DUTY OF WATER ON THE LOWER RIO GRANDE VALLEY

SEASON 1914-1920

By

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Prepared cooperatively
by
Texas Board of Water Engineers
and
United States Department of Agriculture
Bureau of Public Roads
Division of Irrigation

November, 1920

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FOREWORD

All of the duty of water data contained in the following report were obtained by Mr. W. L. Rockwell from 1914 to September 1, 1919, and by Mr. H. H. Kidder, from September, 1919 to July 1, 1920, who also prepared most of the material for this report. The report was finally written and revised by Mr. R. G. Hemphill during the latter part of 1920.

Due to frequent inquiries and a demand for duty of water information in Texas, and especially in the Lower Rio Grande Valley, it was decided by the present Texas Board of Water Engineers to mimeograph additional copies for distribution to various interested persons and State and Federal Agencies. There were few typewritten copies made of the original report and most of them were lost or misplaced in the general events of the times.

While the duty of water data contained in this report were obtained over twenty years ago, much of them have changed little and are useful at the present time. Discretion should be used, however, in making comparisons of factors affecting duty of water prior to 1920 with those prevailing factors of today.

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September, 1942.

DUTY OF WATER ON THE LOWER RIO GRANDE VALLEY SEASON 1914-1920

INTRODUCTION

Duty of water in irrigation is the relation between a given quantity of water and the area which it serves. The manner of expressing the duty varies, but the units commonly used are the second-foot, or cubic foot per second, and the acre foot, which is the amount of water required to cover an acre a foot deep. Thus the duty may be expressed as one second-foot to 100 acres, or, as one and one half acre-feet per acre. The former is unsatisfactory for the reason that it is a rate and does not indicate a definite quantity of water until the time element is fixed, but this objection does not hold for the latter, and it is therefore generally preferred. Where the quantity applied is small, the duty is best expressed in terms of acre-inches instead of acre-feet, an acre-inch being the amount of water required to cover an acre an inch deep. Expressing the duty in acre-feet or acre-inches per acre is equivalent to stating, in feet or inches, the depth of water applied. These units are used throughout this report.

The yield of crops depends on the type of soil, the time of irrigation, and the amount of water applied. When water is applied so as to eliminate controllable losses, different quantities of water will produce different crop yields, but the increase in yield is not in direct proportion to the increase in quantity of water applied. With a few exceptions as to soils and crops, there is a point at which the further application of water not only ceases to pay but may cause a loss by decreasing the yield. For the good of all irrigation interests it is important that this point, for the various crops, be definitely known.

Systematic experiments to determine the proper duty of water in the Lower Rio Grande Valley were started in 1914 by W. L. Rockwell, then in charge of the Texas work of the Division of Irrigation Investigations of the U. S. Office of Public Roads and Rural Engineering (now the Bureau of Public Roads). This work was directly in line with the desire of the Board of Water Engineers to learn definitely the irrigation requirements for maximum net returns from crops under the different climatic conditions prevailing in the state. This common object led, in the fall of 1915, to a cooperative agreement which outlined a plan of work, placed its execution in direct charge of the local representative of the Office of Public Roads and Rural Engineering, and provided for stated contributions from both parties to defray the expenses of the investigations.[1/]

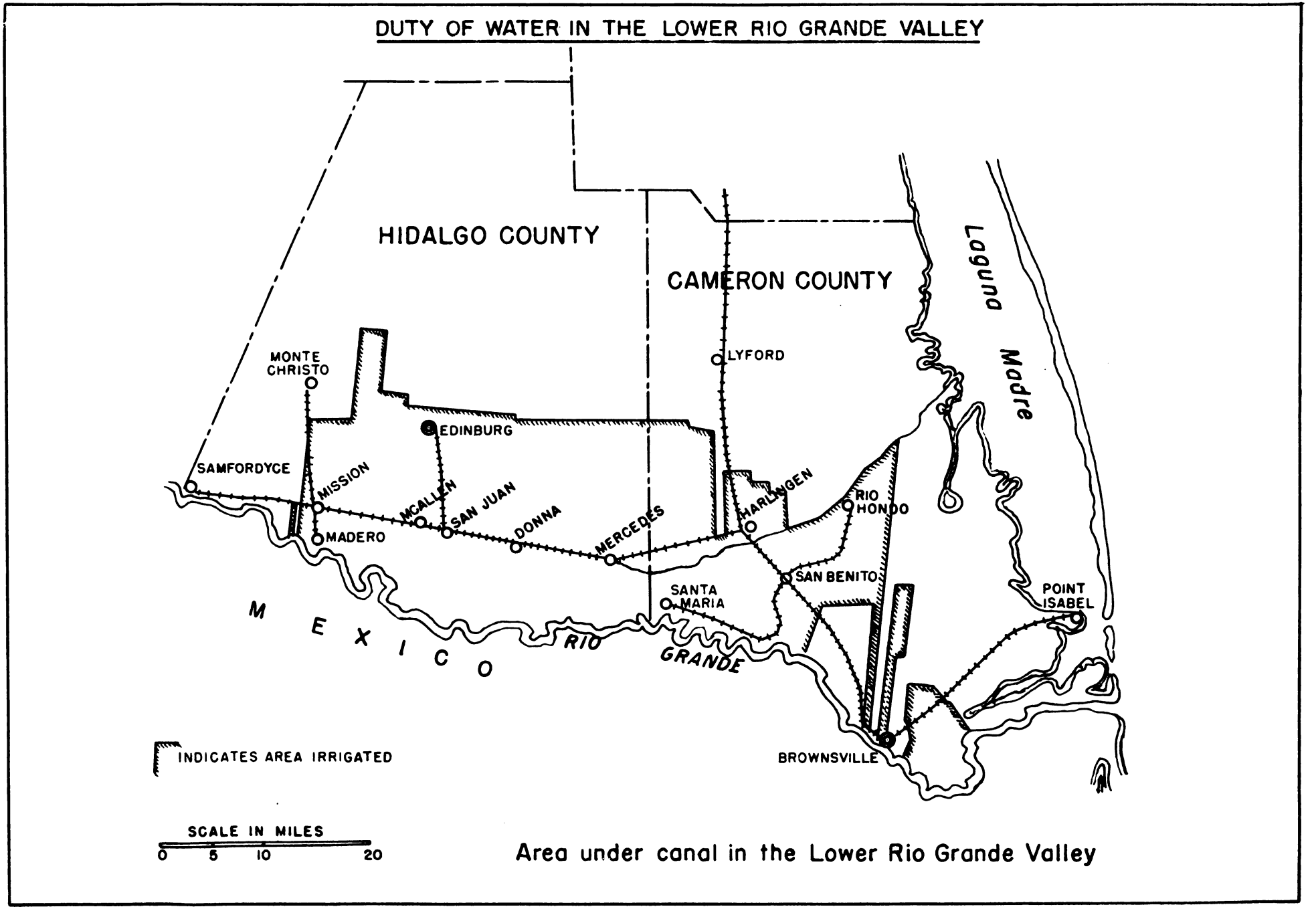
Previous to the signing of the cooperative agreement, the American Rio Grande Land and Irrigation Company, through Mr. F. H. Price, its President, and Mr. F. W. Shaw, its Chief Engineer and General Manager, had generously extended to Mr. Rockwell the privilege of selecting a site for a station from any of its holdings. The site selected, containing 31 acres, was accepted on behalf of the Board October 28, 1915, by Mr. E. B. Gore, one of its members, and a three year lease with the privilege of renewal was obtained. It is situated about one mile south of Mercedes, Texas, on the North Bank of the Arroya Colorado and 1000 feet east of the main canal of the American Rio Grande Land and Irrigation Company. In addition to furnishing the land, farm buildings and water, free of cost, the Company fenced the grounds, leveled the fields, and constructed the main farm laterals.

1/ Mr. W. L. Rockwell continued in charge of the work until Sept. 1, 1919, and the majority of the experiments reported here were carried on under his directions. He was succeeded by Mr. H. H. Kidder who remained in charge until July 1, 1920, and who is to be credited with the preparation of the report of the work.

THE LOWER RIO GRANDE VALLEY

Near the town of Sam Fordyce, and about 80 miles from its entrance into the Gulf of Mexico, the Rio Grande leaves its canon bed and enters the delta, or Lower Valley. On the American side the northern limit of the fan approximates a line drawn a few miles west of the towns of McAllen and Lyford. The easterly slope of the fan is about one foot per mile, and the slope away from the river to the north ranges from six inches to four feet per mile. The eastern part of the delta is low, flat, and poorly drained, much of it being in a semi-marshy condition. At the upper end of the valley near Mission the slope drops away from the river about 6 inches per mile for four miles, at which point there is an abrupt rise of 32 feet to the first bench. This bench slopes away to the north 2 feet per mile for about three or four miles to a second bench. These benches disappear above Donna, and northeast of that town the delta merges with the Gulf Coastal Plain. The area under canal in the valley is shown in Figure 1.

The overflow of the delta has left many old arroyas and disconnected channels, or resacas. The most important of these overflow channels combine below Mercedes to form the Arroya Colorado, which drains into Laguna Madre thirty miles north of the present mouth of the river. Another main channel is the Resaca de los Fresnos running east from San Benito and draining into an estuary south of the Arroya Colorado. These channels with their tributaries will form the basis of an excellent drainage system for the valley when the need arises for systematic development.


DUTY OF WATER IN THE LOWER RIO GRANDE VALLEY
HIDALGO COUNTY
CAMERON COUNTY
Laguna Madre
MONTE CHRISTO
LYFORD
EDINBURG
SAMFORDYCE
MISSION
MCALLEN
SAN JUAN
DONNA
MERCEDES
HARLINGEN
RIO HONDO
MADERO
SAN BENITO
SANTA MARIA
POINT ISABEL
M E X I C O
RIO GRANDE
BROWNSVILLE
INDICATES AREA IRRIGATED
SCALE IN MILES
0 5 10 20
Area under canal in the Lower Rio Grande Valley

SOILS

There are various types of soil in the valley, but the two occurring most extensively in the irrigated areas are classified by the U. S. Bureau of Soils as the Laredo series, with soils ranging from a silt loam to a clay, and the Brennan series, represented by a loam and a fine sandy loam.[1/]

The Laredo series is represented on the East half of the experiment station by a rather heavy clay to clay loam soil underlaid at four feet by a sandy clay, below which, for several feet lies a yellowish clay. This soil is stiff and tenacious when wet, and when allowed to dry without cultivation, bakes hard and shows large cracks, sometimes extending deep into the subsoil. Granulation is quite pronounced, and if the soil is worked at just the right time a fine state of cultivation may be produced. This is the soil referred to in the following pages as the clay soil.

The soil of the Brennan series occurs on the West half of the experiment station. This is a light colored sandy loam of even texture underlaid at from two to ten feet by a yellowish sandy loam. It takes water readily, does not bake to a great extent, and is easily tilled under a wide range of moisture conditions. This is the soil referred to in the the following pages as the fine sandy loam, or sandy soil.

1/ Reconnaisance Soil Survey of South Texas by George N. Coffey and Party. Field Operations U. S. Bureau of Soils, 1909.

