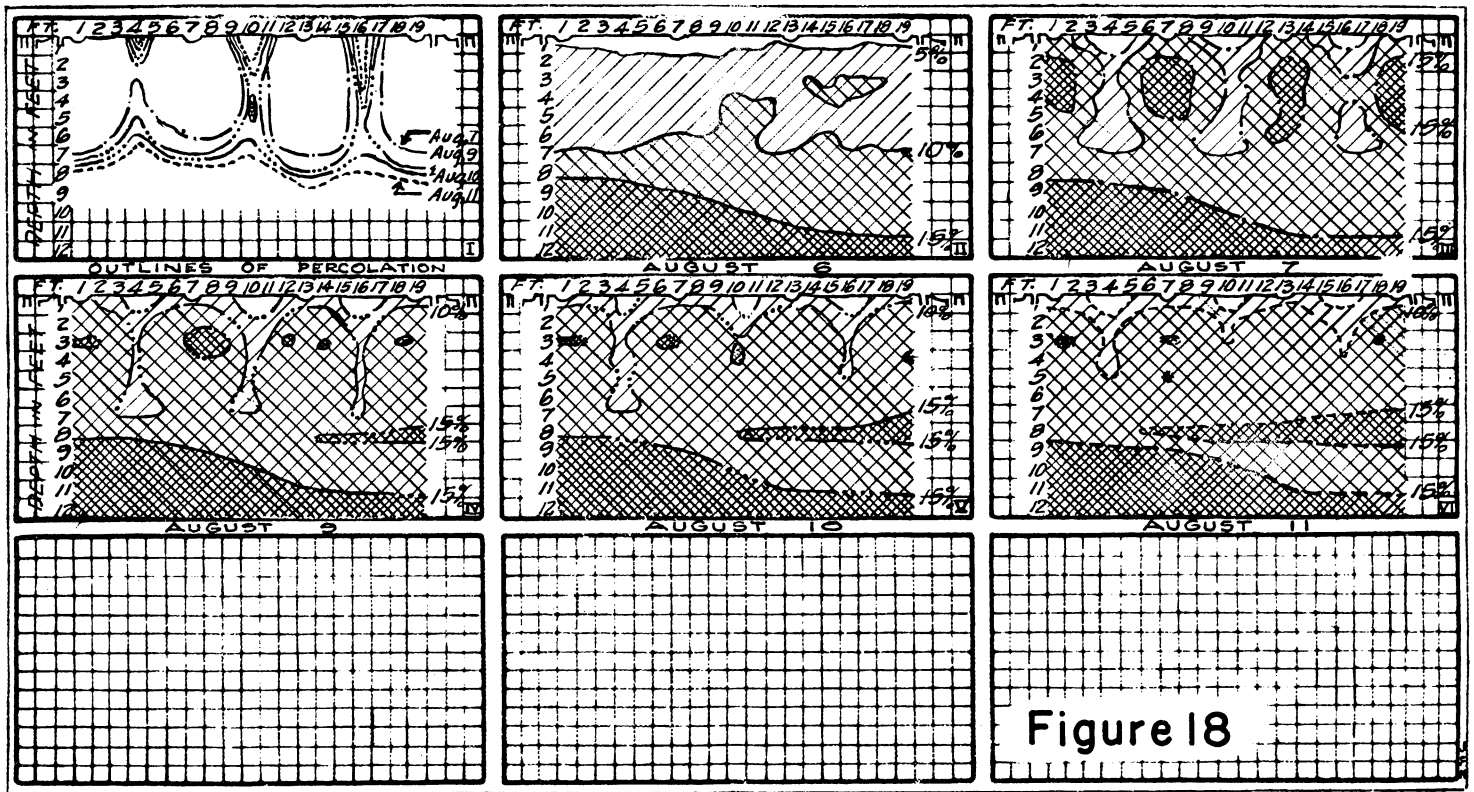

Figure 18

Experiment No. 23:- Percolation of 6-Inch Irrigation in Fine Sandy Loam applied in 3"×12" Furrows, 6' c. to c., in 9½ Hours. Effect of Rainfall, - negligible.

at the end of five days appears to have been nearly as much as after water was applied. This no doubt was due to the condition of the weather at the time, there having been traces of rain, but not sufficient to measure. This condition increased humidity, checked evaporation, and added moisture to the surface soil. Following the tenth day, the moisture content decreased and by the thirtieth day was the same as before irrigation. This experiment, with the duplicate No. 10, indicates that if two inches of water is added to a dry sandy soil, there will be little lost beyond six feet by gravity. However, a slightly higher percentage permits the added quantity to move rapidly downward into the deep subsoil.

Experiment No. 25

In Experiment No. 25, four inches was applied in furrows, spaced two feet apart, center to center. The time of application, one hour and forty minutes. At the end of the first twenty-four hours, added moisture had passed into the sixth foot, the quantity in each foot decreasing from about 2.50 inches in the surface foot to 1.25 inches at six feet. The quantity gradually decreased, at the end of five days 2.80 inches still being retained in the upper six feet, 1.20 inches having evaporated, and about the same quantity moved below the six foot level. At the end of thirty days, the soil was as dry as before irrigation.

At the end of the fifth day, there was from two to three times the quantity of water in the surface foot as before irrigation. In the second foot there still remained one and one-half to two times the original quantity, and in the third foot, about one hundred and fifty percent the quantity before irrigation.