CLIMATE

Excepting the tip of Florida, the lower Rio Grande Valley is further South than any other part of the United States, and the climate may be classified as semi-tropical. While the valley is rather limited in extent, there is a considerable variation in certain features of the climate between the upper and lower ends. The annual rainfall varies from 28 inches at the coast to 18 inches at Fort Ringgold, near the town of Rio Grande. There is also a great variation from year to year in the same locality, as, for instance, at Brownsville, where a maximum of 60 inches and a minimum of 12 inches have been recorded. At the coast the winter temperature seldom gets down to 32 and the summer temperature does not go above 100 degrees. Further inland there is a wider range, and at Fort Ringgold a maximum of 112 degrees and a minimum of 6 degrees have been recorded. However, more than three or four frosts seldom occur in one winter, and winters with only one frost, or none at all, are not infrequent. There is a high wind movement throughout the year, the annual average velocity being close to 12 miles per hour. The prevailing Gulf breeze tempers the warmer months from April to October in a very marked degree. It starts shortly after sunrise every morning and blows till late into the night, making comfortable a climate which would otherwise be hard to endure.

The U. S. Weather Bureau has maintained a station at or near Mercedes since 1911 and complete meteorological records were taken at the experiment station beginning in 1914.

Figure 2. Rainfall, Temperature, and Evaporation at Mercedes, Texas.

The meteorological conditions affecting irrigation most are rainfall, temperature, and evaporation, and the records at Mercedes for these features of the climate are shown graphically in Figure 1.

WATER SUPPLY

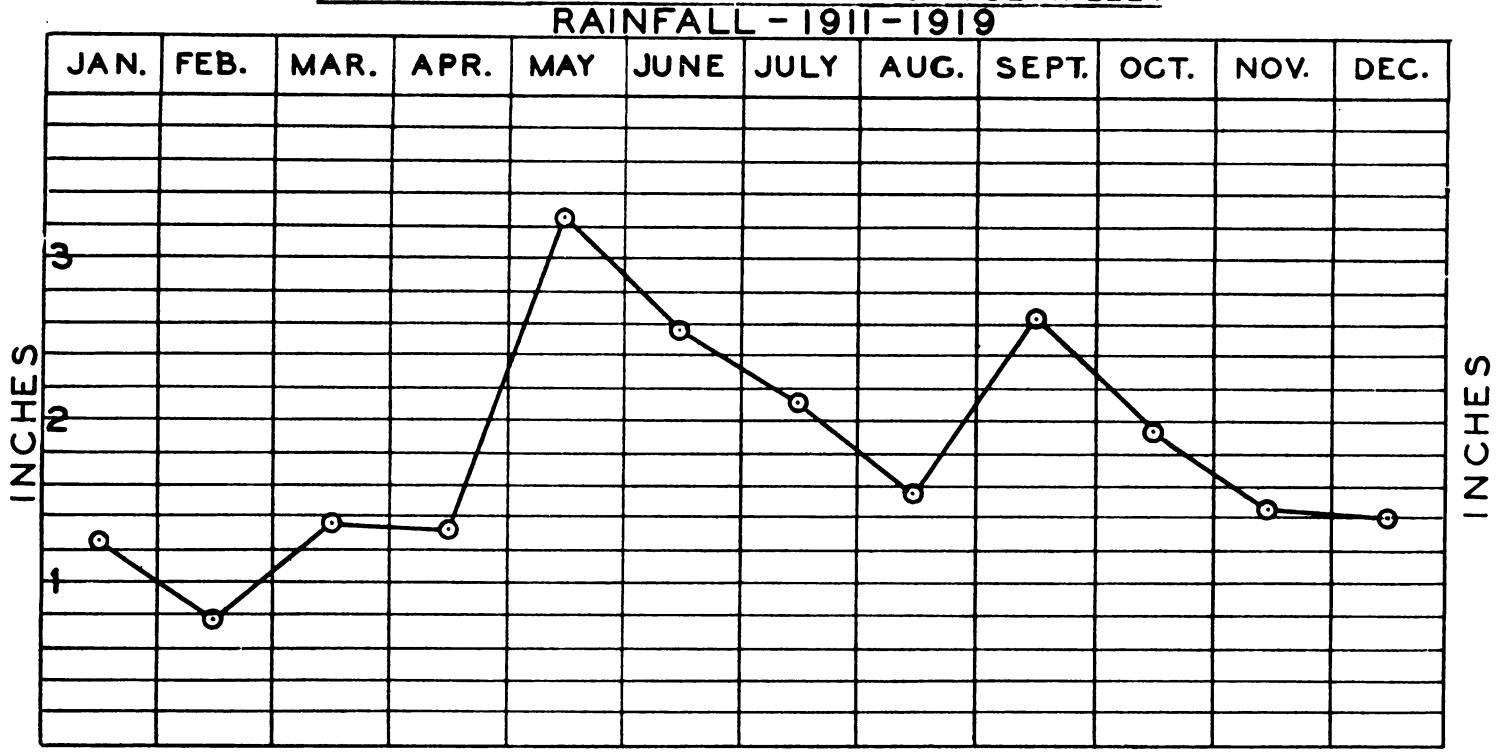
The irrigation water supply of the valley is obtained from the Rio Grande, which, like most streams in arid sections, is subject to great variation in flow. The discharge ranges from 800 second feet up to 100,000 second feet. The period of low water usually comes in early summer. The high floods come late in the summer and are of comparatively short duration. Water for irrigation is raised from the river by large centrifugal pumps driven by steam power. Some of these pumps are as large as 60 inches in diameter, and will discharge 350 second feet under the average lift.

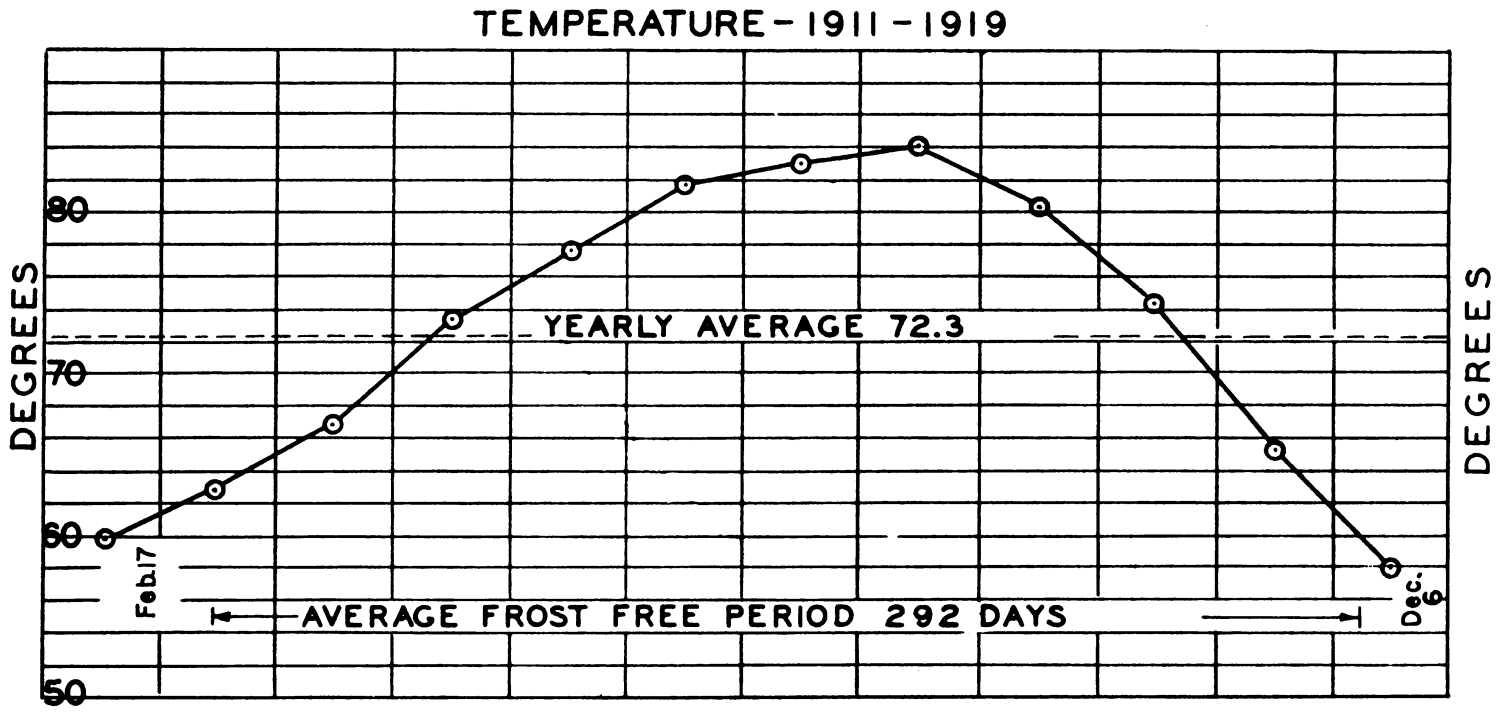
THE EXPERIMENTS

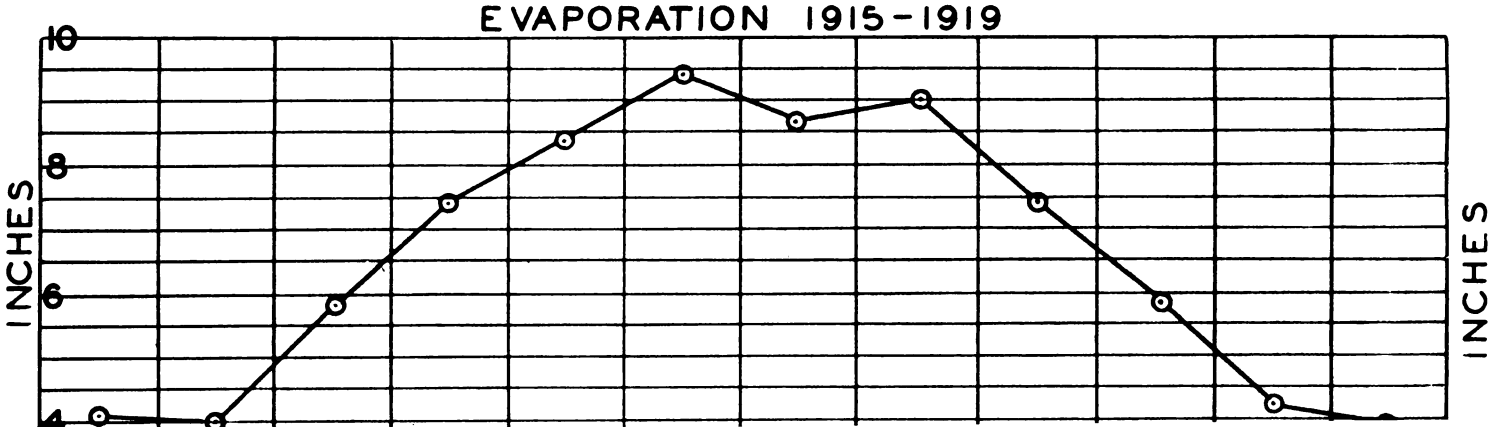
The plan of work provided for the determination of the duty of water for the common crops of the valley on both types of soil at the station. The procedure was to plant an area in each crop and to divide the area into three sections or plots for comparison. The area planted in a single crop for a test ranged in size, except where noted, from an acre down to a tenth of an acre, the chief consideration being a desire for an area large enough to reduce accidental errors to a minimum without introducing variations in soils. All operations on the three plots from the first preparation of the soil to the harvesting of the crop were done at the same

Fig.2. Rainfall, Temperature, and Evaporation from Five Foot Tank. Mercedes, Texas.

DUTY OF WATER IN THE LOWER RIO GRANDE VALLEY







time and in the same manner. The amount of water applied was made the sole variable. At each irrigation the middle plot of the three was given the amount of water which produced the highest returns in previous experiments, while the other two were given a larger and a smaller amount. The best farm practice was followed throughout and the water applied was measured over standard weirs in the laterals immediately above the fields. The amount of water applied, as shown in the following pages, is the so-called "net duty", which includes no canal losses but does include waste at the lower end of the field, if any, and losses from evaporation and deep percolation in the field after application. In general row crops were irrigated in furrows between the rows, while other crops were flooded in beds or between borders 10 to 15 feet apart and 25 to 125 feet long. Plots were diked at the lower end and as the field was smooth and level, they irrigated nicely with very little ponding and consequently practically no waste at these dikes. To limit losses by deep percolations, irrigations were very light, the depth applied ranging from 1 to 4 inches with the average in the neighborhood of two inches.

The proper interpretation of the data obtained is always a difficult part of an investigation of this character. Even when the greatest care is used in agricultural experiments, there are many factors other than those under observation which may influence the result, and conclusions may safely be drawn only from a sufficient number of tests to minimize the effects of these accidental variations. Opinions previously formed may bias the investigator in his study of the complete data, and to eliminate as much as possible of this personal element, deductions have been based chiefly on curves obtained by averaging in a more or less mechanical way curves for individual tests based

on the original records. For lack of data, little consideration could be given to future effects such as the "deadening" of soils, leaching out of fertility, and the necessity of artificial drainage, which may be expected to arise from excessive irrigation.

The effect of rainfall, at certain times and in certain amounts, is open to question. In taking it into account in working up the records of the experiments, the policy was to include as water received all rains over 0.25 inch between the planting and the maturing of the crop. Rains during this period which may have had other than a normal effect are noted.

Estimates based on observed data have been introduced in several places, but in each case the fact is specifically noted.

Throughout the period of the work soil moisture determinations were made at frequent intervals, and always before and after irrigations. From these records it appears that if different amounts of water are applied to three plots, the moisture content in the top foot of soil will be practically the same after two or three days have elapsed. This indicates that shallow rooted crops should show the least effect from varying amounts of water where the tendency is to over-irrigate, and this conclusion is borne out by the results with some of the truck crops.

CORN

Six tests were made with corn on the fine sandy loam and three on the clay soil. Planting was done usually during the first or second week in March, and the crop was harvested during the last two weeks of August. Local seed of the Tuxpan variety were planted except for the tests in 1917 and in 1918 on the clay soil, which were made with Laguna corn. It was generally necessary to irrigate to germinate the seed, and often there were "skips" which had to be replanted. Rows were 42 inches apart except in 1919 when they were spaced 36 inches. The first tests were made with the corn spaced 10 to 12 inches in the row, but later this distance was increased considerably. The crops were frequently cultivated, and in other particulars as well, the best practice was followed. Weights were taken in the shuck for some of the tests and the yield computed on a basis of 85 pounds per bushel which was determined to be a proper figure for the purpose.

Following a heavy rain on June 8, 1916, smut appeared, and before the end of the season not less than ten per cent of the crop had been destroyed. Daily showers in July of the same year prevented the corn from maturing and a large per cent of the ears rotted after the seed had sprouted. Allowance was made for these losses in tabulating the yields. In 1918 a rain of 3.10 inches came immediately after an irrigation, and was, therefore, probably much less effective than it would have been at some other time. In 1919 a rain of 3.64 inches occurred early in July after the crop was practically finished, and it is likely that it, too, had a comparatively small effect.

The results are shown in Table I and Figures 3 and 4. On the sandy soil the yield increased very rapidly with the increase in water up to about

18 to 20 inches. There the curve breaks, and further increases in yield are obtained only with a proportionately much larger quantity of water. The curve of the yield per acre inch shows that the water is most efficient when the soil received 18 inches in depth. The conclusion is that average best results with corn on the fine sandy loam will be obtained with approximately twenty inches of water.

The clay soil is well adapted to corn, and the yields obtained varied within narrow limits. From the curve, Figure 4, it appears that with the application of more than twenty inches of water, the yield may be expected to drop off, and that depths between seventeen and twenty inches will increase the yield only slightly. The conclusion is that average best results with corn on clay soil will be obtained with a depth of approximately 17 inches.

Table I	Irrigation of Corn
Figure 3	Irrigation of Corn on sandy soil
Figure 4	Irrigation of Corn on clay soil

TABLE I. IRRIGATION OF CORN

Year	Irrigation Period	Season Days	Number	Depth Applied Inches	Rainfall Inches	Total Water in Inches	Yield Bushels per Acre	Yield Bushels per Acre Inch
SANDY SOIL								
1916	Mar 4 - June 3	91	4	6.99	7.77	14.76	30	2.0
	Mar 4 - June 3	91	4	9.10	7.77	16.87	46	2.7
	Mar 4 - June 3	91	4	11.47	7.77	19.24	56	2.9
1916	Mar 4 - May 26	83	3	6.91	7.77	14.68	34	2.3
	Mar 4 - May 26	83	3	9.00	7.77	16.77	49	2.9
	Mar 4 - May 26	83	3	10.92	7.77	18.69	58	3.4
1917	Mar 26 - June 18	84	5	9.50	4.60	14.10	46	3.3
	Mar 26 - June 18	84	5	13.00	4.60	17.60	52	3.0
	Mar 26 - June 29	95	6	18.87	4.60	23.47	50	2.2
1917	Mar 26 - June 18	84	5	9.50	4.60	14.10	49	3.5
	Mar 26 - June 18	84	5	13.00	4.60	17.60	59	3.4
	Mar 26 - June 29	95	6	18.87	4.60	23.47	56	2.4
1918	Mar 8 - June 7	91	4	6.17	9.93	16.10	60	3.7
	Mar 8 - June 7	91	4	8.17	9.93	18.10	75	4.1
	Mar 8 - June 7	91	4	10.17	9.93	20.10	87	4.3
1919	Mar 5 - June 12	99	3	6.50	15.13	21.63	73	3.4
	Mar 5 - June 12	99	3	8.50	15.13	23.63	75	3.2
	Mar 5 - June 12	99	3	10.50	15.13	25.63	78	3.0
CLAY SOIL								
1915	Apr 23 - June 20	58	4	2.46	4.06	6.52	65	10.0
	Apr 23 - June 20	58	4	8.12	4.06	12.18	75	6.2
	May 17 - June 20	34	3	14.66	4.06	18.72	87	4.6
1918	Mar 29 - July 2	95	3	11.50	9.53	21.03	55	2.6
	Mar 29 - July 2	95	3	12.80	9.53	22.33	56	2.5
	Mar 29 - July 2	95	3	13.92	9.53	23.45	56	2.4
1919	Mar 8 - June 12	96	3	6.25	11.52	17.77	78	4.4
	Mar 8 - June 12	96	3	8.00	11.52	19.52	78	4.0
	Mar 8 - June 12	96	3	10.25	11.52	21.77	76	3.5