Experiment No. 26

In Experiment No. 26, six inches was applied in 3 by 12 inch furrows, spaced two feet apart, center to center. The time used in the application was two hours and forty minutes.

During the period of the experiment, there were numerous light showers or sprinkles of rain not sufficient to measure, but which produced high humidity and small evaporation. On the fourth day following irrigation, a rain of 0.62 inch occurred. At the end of the third day, and preceding rain, there was still five of the six inches of applied water in the upper six feet of soil, one inch having been lost by evaporation and percolation. Following the rain, the moisture percentage gradually fell and at the end of the experiment, there was about 2.50. inches of the 7.00 inches received by irrigation and rainfall still retained by the six feet of surface soil.

Experiment No. 27

In Experiment No. 27, two inches was applied, and a sprinkle of 0.08 inch came the same day. The irrigation water was applied in 3 by 12 inch furrows, spaced four feet apart, center to center. Before irrigation, there was 6.0 percent moisture in the surface foot and an average of 9.7 in the upper six feet. In forty-eight hours, the applied water had united between furrows and at a few points extended into the third foot. The movement seems to have ceased at the end of the second day. At the end of five days, there was only 0.60 inch of the added

water retained in the soil, 1.48 having been lost into the air. Eighteen days after irrigation, there was a shower of 0.25 inch. At the end of nineteen days, the quantity of soil moisture was the same as before irrigation. Twenty-eight days after irrigation, a rain of 2.56 inches occurred, a portion of which passed below the eight foot level.

The duplicate experiments 11 and 27 indicate that if two inches is added to a dry soil in furrows spaced four feet, a large percentage will be retained in the upper three feet, but that it is too wide spacing to obtain a uniform distribution in the first and second feet. Eighteen inches appears to be near the limit of lateral surface movement in this soil.

Experiment No. 28

In Experiment No. 28, which is a duplicate of No. 15, four inches of water was applied in 3 by 12 inch furrows, spaced four feet apart, center to center. Before irrigation, there was 4.2 percent of moisture in the surface foot and an average of 9.2 percent in the upper six feet. The moisture met between furrows and moved downward beyond the eight foot level during the first twenty-four hours. However, there was a strip about one foot wide extending to a depth of two feet midway between furrows that received very little water.

At the end of five days, the upper six feet of soil still retained 3.45 inches of the added water. At the end of ten days, this was reduced to 2.45 inches.

Experiment No. 29

In Experiment No. 29, six inches was applied in 3 by 12 inch furrows, spaced 4.0 feet, center to center. Time of application, 5 hours and 40 minutes. Before irrigation, there was 5.1 percent moisture in the surface foot of soil and an average of 8.2 percent in the upper six feet. Twenty-four hours after irrigation, the added moisture had moved downward four feet and united between furrows. At all times, the central surface foot between furrows remained quite dry, otherwise the distribution was quite uniform to the seventh foot. Four days after irrigation, there was 4.5 inches of the irrigation water in the upper six feet of soil, but little of it having reached the seven foot level. The losses at this time were about equal, 0.75 inch having escaped into the air. A 2.56 inch rain came the fifth day, which sent considerable moisture into the subsoil.

Experiment No. 30

In Experiment No. 30, two inches was applied in 3 by 12 inch furrows, spaced six feet, center to center. Time, 2 hours and sixteen minutes. Before irrigation, there was 10.8 percent in the surface foot and an average of 12.0 percent in the upper six feet of soil. The two inches applied moved laterally on the surface about eighteen inches and downward immediately underneath the furrows from two to six feet. This experiment further indicates that long time and slow application affect downward movement very appreciably, but have little influence on lateral movement near the surface or in the upper two feet of soil. At the end of five days, the soil still retained 0.30 inches of the added water. The percentage indications point to about one inch having moved below the six foot level and a half inch escaped into the air.

Experiment No. 31

In Experiment No. 31, four inches of water was applied in 3 by 12 inch furrows, spaced six feet, center to center. Time, six hours and eight minutes. The surface foot contained 6.2 percent, and the average percentage in the upper six feet of soil was 9.7. During the afternoon of the day the plat was irrigated, there occurred a shower of 0.55 inch. Four days after irrigation, a shower of 0.47 inch came. At this time, 5.02 inches had been applied and there remained 2.2 inches in the surface six feet. On account of humidity due to the showers and the wide spacing of the furrows, evaporation was small, two inches passing into the deep subsoil and three-fourths inch into the air.

This completes the experiments conducted in Brennan fine sandy loam soil.

These experiments conclusively indicate that in this soil, for shallow rooting crops, the water must be applied very near the plant - not to exceed six inches distant. That for field crops, the water should be applied not to exceed one foot from the plant. Water should be applied quickly and in small quantities, for truck from one to two inches, and for field crops, one to three inches, the quantity of application depending upon the amount of moisture in the soil and the stage of plant growth.