DUTY OF WATER IN THE LOWER RIO GRANDE VALLEY

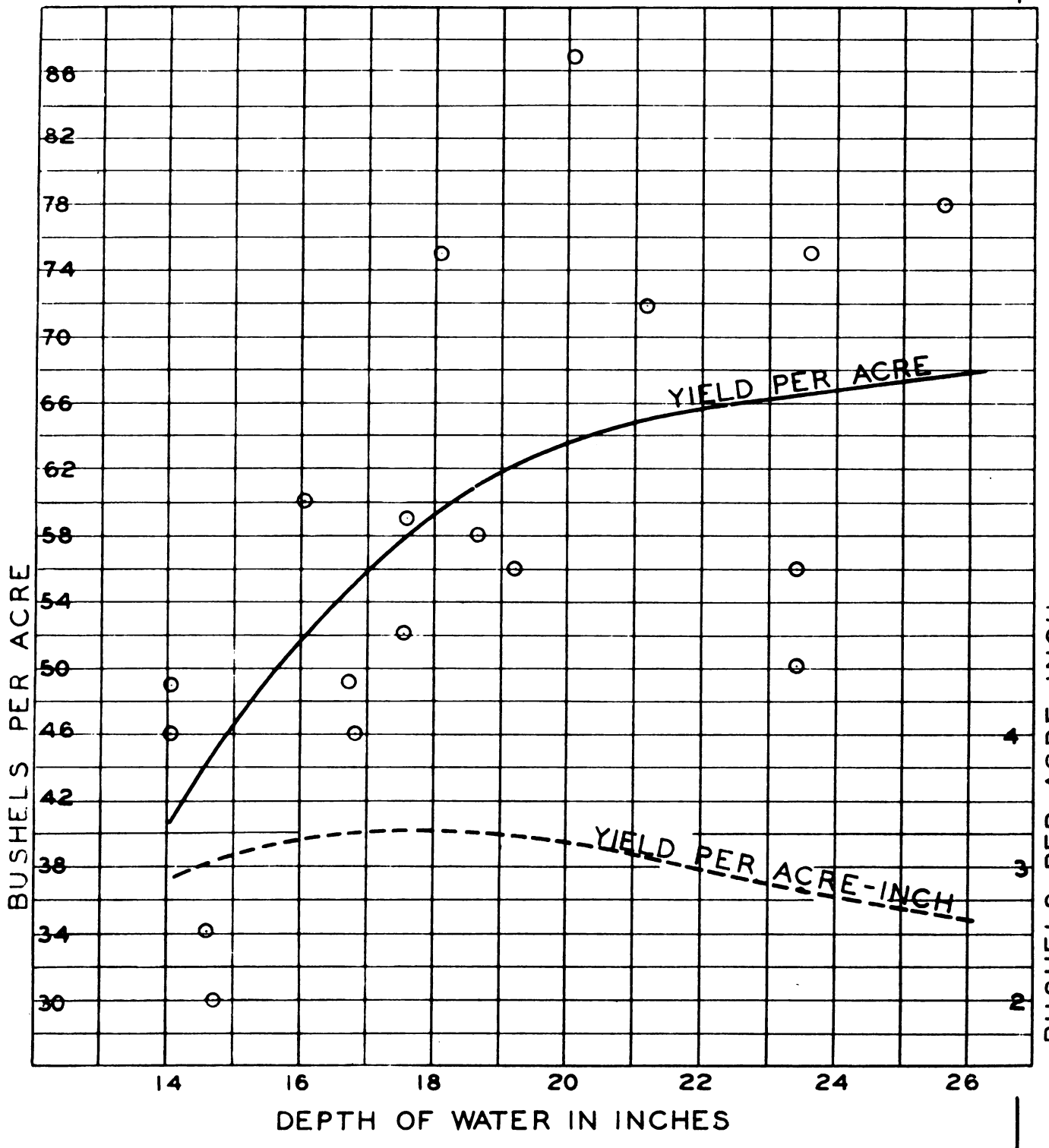


Fig. 3

Irrigation of corn on sandy soil

DUTY OF WATER IN THE LOWER RIO GRANDE VALLEY

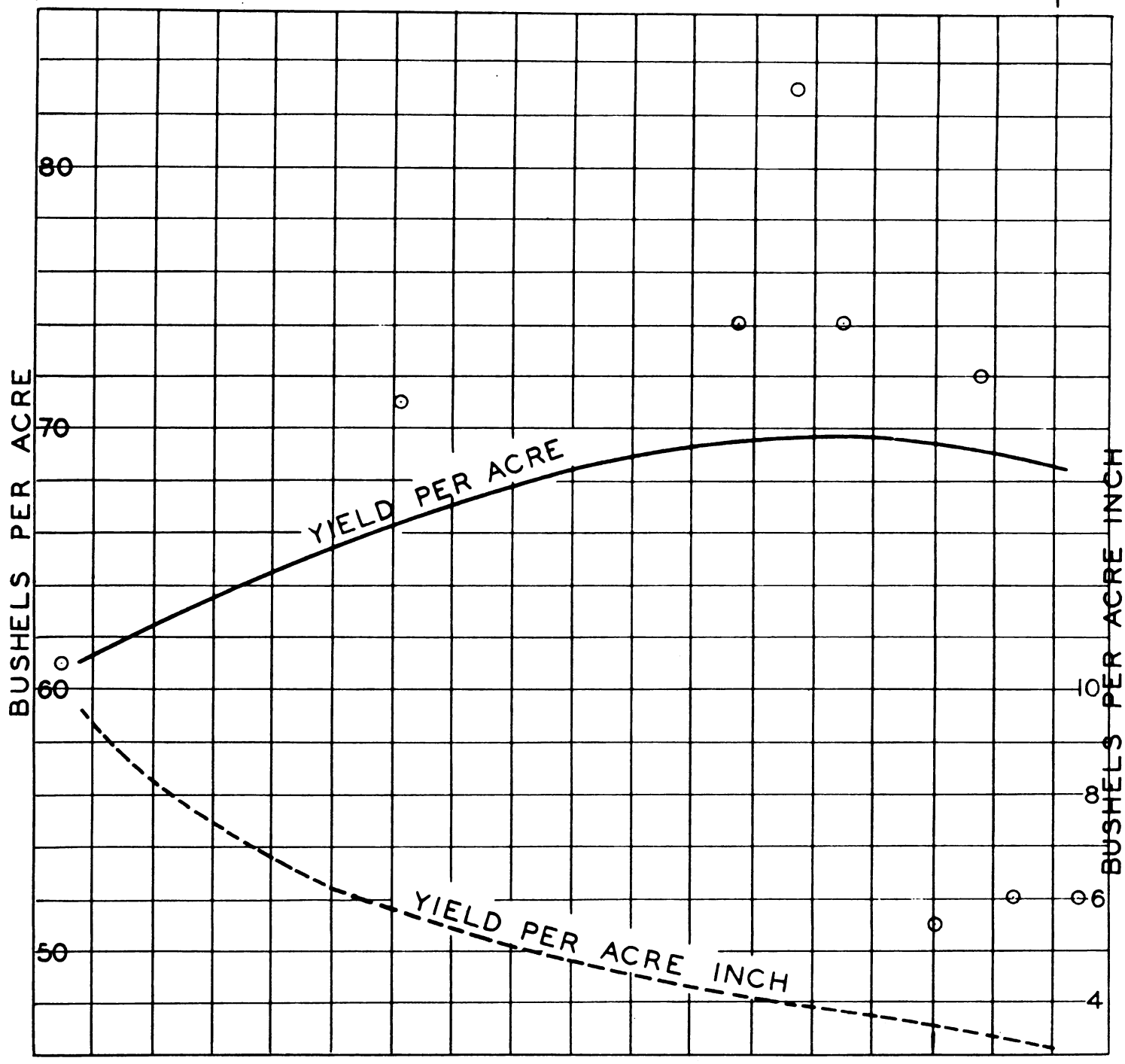


Fig. 4

Irrigation of corn on clay soil

Cotton was grown in 1916, 1917, and 1918 on the sandy soil. Planting was done in the first part of March except in 1916 when it was necessary to replant in April. The seed used were of the Mebane Triumph variety except in 1917 when Lone Star seed was planted. It appears, however, that this variety is not as well adapted to the locality as the Mebane. It does not set fruit as low on the plant, nor as early, and the foliage is much heavier, thus preventing early maturity and inducing weevil damage. Rows were 42 inches apart and plants were spaced 12 to 18 inches apart in the rows. Cultivation was consistently carried on throughout the season except when interferred with by rainy periods. Irrigation was in furrows between the rows. The crops were picked in July and August.

Each year the crop was damaged more or less by boll weevils and cut worms. In 1917 the damage due to the latter was so large that it was necessary to discard one set of tests on account of the resulting poor stand. Heavy rains in July, 1916, reduced the yield considerably in that year.

For the single experiment on clay soil Mebane seed were planted April 8, 1915, after a previous planting had failed to germinate. There was very little rain until after the plants were matured, and irrigation and cultivation were carried on under excellent conditions. Picking was begun in July and continued until November. The plots for this test were very small, containing only 504 square feet, and the care the crop received could not well be duplicated in actual practice on large fields, but the results are interesting in that they show what can be done when conditions are most favorable.

The results of the experiments with cotton are shown in Table II and Figure 5. An examination of these results shows that on the sandy soil the average yield increased rapidly up to the point where 16 inches of water was received and that depths in excess of 18 inches increased the yields only to a small extent. The conclusion is that the average best results from cotton on the sandy soil will be obtained with 18 inches of water.

Table II	Irrigation of Cotton.
Figure 5	Irrigation of Cotton on Sandy Soil

TABLE II. IRRIGATION OF COTTON.

Year	Irrigation Period	Season Days	Number	Depth Applied Inches	Rainfall Inches	Total Water in Inches	Yield Bales per Acre	Yield Pounds per Acre Inch
SANDY SOIL								
1916	Mar 7 - June 23	109	5	6.08	9.80	15.88	.43	14
	Mar 7 - June 23	109	6	10.51	9.80	20.31	.81*(1)	20
	Mar 7 - June 23	109	6	14.14	9.80	23.94	.95	20
1917	May 5 - June 22	49	3	4.00*(2)	9.50	13.50	.74	28
	May 5 - June 22	49	4	7.00	9.50	16.50	.86	26
	May 5 - June 22	49	4	11.00	9.50	20.50	.88	22
1917	May 5 - June 22	49	3	4.00*(2)	9.50	13.50	.60	22
	May 5 - June 22	49	4	7.00	9.50	16.50	.99	30
	May 5 - June 22	49	4	11.00	9.50	20.50	.96	22
1918	Mar 8	1	1	1.50*(3)	9.53	11.03	.76	34
	Mar 8 - June 13	98	2	2.27	9.53	11.80	.83	35
	Mar 8 - June 13	98	2	3.30	9.53	12.83	.83	32
CLAY SOIL								
1915	Apr 8 - July 7	91	4	2.79*(4)	2.26	5.05	2.33*(5)	235
	Apr 8 - July 7	91	4	6.85	2.26	9.11	2.63	147
	Apr 8 - July 7	91	4	12.37	2.26	14.63	2.91	101

* (1) Measured yield corrected by factor of 1.11 to take care of deficient stand caused by cutworm. This factor determined by count of plants in three plots.

* (2) A three-inch irrigation twelve days before planting to work up a seed bed is not included.

* (3) Included are light irrigations made four days before planting. The first plot received no other irrigation.

* (4) Includes a half-inch irrigation at time of replanting but does not include a four-inch irrigation at time of first planting one month before.

* (5) These yields were obtained on plots containing only 504 square feet each and represent what can be done under ideal conditions rather than actual practical field conditions.