Laredo Clay Soil

Experiment No. 34

Experiment No. 34 was the first work done in Laredo clay soil. Two inches was applied in 3 by 12 inch furrows, spaced six feet, center to center. One hour and thirty-two minutes was given to the irrigation. Before applying, the first foot contained 22.7 percent of moisture, the upper six feet, 24.5 percent. During the first twenty-four hours, the moisture united between furrows and moved downward from two to three feet. After the first day, the distribution was quite uniform near the surface, as elsewhere. By the third day, the moisture had reached the seventh foot, and at the end of the fourth day, there remained of the added moisutre 1.00 inch in the upper six feet of soil, the percentage ranging with depth as follows: 29.9, 28.2, 26.2, 25.1, 22.9, 21.8, from one to six feet depth respectively. At the end of the fourth day, there had been little loss by deep percolation, but about three-fourths inch evaporation. There was a slow downward movement of moisture throughout the experiment.

Experiment No. 35

Experiment No. 35, run from March 3 to April 6. Two inches of water was applied in the standard furrow, spaced six feet apart. Before irrigation, the surface foot contained 23.9 percent moisture, the upper six feet an average of 24.3 percent. Two hours and forty-nine minutes was required to make the application.

During the first twenty-four hours, increase in moisture content reached into the seventh foot, and all the space between furrows was affected. By the third day, the moisture was quite evenly distributed laterally and gradually decreased downward from thirty-three to twenty-three percent in the seventh foot. The upper four feet of this soil is heavy and finely divided. From four feet downward the

sand percentage increases, the tenth foot consisting of a very fine sand. It will be noted that when there was from twenty to twenty-five percent moisture in the upper soil, the tenth foot contained only ten percent, which no doubt represents as much free water in the finely divided sand as twenty percent in the fine grained clay.

During the early part of the experiment, there were several showers and heavy fogs during the forenoon which prevented much evaporation and at times increased the moisture in the first foot. At the end of five days, there were 2.00 inches more moisture in the upper six feet of soil than before irrigation, the loss of one-fourth to one-half inch being divided between evaporation and percolation.

Experiment No. 39

In Experiment No. 39, six inches of water was applied in 3 by 12 inch furrows spaced two feet, center to center. The moisture content of the surface foot before irrigation was 22.9 percent and of the upper six feet 22.7 percent. The time of application extended over twenty-one and one-half hours. During the first twenty-four hours after irrigation, there was an increase of moisture in the third and fourth feet, also in the sixth, seventh, and eighth feet. The third, fourth, and fifth feet are a fine grained, heavy clay, in which the movement of moisture is very slow. Below this clay, the soil increases in sandiness, the ninth and tenth feet being a quick sand. The clay soils contract and crack in drying,and it is likely these cracks extended through to the sandy subsoil and allowed the water to reach the deep subsoil before the fine clay above was moistened.

At the end of the fifth day, the upper six feet contained 2.14 inches of added water. From the evaporation tests, there would be about 1.25 inches loss into the air, indicating a percolation loss below six feet of 2.61 inches. Practically all the 2.14 inches was in the upper two feet of soil.

Rains followed, causing further losses into the deep subsoil, but increasing the moisture ontent of the surface very little, rather tending to hold it uniform.

Experiment No. 40

In Experiment No. 40, the moisture content of the surface foot before irrigation was 20.2 percent and of the upper six feet averaged 22.1 percent. Six inches was added in 3 by 12 inch furrows, spaced four feet, center to center. Time of application, one hour and forty minutes. During the first twenty-four hours, the added water reached the fourth foot and spread uniformly between furrows, even on the surface. It moved steadily downward and at the end of the fifth day, there was still 4.5 inches of the added water in the upper six feet of soil. Experimental tests indicate that of the balance 1.0 inch was lost in the air and 0.50 inch passed below the six foot level.

Twenty-nine days after irrigation and immediately following a rain of 1.64 inches, there was 4.60 inches added water in the upper six feet of soil.

Experiment No. 41

The application in Experiment No. 41 was five inches, the 3 by 12 inch furrows being spaced six feet, center to center. Time of application, fourteen hours

and forty minutes. Before irrigation, the moisture percentage in the surface foot of soil was 27.3 and in the upper six feet averaged 26.3 percent. The experiment was conducted from January 31 to March 3. During the first twenty-four hours, the distribution to a depth of from four to six feet became quite uniform between furrows. Later the movement continued downward and at the end of the fifth day, the moisture percentages show 2.14 inches of the added water still in the upper six feet of soil, tho larger portion being in the first and second feet. Allowing one and one-quarter inch lost by evaporation, 1.61 inches was lost below a six foot depth.

Experiment No. 42

In Experiment No. 42, two inches of water was applied by flooding. Time of application, one hour. Before irrigation, there was in the surface foot an average of 25.2 percent moisture, and in the upper six feet, 24.9 percent. At the end of the first day, the water moved into the second foot, but at no time penetrated beyond the fifth foot, very little reaching that depth. At the end of the fifth day, there was 1.60 inches of irrigation water in the upper six feet, the balance having escaped by evaporation. The greater part of the retained water remained in the upper two feet of soil. After twenty days, there was a little less moisture in the soil than before irrigation.

Experiment No. 43

In Experiment No. 43, four inches was applied by flooding to a soil containing 26.8 percent moisture in the surface foot and an average of 25.1 percent in the upper six feet. The time of application, one hour and thirty minutes on February 14th. The moisture moved into the fourth foot, the limit of penetration. No cultivation was given, and on the heavy soil rapid capillarity was induced. At the end of five days, only 0.85 inch of the four inches applied remained in the soil, the balance having escaped into the air.