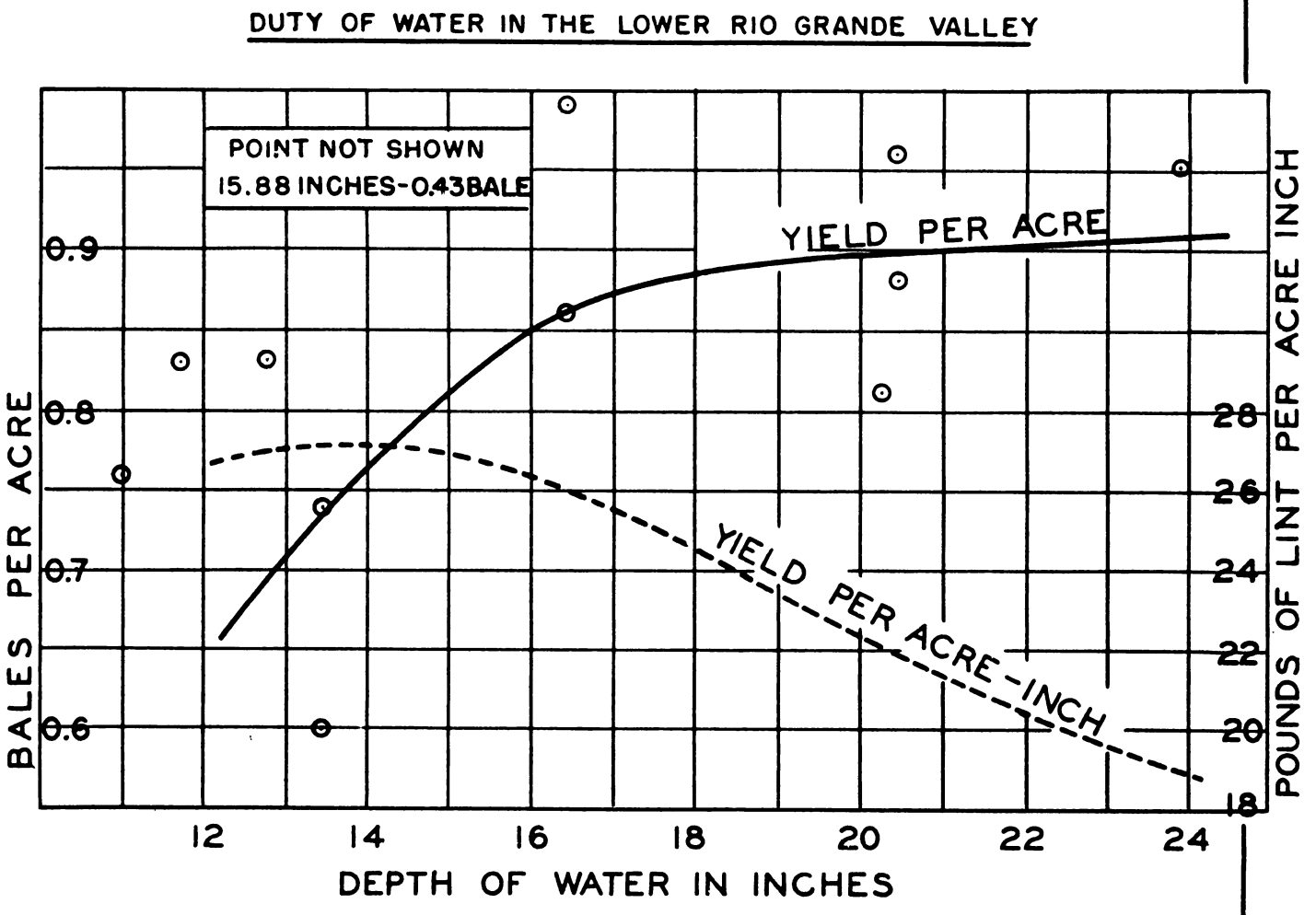


Fig. 5

Irrigation of cotton on sandy soil

SUGAR CANE

Three crops of sugar cane were grown on the clay soil and one on the sandy soil. The results from the sandy soil indicate that the heavier type is better adapted to the crop. Planting was done in December and January after the ground had been thoroughly prepared. Furrows were plowed eight inches deep and six feet apart. The stocks were cut in three foot lengths and laid in the furrow to lap about one foot. This required five tons of seed to the acre. The varieties grown were Purple, D-74, and Striped. The crops were cultivated carefully and irrigated frequently. Water was applied in one or two furrows between the rows, and the amount ranged from one to four inches at an application, the larger quantity being required late in the season. The 1919 crop was a second year crop, while the others were first year crops. Harvesting was done about December 1, and careful tests were made of representative samples of each variety in each plot to determine the concentration (Brix), sucrose, and purity. To put the results of the tests on a comparable basis these figures have been used to convert the yield in tons of cane per acre to a yield in pounds of sugar per acre. The quantities of sugar shown are based on the average extraction under good sugar mill practice.

The results are shown in Table III and Figure 6. An examination of these results shows that the crop requires and can use profitably a large amount of water. The maximum average yield of the D-74 variety was obtained with 47 inches of water and 49 inches produced the largest yield of the Purple variety. A greater depth of water decreased the yield for both. The yield of the Striped cane continued to increase up to the maximum depth applied, which was 56 inches, and it is probable that the best yield would be obtained with a greater amount of water.

The curve in Figure 6, including the results for all varieties, warrants the conclusion that the average best yield will be obtained with 48 to 50 inches of water.

Table III	Irrigation of Sugar Cane
Figure 6	Irrigation of Sugar Cane on Clay Soil

TABLE III. IRRIGATION OF SUGAR CANE.

Year	Irrigation Period	Season Days	Number	Depth Applied	Rainfall Inches	Total Water in Inches	Yield Tons per Acre	Sugar Pounds per Acre	Sugar Pounds per Ac.In.
PURPLE VARIETY.									
1917	Mar 1-Aug 29	182	12	25.81	11.62	37.43	30.9	4036	108
	Mar 1-Aug 29	182	12	37.81	11.62	49.43	32.2	6824	138
1917-18									
	Dec 15-Sept 21	280	18	25.59	12.45	38.04	18.3	3749	99
	Dec 15-Sept 21	280	18	33.31	12.45	45.76	26.1	6219	136
	Dec 15-Sept 21	280	18	43.77	12.45	56.22	37.0	6899	123
1919	Mar 13-Sept 11	182	9	16.05	24.17	40.22	20.2	4627	115
	Mar 13-Sept 11	182	9	22.25	24.17	46.42	21.8	4543	98
	Mar 13-Sept 11	182	9	28.25	24.17	52.42	16.0	3387	65
D-74 VARIETY									
1917	Mar 1-Aug 29	182	12	25.81	11.62	37.43	27.9	4461	119
	Mar 1-Aug 29	182	12	37.81	11.62	49.43	28.6	5573	113
1917-18									
	Dec 15-Sept 21	280	18	25.59	12.45	38.04	18.3	2612	69
	Dec 15-Sept 21	280	18	33.31	12.45	45.76	29.8	5752	126
	Dec 15-Sept 21	280	18	43.77	12.45	56.22	39.1	5036	90
1919	Mar 13-Sept 11	182	9	16.05	24.17	40.22	14.6	3054	76
	Mar 13-Sept 11	182	9	22.25	24.17	46.42	20.9	4748	102
	Mar 13-Sept 11	182	9	28.25	24.17	52.42	15.0	3654	70
STRIPED VARIETY									
1917	Mar 1-Aug 29	182	12	28.31	11.62	39.93	20.0	6145	154
	Mar 1-Aug 29	182	12	39.31	11.62	50.93	32.9	6397	126
1917-18									
	Dec 15-Sept 21	280	18	25.59	12.45	38.04	14.9	2791	73
	Dec 15-Sept 21	280	18	33.31	12.45	45.76	26.6	4832	106
	Dec 15-Sept 21	280	18	43.77	12.45	56.22	36.0	6197	110
1919	Mar 13-Sept 11	182	9	16.05	24.17	40.22	22.2	3881	97
	Mar 13-Sept 11	182	9	22.25	24.17	46.42	20.4	3970	86
	Mar 13-Sept 11	182	9	28.25	24.17	52.42	22.8	5224	100

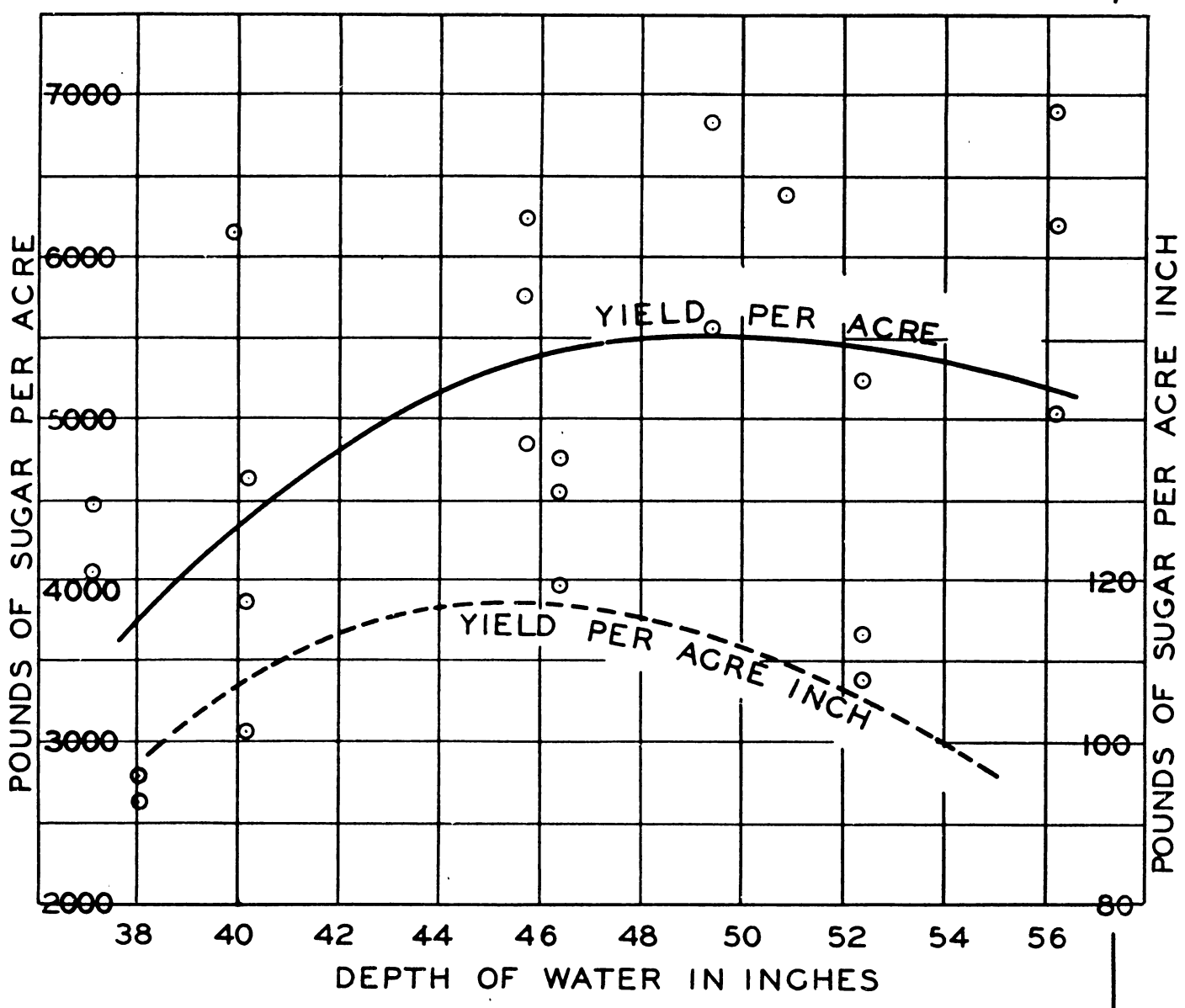


Fig. 6

Irrigation of sugar cane on clay soil

Rhodes Grass

Tests with Rhodes grass on fine sandy loam were made during two seasons, and results were secured from six plots each season. These plots were planted in the spring of 1917 and the growth of a year put them in shape to yield fair crops during 1918 and 1919 when the tests were made. The period covered by the tests was from the first irrigation in March to the fifth cutting of the crop in November. In 1918 borders for irrigation were low and the heavy mat of grass at the ground surface occasionally caused some spreading of water from one plot to another. However, the amount was small and could not have affected the final results very materially. Two of the plot showed a shading of the fine sandy loam to a heavier phase which covered a small area. These are noted in Table IV which gives a summary of the results obtained.

Table IV Irrigation of Rhodes Grass.

Figure 7 Irrigation of Rhodes Grass on Sandy Soil.

As the season for this crop is long and the yield fairly large, a heavy use of water is to be expected. An examination of the curve in Figure 7 indicates that average best results will be obtained with 48 inches of water.

TABLE IV. IRRIGATION OF RHODES GRASS.