Experiment No. 44

In Experiment No. 44, six inches depth of water was applied by flooding, the percentage of moisture in the surface foot before irrigation being 22.7, and in the upper six feet an average of 23.6 percent. An hour and fifteen minutes was taken in the application. In three days, the moisture had reached the third foot and in six days, the fifth foot, the limit of movement. At that time there remained of the added water 2.06 inches, the balance having escaped by evaporation, and perhaps a portion by lateral movement to dryer soil about the experimental plat. The three succeeding experiments indicate a lateral movement of six to eight feet, which no doubt accounts for a portion of the loss by moisture in the experiments conducted in this type of soil. However, the use of the furrows outside the test plat largely overcome this effect, reducing the loss to a minimum. In a field, this would be overcome by universal application, on which would tend to increase the quantity retained by the soil.

Experiment No. 45

In Experiment No. 45, six inches of water was applied in three by twelve inch

furrows, spaced two feet, center to center. Time of application, eights hours and fifteen minutes. The especial purpose of this and other experiments conducted similarly being to learn the extent of the lateral movement of moisture in soils. When the irrigation water was applied, the moisture percentage in the surface foot of soil was 19.9 and the average in the upper six feet, 20.4.

During the first twenty-four hours, the moisture reached the third and fourth feet vertically and moved laterally in either direction to the limit of the sampling, eight feet, increasing the moisture in the surface foot about five percent and in the second foot depth, five to seven percent. The form of the wetted area was that of a shallow basin having the greatest depth under the point of application and extending outward and upward until the surface was reached. It is evident that the close grained soil at two and three feet depths checked the vertical and increased the lateral movement.

Experiment No. 46.

In Experiment No. 46, four inches of water was applied in three furrows, spaced two feet, center to center, and samples were taken for a distance of eight feet outside the outer furrows. The experiment was conducted during March and April.

Before water was applied, the surface foot contained 20.2 percent of moisture and the upper six feet an average of 22.1 percent.

During the first twenty-four hours following irrigation, moisture moved laterally in one direction at least eight feet, the percentages in the surface foot ranging from 32.0 under the furrows to 23.0 at eight feet. In the opposite direction, the movement was limited to six feet, this notwithstanding the fact that the moisture contained by the soil before irrigation was the same on either side. The downward movement during the first two days was about two feet and finally reached a depth of five feet. From the point of application laterally, the depth affected gradually decreased, the surface being reached at six and eight feet.

Experiment No. 47

In Experiment No. 47, two inches was applied in three furrows, spaced two feet, center to center. Time of application, twenty minutes. Before irrigation, the surface foot contained 22.0 percent moisture, and the six feet and average of 22.0 percent. On the day water was applied, there was 0.10 rain; on the second day after, 0.21 inch; and on the third day after, 0.48 inch, or a total of 0.79 inch.

During the first twenty-four hours, the water had moved laterally six and seven feet in opposite directions from the point of application. It did not move to exceed one foot laterally after the first day, the percentages under the furrows being about 33.0 or an increase of ten percent, and at the limit of movement from two percent to no increase. The vertical movement under the furrows was about three feet, most of the water remaining in the upper two feet of soil.

Experiments 45, 46, and 47 indicate that there is in this soil quite a free lateral movement near the surface. That the extent of later movement is appreciably influenced by quantity applied, as well as time of application, the horizontal movement increasing with the increase of these factors. That for shallow rooting

plants irrigated under normal conditions as much as four acre-inches applied will be largely retained in the upper three feet of soil to be used by a crop. This may be applied in furrows spaced as far as eight feet and give a fairly uniform distribution on the surface.

Laredo Silt Loam

Experiment No. 48

Experiment No. 48 is the first conducted in Laredo silt loam type of soil. In this, two inches of water was applied in 3 by 12 inch furrows, spaced two feet, center to center. Before irrigation, the surface foot contained 26.0 percent moisture and the six surface feet an average of 22.4 percent. The time of application, twenty minutes. Water disappeared in the furrows in fifty-eight minutes after the application began. During the first twenty-four hours, water moved into the third foot and did not penetrate farther.

At the end of the fifth day, there was 1.05 inches of the added water in the upper three feet of soil, the balance having escaped into the air. It is possible that a small quantity moved laterally into adjoining soil, but if any, it must have occurred in the surface foot and the quantity very small.

Experiment No. 49

In Experiment No. 49, two inches of water was applied in 3 by 12 inch furrows, spaced four feet, center to center. Time of application, fifty-seven minutes. Before irrigation, the surface foot contained 24.9 percent of moisture and the six upper feet an average of 20.1 percent.

During the first twenty-four hours, moisture moved into the fourth foot. At the end of the fourth day, the upper six feet contained 1.50 inches of the added moisture. The sampling showed the ninth and tenth feet to be saturated, and at this time, there appeared to be an upward movement of this water to the fifth and sixth feet. During the fifth day, a rain occurred, increasing the moisture to a depth of four feet at least. At the end of ten days, there was about one inch more moisture in the upper six feet of soil than before water was applied.

Experiment No. 50

In Experiment No. 50, two inches of water was applied in 3 by 12 inch furrows, spaced six feet, center to center. Time of application, one hour and eighteen minutes. Before irrigation, the surface foot contained 24.9 percent of moisture, the average of six feet depth, 21.1 percent. At the end of the first day, water had reached the third foot, and did not move farther vertically. At the end of five days, there was 1.80 inches of the added water in six feet depth of soil. The balance escaped into the air. At the end of ten days, the percentages indicate only one third inch water retained, the balance having evaporated.