Year	Period	Irrigation Season Days	Irrigation Number	Irrigation Depth Applied Inches	Rainfall Inches	Total Water in Inches	Yield Tons per Acre	Yield Pounds per Ac.In.
SANDY SOIL								
1918	Mar 7 - Oct 11	218	7	28.00	11.02	39.02	4.4	223
	Mar 7 - Oct 11	218	7	30.92	11.02	41.94	5.4	256
	Mar 7 - Oct 11	218	7	38.41	11.02	49.43	5.2	210
1918	Mar 7 - Oct 11	218	7	38.62	11.02	49.64	5.6	225
	Mar 7 - Oct 11	218	7	38.70	11.02	49.72	5.4	213
	Mar 7 - Oct 11	218	7	46.17	11.02	57.19	5.5	191
1919	Mar 5 - Aug 25	173	4	11.37	18.01	29.38	4.3	291
	Mar 5 - Aug 25	173	4	13.00	18.01	31.01	5.0	321
	Mar 5 - Aug 25	173	4	17.00	18.01	35.01	4.9	277
1919	Mar 5 - Aug 25	173	4	17.00	18.01	35.01	5.0	285
	Mar 5 - Aug 25	173	4	19.60	18.01	37.61	5.2	278
	Mar 5 - Aug 25	173	4	22.00	18.01	40.01	5.3	264

DUTY OF WATER IN THE LOWER RIO GRANDE VALLEY

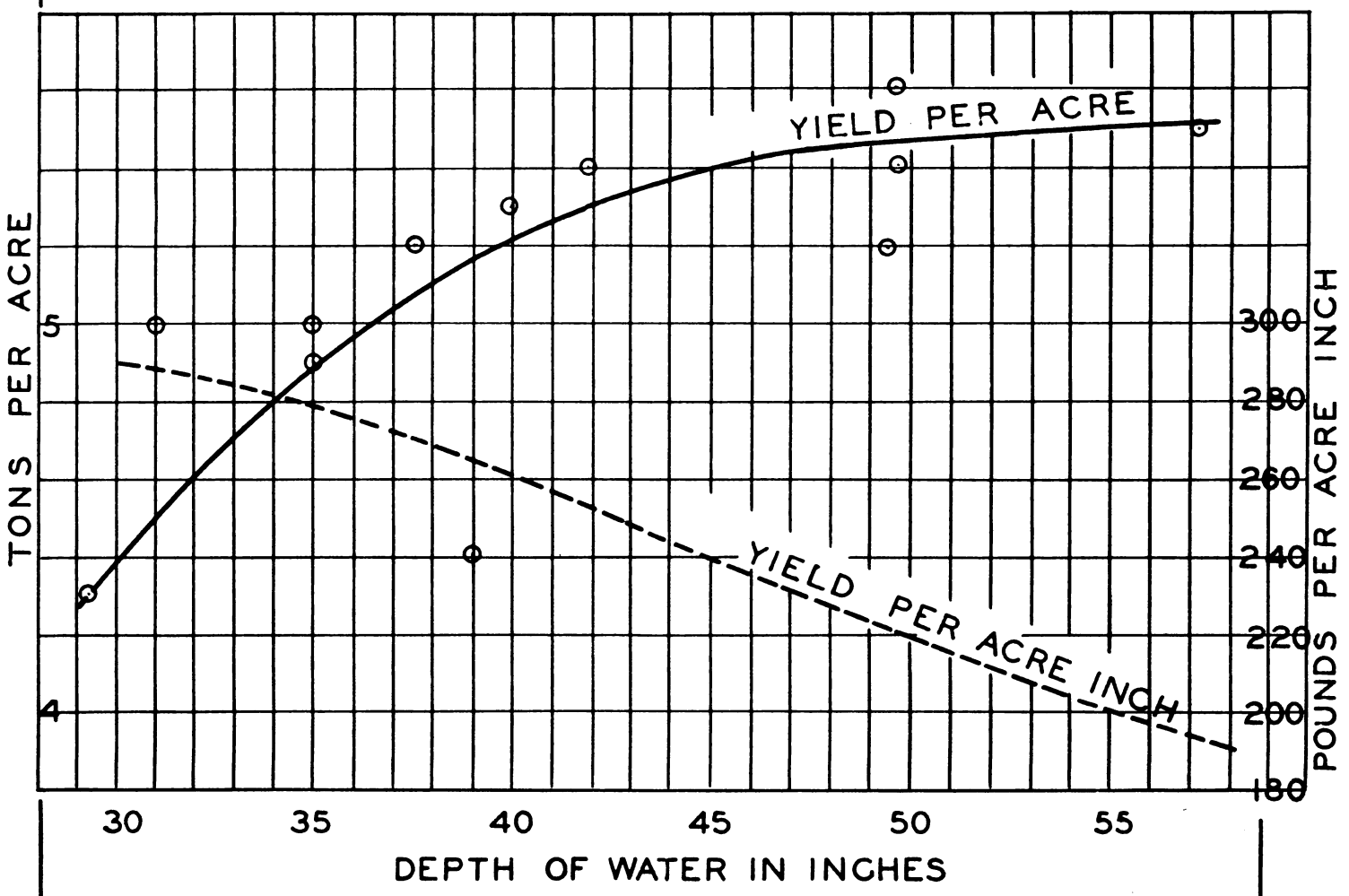


Fig. 7

Irrigation of Rhodes Grass on sandy soil

CABBAGE.

Cabbage crops were grown on the sandy soil during the winters of 1916, 1918, and 1919. In 1916 plants of the St. Louis Late Market variety were set out during the last week in November. In 1918 plants of the Steins Early Flat Dutch variety were set out in the latter part of September. In 1919 both varieties were grown, the Flat Dutch variety being transplanted in September and the other in November. Harvesting of the early variety commenced usually in December, while the late variety matured in March and April.

Rows were 30 inches apart and the plants were spaced 18 to 20 inches in the rows. The plots were cultivated frequently and the top soil kept well mulched and free of weeds. Irrigations were applied at regular intervals except when moisture was supplied by good rains.

These crops suffered very little damage from the usual pests. In 1916 and 1917 the plants were attacked by the cabbage aphis just after transplanting, and in 1918 and 1919 the green cabbage worm appeared, but both were checked by proper spraying before any considerable damage was done. In 1917 a temperature of 21 degrees in March killed many of the plants and stopped the growth of others. A large part of the crop had been harvested when the freeze came and had the remained matured, it is probable that the only difference would have been an increase of yield on the plots from which the smaller crops were harvested. Records of this crop are included but in arriving at conclusions they have been given only half the weight which otherwise would have attached to them.

Tests with cabbage on clay soils were made in 1914 and 1919. These crops were handled in practically the same manner as those on the sandy soil. Transplanting was done in November and harvesting was started late in February and

continued until the middle of April. Cultivation was frequent enough to keep the top soil loose and irrigations were applied as needed. The variety grown in 1914 was the Danish Baldhead, in 1919, the St. Louis Late Market.

The results of the tests on both types of soil are shown in Table V and figures 8 and 9. It appears from an examination of these records that on the sandy soil the best average yield will be obtained with 14 inches of water, and that the application of larger amounts only decreases the yields. This is not characteristic of the sandy soil, and it is probable that other factors played a part in determining the yields. The clay soil is particularly well adapted to cabbage and the trend of the curve in Figure 9 indicates that the best yield will be obtained with some quantity in excess of 16 inches.

Table V Irrigation of Cabbage.

Figure 8 Irrigation of Cabbage on Sandy Soil.

Figure 9 Irrigation of Cabbage on Clay Soil.

TABLE V. IRRIGATION OF CABBAGE.

Year	Irrigation Period	Season Days	Number	Depth Applied Inches	Rainfall Inches	Total Water in Inches	Yield Tons per Acre	Yield Pounds per Ac.In.
SANDY SOIL								
1916-17	Nov 30-Feb 22	85	7	6.98	1.64	8.62	5.26*(1)	1220
	Nov 30-Feb 22	85	7	10.70	1.64	12.34	11.77	1908
	Nov 30-Feb 22	85	7	13.93	1.64	15.57	11.10	1426
1916-17	Nov 30-Feb 27	90	10	10.45	1.64	12.09	6.81*(1)	1126
	Nov 30-Feb 27	90	10	13.75	1.64	15.39	17.35	2243
	Nov 30-Feb 27	90	10	17.75	1.64	19.39	5.37	554
1918-19	Oct 3 -Nov 20	49	4	4.38	8.72	13.10	9.19	1402
	Oct 3 -Dec 17	76	5	9.38	8.72	18.10	10.34	1142
	Oct 3 -Dec 17	76	5	13.38	8.72	22.10	9.60	869
1919-20	Sept 10-Jan 7	120	4	6.33	9.50*(2)	15.83	4.84*(3)	949
	Sept 10-Jan 7	120	4	9.33	9.50	18.83	4.53	686
	Sept 10-Jan 7	120	4	12.33	9.50	21.83	4.55	562
1919-20	Nov 26 -Mar 24	120	5	5.50	.82	6.32	9.72*(4)	3076
	Nov 26 -Mar 24	120	5	9.00	.82	9.82	9.39	1919
	Nov 26 -Mar 24	120	6	16.00*(5)	.82	17.32	7.37	851
CLAY SOIL								
1914-15	Nov 10-	1	1	1.99	7.42	9.41	15.70	3340
	Nov 10- Feb 15	98	3	2.45	7.42	9.87	16.30	3300
	Nov 10- Feb 17	100	5	7.08	7.42	14.50	21.50	2960
1919-20	Nov 26- Mar 24	120	5	5.67	.82	6.49	8.33	2569
	Nov 26- Mar 24	120	5	9.67	.82	10.49	9.81	1870
	Nov 26- Mar 24	120	5	13.67	.82	14.49	12.80	1767

* (1) The 1916-17 crop was damaged by temperature of 21 degrees on March 5. Records should be given not more than half the weight which would otherwise attach.

* (2) Includes a 3.73 inch rainfall three days after the first irrigation.

* (3) Variety Steins Early Flat Dutch.

* (4) Variety St. Louis Late Market.

* (5) Through an error of laborer this plot received an extra 3-inch irrigation on February 25.

DUTY OF WATER IN THE LOWER RIO GRANDE VALLEY

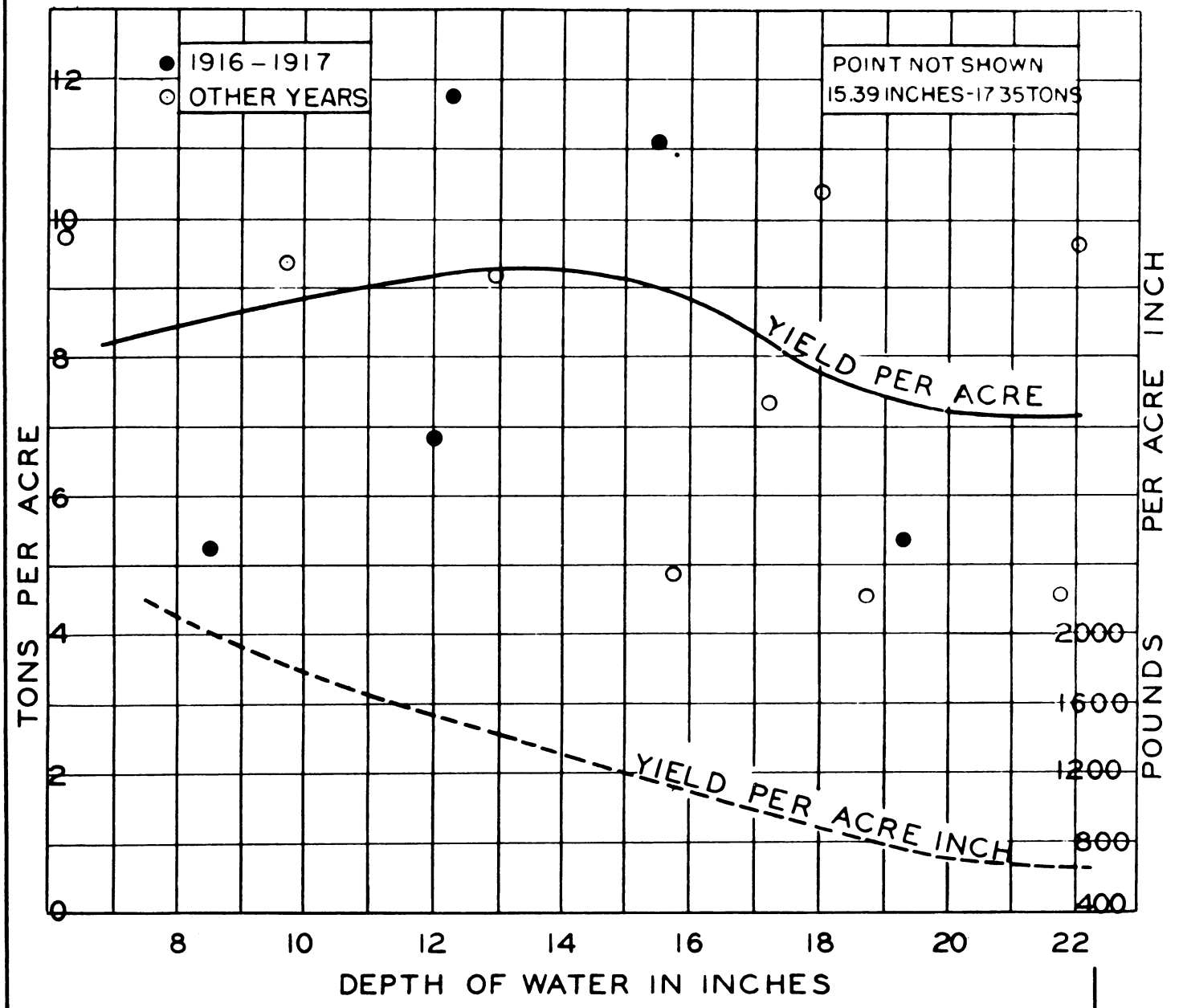


Fig. 8

Irrigation of cabbage on sandy soil

DUTY OF WATER IN THE LOWER RIO GRANDE VALLEY

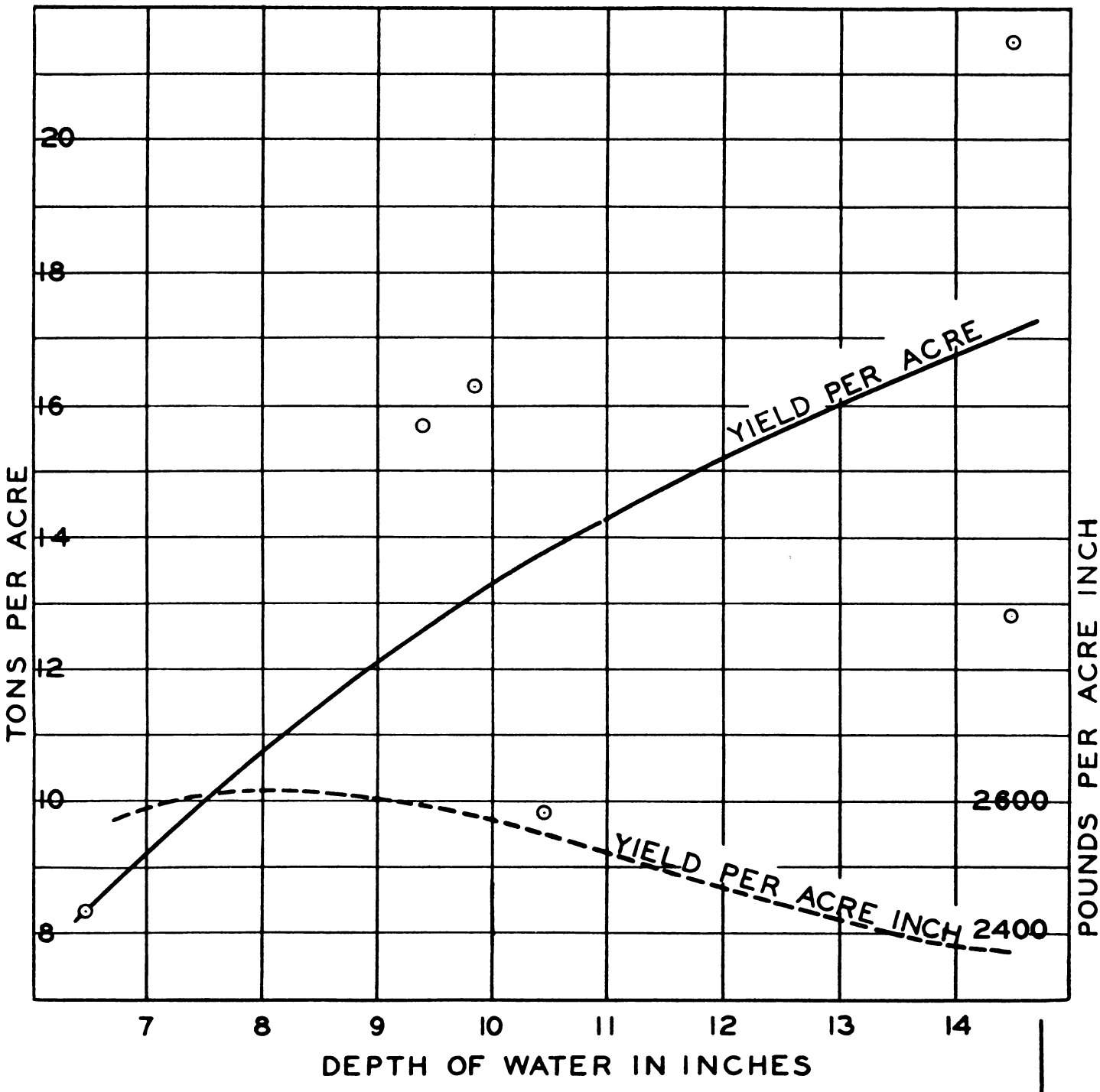


Fig. 9

Irrigation of cabbage on clay soil

LETTUCE

Three crops of lettuce were grown on the sandy soil and four on the clay soil. The time of planting ranged from October to December, and the crops were harvested from January to March, inclusive. The varieties used were New York and Big Boston. Plants were spaced 10 to 12 inches apart in either single or double rows, experience indicating that the latter method is to be preferred. Plots were cultivated frequently and when needed, water was applied in furrows between the rows, or by flooding between borders. On account of the deep cracks some difficulty was experienced in applying to the clay soil the exact amount of water desired, and occasionally it was necessary to make deductions for the amount of water which ran off the plot through these cracks. In 1916-17 some of the plants were affected by the head rot, and towards the end of the season continued warm weather caused many of the plants to go to seed. The 1918-19 crop was damaged to some extent by cold weather in January. In 1917-18 and 1919-20 rabbits were responsible for low yields on two plots. On the sandy soil only the 1919-20 crop grew to maturity without damage from either cold weather or head rot. The winter afforded good growing weather and little rainfall, and the result was that the crop responded well to the different amounts of water applied.

The results are shown in Table VI. On the sandy soil the highest yield was obtained with eight inches of water. Yields with amounts in excess of eight inches were damaged to such an extent by freezing weather, head rot, and rabbits that the exact effect of the water cannot be determined, but it is clear that, had the crops reached maturity undamaged, the yields would have been lower than that obtained with eight inches. On the clay soil the yield

continued to increase with the increase in water up to at least 18 inches, but a larger quantity than 12 inches does not appear to be warranted by the increase in yield which would thereby be obtained. The fact that only one crop was brought to full maturity and completely harvested makes it difficult to draw any strictly reliable conclusions, but a consideration of all the facts indicates that the best quantity of water for lettuce is eight inches on the sandy loam and twelve inches on clay soil.

Table VI Irrigation of Lettuce

Figure 10 Irrigation of Lettuce on Sandy Soil

Figure 11 Irrigation of Lettuce on Clay Soil

TABLE VI. IRRIGATION OF LETTUCE.

Year	Irrigation Period	Season Days	Number	Depth Applied Inches	Rainfall Inches	Total Water in Inches	Yield Pounds per Acre	Yield Pounds per Ac. In.
SANDY SOIL								
1916-17	Oct 30 - Feb 1	95	9	6.56	2.87	9.43	11000*(1)	1170
	Oct 30 - Feb 1	95	9	11.01	2.87	13.88	8325	600
	Oct 30 - Feb 1	95	9	15.45	2.87	18.32	8450	460
1916-17	Oct 30 - Feb 1	95	9	5.67	2.87	8.54	7420*(1)	870
	Oct 30 - Feb 1	95	9	9.30	2.87	12.17	7075	580
	Oct 30 - Feb 1	95	9	13.05	2.87	15.92	7775	490
1918-19	Oct 16 - Dec 17	63	3	5.66	8.96	14.62	9080*(2)	622
	Oct 16 - Dec 17	63	4	8.66	8.96	17.62	7860	448
	Oct 16 - Dec 17	63	4	10.66	8.96	19.62	9550	484
1918-19	Oct 16 - Dec 17	63	3	5.66	8.96	14.62	8240*(2)	564
	Oct 16 - Dec 17	63	4	8.66	8.96	17.62	8960	508
	Oct 16 - Dec 17	63	4	10.66	8.96	19.62	10000	510
1919-20	Nov 4 - Jan 7	65	3	3.25	.82	4.07	14960*(3)	3680
	Nov 4 - Jan 7	65	3	5.25	.82	6.07	20000	3300
	Nov 4 - Jan 7	65	3	7.00	.82	7.82	21000	2700
CLAY SOIL								
1914-15	Not irrigated	0	0	0	8.38	8.38	21304	2540
	Jan 25 - Feb 27	34	4	2.20	8.38	10.58	27826	2630
	Jan 25 - Feb 27	34	4	7.08	8.38	15.46	29130	1880
1917-18	Oct 24 - Feb 1	100	7	8.00	.55	8.55	5930	695
	Oct 24 - Feb 1	100	7	10.75	.55	11.30	7540	670
	Oct 24 - Feb 1	100	7	13.00	.55	13.55	5930*(3)	438
1918-19	Oct 22 - Nov 14	23	2	5.00	9.61	14.61	5610	384
	Oct 22 - Nov 14	23	2	5.50	9.61	15.11	6090	440
	Oct 22 - Nov 14	23	2	6.00	9.61	15.61	7700	495
	Oct 22 - Nov 14	23	2	6.00	9.61	15.61	8620	550
	Oct 22 - Nov 14	23	2	6.00	9.61	15.61	10175	655
	Oct 22 - Nov 14	23	2	7.25	9.61	16.86	8780	520
	Oct 22 - Nov 14	23	2	7.50	9.61	17.11	7530	440
	Oct 22 - Nov 14	23	2	10.25	9.61	19.86	7780	392
1919-20	Nov 14 - Feb 11	89	4	5.13	.82	5.95	27250	4580
	Nov 14 - Feb 11	89	4	7.63	.82	8.45	28500	3380
	Nov 14 - Feb 11	89	4	9.50	.82	10.32	27800*(4)	2700

* (1) Due to warm and damp weather about 40 to 50 per cent of this crop went to seed and was not harvested.
* (2) A part of this crop was damaged by cold weather on January 3.
* (3) The yield on this plot was reduced considerably by rabbits eating the young plants.
* (4) This plot was affected by root rot.