Experiment No. 51

In the 51st experiment, four inches was added in 3 by 12 inch furrows, spaced

two feet, center to center. Time of application, thirty-four minutes. Before irrigation, the surface foot contained 13.3 percent moisture, and the six feet an average of 18.9 percent. The water moved downward the first day into the third foot and there does not appear to have been more vertical movement. At the end of the fifth day, there was 2.65 inches more water in the upper four feet than before irrigation. There appears to have been an upward movement from the saturated subsoil to the fourth, fifth, and sixth feet. This may have been induced by the holes produced in sampling.

Experiment No. 52

In the 52nd experiment, four inches of water was added in furrows spaced four feet, center to center. Time of application, one hour and twelve minutes. Before irrigation, the surface soil contained 23.2 percent moisture and to six feet depth an average of 21.5 percent. In twenty-four hours, the moisture reached the three foot level and continued downward and laterally spreading quite uniformly throughout the upper five feet of soil. At the end of five days, there was still retained of the added water 2.1 inches. The experiment was conducted during a hot, dry August, inducing heavy evaporation. Little moisture moved below six feet depth.

Experiment No. 53

In the 53rd experiment, four inches was applied in furrows spaced six feet, center to center. Time of application, eight hours and twenty-six minutes. Before water was applied, the surface soil contained 16.2 percent moisture, and the upper six feet an average of 20.4 percent. The moisture movement was quite irregular in this experiment. The first day, the vertical movement was quite universal to a depth of three feet, but beyond that depth there were pockets and dry areas, the extreme vertical movement for the first twenty-four hours being about seven feet. In the succeeding four days or after the first day, there was little movement and at the end of the fifth day, 3.3 inches of the added water still remained in the surface soil, the balance having been lost into the air.

Experiment No. 54

While applying the water in Experiment No. 54, it began raining, 0.33 inch falling, making the application 6.06 inches, instead of 6.00, and producing a combination of furrow and flooding irrigation. Time of application, two hours and fifty minutes. Before irrigation began, the surface soil contained 17.7 percent moisture and the upper six feet an average of 21.4 percent. In twenty-four hours, water had reached the fifth foot, and on the fourth day, the seventh foot, the vertical limit of movement. On the fifth day, the average percentages varied with depths as follows: 28.5, 26.5, 24.4, 21.7, 23.3, and 23.4, and there was 2.75 inches of the irrigation water still retained in the six upper feet of soil. Approximately two inches was lost into the air and one and one-quarter inch by percolation.

Experiment No. 55

Six inches of water was added in Experiment No. 55, in furrows spaced four feet, center to center. Time of application, three hours and fifty-five minutes. Before irrigation, there was 12.9 percent of moisture in the surface foot and an average of 17.8 percent in the upper six feet.

The first day, the moisture penetrated the fourth foot when the general movement appears to have ceased, the only further change being an equalization of percentages to eight feet depth.

On the fifth day, there was 5.50 inches more water in the upper six feet of soil than before water was applied. This quantity had been increased, however, by two light showers on two successive days. This quantity, with one-half inch additional was lost into the air, as very little passed into the deeper subsoil.

Experiment No. 56

In Experiment No. 56, six inches was applied in furrows spaced six feet apart, center to center. Time of application, four hours and forty-eight minutes. Before irrigation, the surface soil contained 25.3 percent of moisture and the upper six feet an average of 21.4 percent.

The vertical movement was not very uniform, but moved in pockets, the extreme penetration during the first day being about six and one-half feet. At the end of the fourth day, there was 3.95 inches of added water still in the upper six feet of soil, an inch and one-fourth evaporated and three-fourths inch moved below the six foot level. Twenty-four hours later, the moisture percentages show only 2.15 inches in the soil, indicating two inches evaporation and 1.85 inches percolation.

Experiment No. 57

In Experiment No. 57, two inches of water was applied by flooding, the time of application being sixteen minutes. Before irrigation, the surface foot contained 27.8 percent moisture, and the upper six feet of soil an average of 21.6 percent. During the first day, the irrigation water scarcely reached the second foot, and after four days, ceased movement at the third foot. At the end of five days, the upper three feet had lost into the air all the added water, also the moisture from a light rain occurring on the fifth day.

Experiment No. 58

In Experiment No. 58, four inches of water was applied by flooding. Time required, thirty-eight minutes.

Before irrigation, the surface foot contained 17.8 percent moisture and the upper six feet 22.3 percent. During the first day, the water entered the upper two feet of soil and after four days ceased movement, having penetrated about half way through the third foot.

At the end of four days, there was 2.6 inches more water in the upper three feet of soil than it contained before irrigation, the balance plus 0.69 inch rain having escaped by evaporation. At the end of nine days, there was 1.80 inches of added water in the upper three feet, a total of 2.90 inches having evaporated.

Experiment No. 59

In Experiment No. 59, six inches was added by flooding. Time required, forty-one minutes. Before irrigation, the surface contained 22.2 percent moisture, and

the upper six feet an average of 21.1 percent. The vertical movement over the plot was somewhat irregular. Over a portion, the water applied reached the second and third foot; in other parts, the increase reached the seventh and eighth feet. At the end of five days, over a portion of the plat the vertical movement ceased in the sixth foot; at other points, it extended to nine or ten feet. At that time, there was 3.85 inches more water in the upper six feet than before irrigation. The evaporation experiments indicate a loss of 1.75 to 2.00 inches, leaving a small loss by gravity below six feet.

Experiments 60, 61, and 62 were conducted to learn the extent of lateral movement of moisture in this soil. The water was applied to each in three, 3 by 12 inch furrows.

Experiment No. 60

In Experiment No. 60, two inches of water was applied, the time of application, twenty-six minutes. The ditches of this plat were made a few days before beginning the experiment, and a shower occurred, increasing the moisture in the soil immediately below the furrows. The average percentage under the furrows was 22.0 percent, and that elsewhere 14.2. The variation disappears in the fourth foot.

In five days, the moisture underneath the furrows had reached six feet depth. The variation in sampling does not clearly define the limit of lateral movement, but in twenty-four hours, it had reached on the surface the limit of sampling, or eight feet, though there appears to have been intermediate areas in which there was little, if any, increase in moisture.

Experiment No. 61

In Experiment No. 61, four inches was applied, the moisture percentage in the surface foot being 19.9. In twenty-four hours, the water had reached the fourth foot and had spread laterally six to eight feet, the increase in moisture not being more than two percent beyond four feet. The gravity movement continued into the seventh foot, but the lateral movement after the first day was small.

Experiment No. 62

Six inches of water was applied in Experiment No. 62, the time required, one hour and forty-seven minutes. Before irrigation, the surface foot of soil contained 24.4 percent moisture, and the upper six feet 20.3 percent.

Water was carried by gravity into the seventh foot. Laterally, the movement on the surface reached from four to six feet, at the limit the increase in moisture being from two to three percent. The lateral movement gradually contracted to width of application at depth.

These experiments indicate that for shallow rooting plants, well established in this type of soil, water may be applied with good effect in furrows spaced as far as six or eight feet. This does not include seed beds or the irrigation of plants like lettuce and onions, to which the moisture is best and most economically applied in small quantities as close as practically possible to the plants without

coming in contact with them. To truck crops growing in this type of soil, from one to two and one-half inches may be economically applied, the quantity depending upon the amount of moisture already in the soil and the stage of the plant. To field crops, from one to three and one-half inches may be efficiently applied, the larger quantity being necessary in the event of a very dry soil or at the period of heavy fruiting during very warm, windy weather. The soil should contain the maximum percentage of moisture for that plant during the period of heading, fruiting, or grain production.

Table 1 is a resume of that which goes before. In it is shown the type of soil, the experiment number, quantity of water applied in irrigation, the rainfall occurring during the progress of the experiment, method and time of application, the percentage of moisture in the soil before irrigation, the quantity retained for five days, and the approximate losses by evaporation and gravity.

Distribution of Moisture in Soil — Laredo Loam Soil - Mercedes, Texas

Exp. No.	Applied Inches Irr.	Applied Inches Rainfall	Furrows Sys.	Width of Space: feet	Time of application Mins.	Quantity of Moisture: First foot: Before Irrig. Percent	First foot: Retained Inches Water	Second foot: Before Irrig. Percent	Second foot: Retained Inches Water	Third foot: Before Irrig. Percent	Third foot: Retained Inches Water	Fourth foot: Before Irrig. Percent	Fourth foot: Retained Inches Water	Fifth foot: Before Irrig. Percent	Fifth foot: Retained Inches Water	Sixth foot: Before Irrig. Percent	Sixth foot: Retained Inches Water	Average Six feet: Before Irrig. Percent	Average Six feet: Retained Inches Water	Evap. loss per Inch	Perc. loss per Inch
1	2.00	0.64	3x6	2.0	90	19.6	0.55	17.6	0.25	16.7	0.25	16.5	0.25	16.6	0.24	17.6	0	17.4	1.54	0.75	0.35
2	2.00	0.64	3x6	3.0	87	19.8	0.60	18.2	0.25	16.1	0.30	15.4	0.32	16.1	0.22	16.8	0.20	17.1	1.89	0.40	0.35
3	2.00	0.13	3x6	4.0	198	22.4	0.16	18.8	0.12	17.0	0.10	16.2	0.19	16.8	0.05	16.8	0.05	18.0	0.70	1.08	0.05
4	2.00	0.20	3x6	6.0	180	15.3	0.33	16.1	0.27	15.3	0.21	14.8	0.19	15.6	0.18	16.5	0.12	15.6	1.30	0.90	0
5	2.00		3x6	6.0	255	16.5	0.21	15.5	0.37	15.1	0.24	15.2	0.16	15.8	0.10	17.0	0.03	15.8	1.11	0.89	0
6	4.00		3x6	2.0	97	14.0	0.72	16.9	0.33	15.4	0.28	14.7	0.32	15.6	0.15	16.9	0.07	15.6	1.90	1.11	1.00
7	4.00		3x6	3.0	115	12.5	0.73	16.0	0.43	15.4	0.21	14.9	0.21	15.9	0.18	17.2	0.14	15.3	1.90	1.00	1.11
8	4.00		3x6	6.0	207	13.2	0.56	16.4	0.31	15.9	0.27	15.5	0.26	16.3	0.17	16.8	0.13	15.7	1.70	0.80	1.50
9	4.00		3x6	4.00	56	11.6	1.23	16.1	0.37	15.2	0.27	14.9	0.29	15.5	0.32	14.9	0.42	14.7	2.90	0.90	0.20
Brenman Fine Sandy Loam Soil																					
10	2.00		3x6	2.0	30	5.1	0.50	8.8	0.44	9.6	0.14	10.1	0	9.7	0	9.8	0.01	8.8	1.09	0.91	0
11	2.00		3x6	4.0	40	5.6	0.40	9.7	0.30	11.3	0.26	10.9	0.12	10.4	0.12	10.6	0	9.7	1.20	0.80	0
24	2.00	0.66 0.87	3x12	2.0	45	6.3	1.00	8.5	0.46	8.0	0.12	7.6	0.16	8.3	0.28	9.2	0.10	8.0	2.10	0.56	0
27	2.00	0.08 2.88	3x12	4.0	60	6.0	0.73	9.0	0.18	10.2	0.07	10.4	0.13	11.5	0.13	11.4	0.03	9.7	0.60	0.48	0

Distribution of Moisture in Soil

Brennan Fine Sandy Loam Mercedes, Texas
Wagemann Field

Exp. No.	Applied Inches Irr.	Applied Inches Rainfall	Furrows Sys.	Width of Space feet	Time of application Mins.	Quantity of Moisture: First foot: Before Irrig. Percent	First foot: Retained Inches Water	Second foot: Before Irrig. Percent	Second foot: Retained Inches Water	Third foot: Before Irrig. Percent	Third foot: Retained Inches Water	Fourth foot: Before Irrig. Percent	Fourth foot: Retained Inches Water	Fifth foot: Before Irrig. Percent	Fifth foot: Retained Inches Water	Sixth foot: Before Irrig. Percent	Sixth foot: Retained Inches Water	Average Six feet: Before Irrig. Percent	Average Six feet: Retained Inches Water	Evap. loss per Inch	Perc. loss per Inch
30	2.00		3x12	6.0	136	10.8	0	9.8	0	10.3	0	10.9	0	11.9	0	12.0	0	10.9	0	0.55	1.15
12	2.00		3x12	6.0	32	5.3	0.35	10.8	0.19	11.4	0.32	12.4	0.22	11.5	0.19	10.8	0.18	10.4	1.45	0.40	0.15
29	6.00	2.56	3x12	4.0	332	5.1	1.30	8.2	0.90	8.0	0.85	8.1	0.70	9.7	0.50	10.1	0.25	8.2	4.50	0.75	0.75
13	2.00		3x12	4.0	19	4.8	0.57	10.5	0.08	11.9	0	11.7	0	11.1	0	10.9	0	10.2	0.65	1.35	0
14	4.00		3x12	2.0	38	4.7	0.67	9.6	0.55	11.6	0.33	11.2	0.38	10.7	0.20	10.6	0.14	9.7	2.25	1.75	0
25	4.00		3x12	2.0	70	5.7	1.05	7.9	0.93	8.7	0.56	9.4	0.22	10.1	0.12	10.0	0.12	8.6	2.80	1.20	1.00
15	4.00		3x12	4.0	91	3.8	0.57	8.9	0.45	11.6	0.35	12.2	0.17	10.8	0.26	10.5	0.20	9.6	2.00	0.95	1.05
28	4.00		3x12	2.0	180	4.2	0	7.9	0	9.3	0	10.8	0	11.5	0	11.2	0	9.2	3.45	0.55	0
16	4.00		3x12	6.0	158	3.3	0.58	8.9	0.56	11.2	0.48	11.8	0.32	11.2	0.36	10.9	0.27	9.5	2.57	0.63	0.80
31	4.00	6.72	3x12	6.0	308	6.2	1.03	8.3	0.43	9.3	0.50	10.5	0.36	12.2	0.17	11.4	0.17	9.7	2.20	0.82	2.00
17	4.00		3x12	fv.	28	2.4	1.10	6.8	0.81	7.6	0.45	7.6	0.11	9.1	0.09	9.1	0.10	7.1	2.66	1.34	0
19	6.00		3x12	2.00	51	3.4	0.89	6.9	0.83	7.3	0.86	7.4	0.83	7.1	0.69	8.0	0.15	6.7	4.25	1.00	0.75
26	6.00	0.90	3x12	2.0	168	4.4	1.30	7.4	0.85	7.5	0.65	8.0	0.52	8.5	0.55	8.7	0.50	7.4	4.37	1.00	1.25
22	6.00	0.10	3x12	4.0	492	4.8	0.61	7.0	0.82	7.9	0.68	8.1	0.74	8.0	0.74	8.0	0.74	8.5	4.03	1.10	0.97
23	6.00	0.20	3x12	4.0	577	3.7	0.51	7.1	0.70	9.2	0.42	9.2	0.47	8.8	0.64	9.1	0.43	7.8	3.17	0.54	2.29
21	5.08	0.92	3x12	6.0	339	3.1	0.82	7.8	0.61	8.5	0.54	8.5	0.54	9.9	0.40	9.5	0.40	7.9	3.26	0.64	2.00
20	6.00	0.92	3x12	fv.	53	2.1	1.51	6.1	1.21	7.8	0.89	7.8	0.89	7.3	0.42	8.4	0.21	6.5	4.80	1.12	1.00

Distribution of Moisture in Soil — Laredo Clay

Exp. No.	Applied Inches Irr.	Applied Inches Rainfall	Furrows Sys.	Width of Space feet	Time of application Mins.	Quantity of Moisture: First foot Before Irrig. Percent	First foot Retained Inches Water	Second foot Before Irrig. Percent	Second foot Retained Inches Water	Third foot Before Irrig. Percent	Third foot Retained Inches Water	Fourth foot Before Irrig. Percent	Fourth foot Retained Inches Water	Fifth foot Before Irrig. Percent	Fifth foot Retained Inches Water	Sixth foot Before Irrig. Percent	Sixth foot Retained Inches Water	Average Six feet Before Irrig. Percent	Average Six feet Retained Inches Water	Evap. loss per Inch	Perc. loss per Inch
34	2.00		3x12	4.0	82	22.7	1.00	24.2	0.60	25.3	0.10	25.2	0	24.6	0.21	24.5	0.40	24.5	1.00	0.65	0.35
35	2.00	0.50	3x12	6.0	169	23.9	0.85	27.0	0.30	27.0	0.10	24.8	0.10	22.3	0.25	20.6	0.40	24.3	2.00	0.35	0.15
39	6.00		3x12	6.0	1290	22.9	1.07	23.5	0.63	24.3	0.08	23.5	0.05	21.5	0.20	20.5	0.15	22.7	2.14	1.25	2.61
40	6.00		3x12	4.0	100	20.0	1.55	20.9	1.10	22.6	0.90	22.2	0.54	22.7	0.20	22.1	0.20	21.6	4.50	1.00	0.50
41	5.00		3x12	6.0	885	25.4	1.05	26.0	0.45	26.1	0.34	24.7	0.30	24.3	0	23.5	0	25.0	2.14	1.25	1.61
42	2.00		Flood		60	25.2	0.95	25.7	0.50	26.0	0.15	25.0	0	23.6	0	24.1	0	24.9	1.60	0.40	0
43	4.00		Flood		90	26.8	0.45	25.1	0.40	24.6	0	23.8	0	25.0	0	25.5	0	25.1	2.14	1.86	0
44	6.00		Flood		75	22.7	0.90	22.9	0.70	22.4	0.70	23.8	0.20	24.9	0.25	25.0	0.19	23.6	2.06	3.94	0

Distribution of Moisture in Soil — Laredo Silt Loam

Exp. No.	Applied Inches Irr.	Applied Inches Rainfall	Furrows Sys.	Width of Space feet	Time of application Mins.	Quantity of Moisture: First foot Before Irrig. Percent	First foot Retained Inches Water	Second foot Before Irrig. Percent	Second foot Retained Inches Water	Third foot Before Irrig. Percent	Third foot Retained Inches Water	Fourth foot Before Irrig. Percent	Fourth foot Retained Inches Water	Fifth foot Before Irrig. Percent	Fifth foot Retained Inches Water	Sixth foot Before Irrig. Percent	Sixth foot Retained Inches Water	Average Six feet: Before Irrig. Percent	Average Six feet: Retained Inches Water	Evap. loss per Inch	Perc. loss per Inch
48	2.00		3x12	2.0	20	26.0	0.40	21.8	0.60	20.7	0	21.9	0	21.2	0	22.8	0.05	22.4	1.05	0.95	0
49	2.00		3x12	4.0	40	24.9	0.60	21.4	0.45	17.5	0.65	19.9	0	18.4	0	18.7	0	20.1	1.50	0.50	0
50	2.00		3x12	6.0	78	24.9	0.25	19.0	1.00	19.4	0.55	20.5	0	20.3	0	20.6	0	21.1	1.80	0.20	0
51	4.00		3x12	2.0	34	13.3	0.75	15.1	1.25	18.7	0.20	20.5	0.45	22.9	0	22.7	0	18.9	2.65	1.35	0
52	4.00	0.07	3x12	4.0	72	23.2	0.45	19.2	0.90	20.2	0.40	21.5	0.05	21.4	0	23.4	0.10	21.5	2.10	1.97	0
53	4.00		3x12	6.0	506	16.2	1.75	18.8	0.90	21.2	0.25	20.5	0.15	22.8	0.10	23.2	0.15	20.4	3.30	0.70	0
54	6.00		3x12	2.0	170	17.7	1.50	19.7	0.90	21.7	0.35	21.9	0	23.8	0	23.2	0	21.4	2.75	2.00	1.25
55	6.00	0.50	3x12	4.0	235	12.9	2.20	15.2	1.40	18.4	0.55	19.0	0.50	20.1	0.40	21.4	0.45	17.8	5.50	1.00	0
56	6.00		3x12	6.0	288	25.3	0.30	18.8	1.10	19.5	0.60	20.7	0.15	21.0	0	23.3	0	21.4	2.15	2.00	1.85
57	2.00		Flood		16	27.8	0	17.7	0	19.8	0	21.2	0	20.9	0	22.5	0	21.6	0	2.15	0
58	4.00	0.69	Flood		38	17.8	1.80	21.2	0.80	22.7	0	23.1	0	24.4	0	24.5	0	22.3	2.60	2.09	0
59	6.00		Flood		41	22.4	1.10	17.8	1.40	19.9	0.70	21.1	0.30	23.5	0.25	22.6	0.10	21.1	3.85	1.75	0.40