DUTY OF WATER IN THE LOWER RIO GRANDE VALLEY

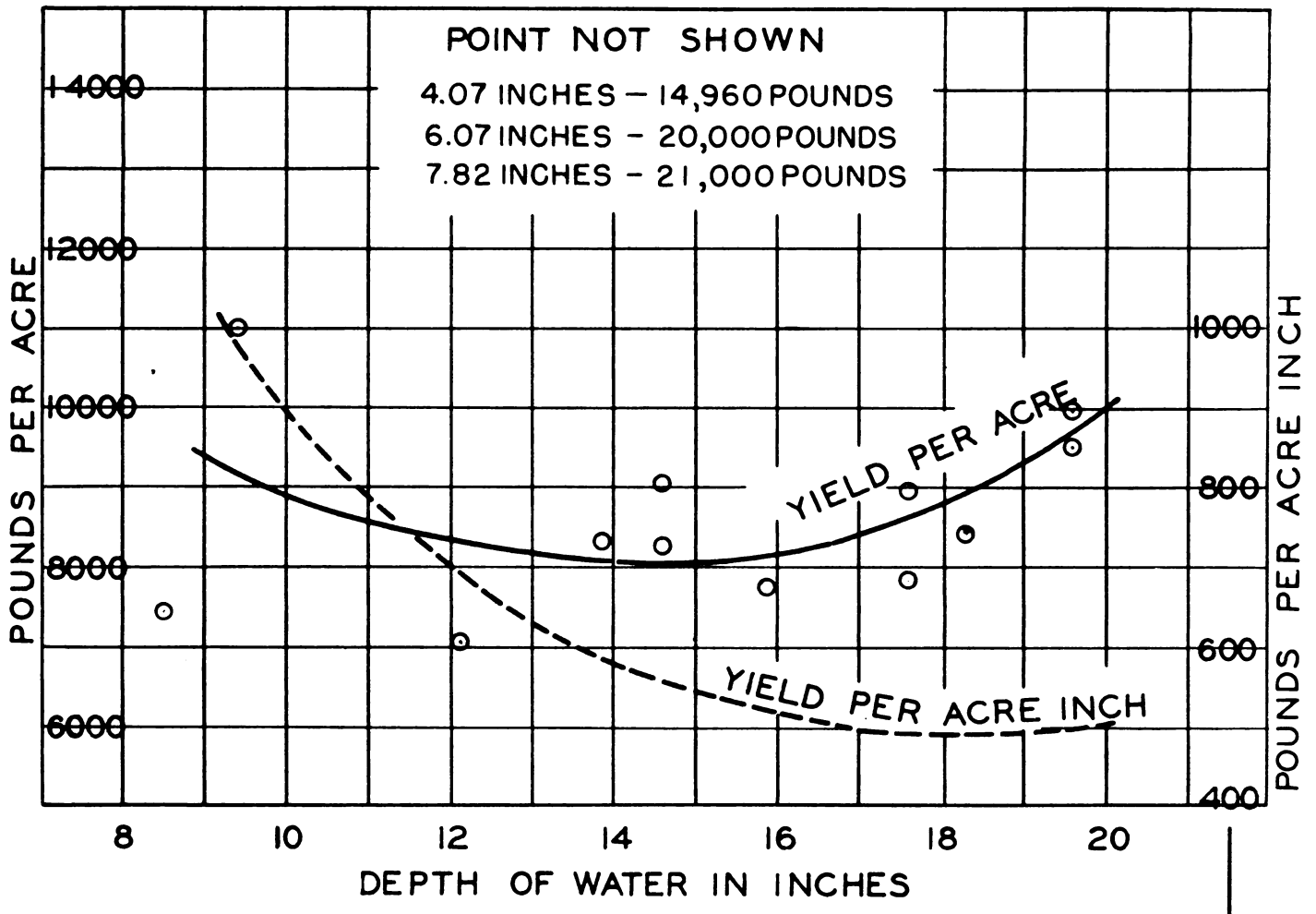


Fig. 10

Irrigation of lettuce on sandy soil

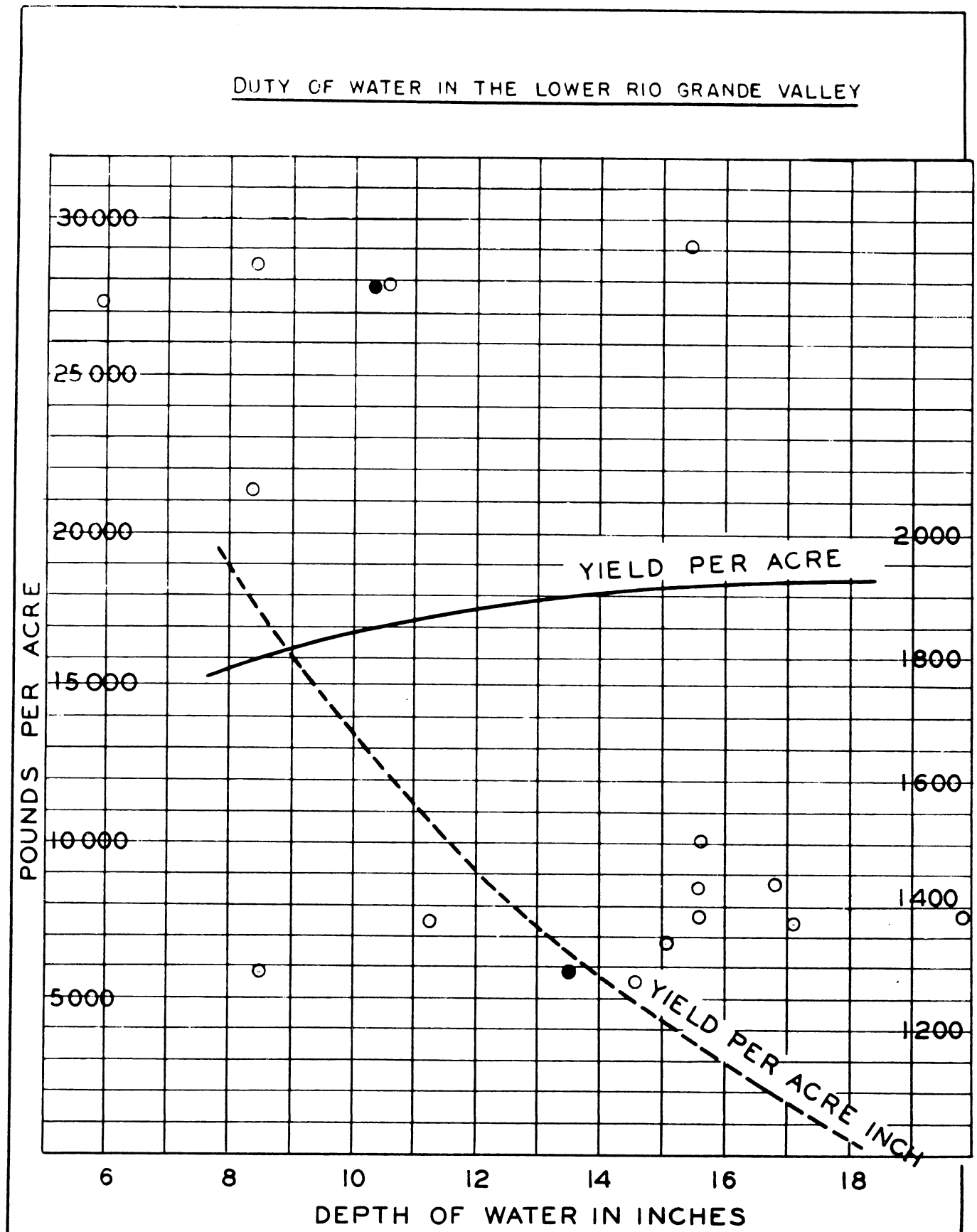


Fig. 11

Irrigation of lettuce on clay soil

CAULIFLOWER.

Cauliflower of the Snowball variety was planted in a well prepared seed bed on July 10, 1919, and transplanted sixty days later. On January 6 the heads were tied up to make them bleach. Harvesting began on January 20 and continued until February 6.

The results of the tests are given in Table VII. They show that the clay soil is much better adapted to the crop than the sandy soil. It is clear also that there is little or no advantage in applying heavy irrigations to the crop on either soil as a difference of six inches of water made practically no difference in the yield. No conclusions can be drawn as to the amount of water which will give the best results, but there are indications that the quantities should be much the same as for cabbage, which produces the best yield on the sandy soil with 14 inches of water and on the clay soil with 16 inches or more.

Table VII Irrigation of Cauliflower.

TABLE VII. IRRIGATION OF CAULIFLOWER.

Year	Irrigation Period	Season Days	Number	Depth Applied Inches	Rainfall Inches	Total Water in Inches	Yield Pounds per Acre	Yield Pounds per Ac.In.
SANDY SOIL								
1919-20	Sept 20 - Jan 7	119	4	5.50	9.30	14.80	10250	695
	Sept 20 - Jan 7	119	4	8.50	9.30	17.80	10740	604
	Sept 20 - Jan 7	119	4	11.50	9.30	20.80	10900	525
CLAY SOIL								
1919-20	Sept 10 - Jan 7	119	4	5.33	9.30	14.63	16000	1100
	Sept 10 - Jan 7	119	4	8.33	9.30	17.63	16450	935
	Sept 10 - Jan 7	119	4	11.33	9.30	20.63	15425	750

BEETS

Three crops of beets were grown, two on the clay soil and one on the sandy soil. Seed of the Crosby Egyptian variety were planted in the latter part of October and the beets were harvested in February and March. Cutworms and grasshoppers were numerous and did considerable damage before they could be checked with Paris green and lime. The 1917 crop was damaged to such an extent that it was necessary to replant in November. Later on cold weather checked the growth of the crop, and at the time of harvesting some damage was being done by rats.

The results of the tests are shown in Table VIII. On the sandy soil best results were obtained with 7 inches, the smallest amount of water applied; but on the clay soil both tests showed a fairly uniform increase in yield with the application of more water. The indications are that the best yield on the clay soil will be obtained with a quantity in excess of 16 inches.

Table VIII Irrigation of Beets

TABLE VIII. IRRIGATION OF BEETS

Year	Irrigation Period	Season Days	Number	Depth Applied Inches	Rainfall Inches	Total Water in Inches	Yield Pounds per Acre	Yield Pounds per Ac. In.
CLAY SOIL								
1917-18	Oct 24 - Apr 2	160	8	9.15	3.52	12.67	12894	1020
	Oct 24 - Apr 2	160	8	11.90	3.52	15.42	16335	1060
	Oct 24 - Apr 2	160	8	15.70	3.52	19.22	18861*(1)	980
1919-20	Oct 25 - Feb 11	109	5	6.25	.82	7.07	20600	2920
	Oct 25 - Feb 11	109	5	10.75	.82	11.57	20900	1810
	Oct 25 - Feb 11	109	5	15.00	.82	15.82	22250	1410
SANDY SOIL								
1919-20	Nov 4 - Mar 24	141	5	6.00	1.07	7.07	16640	2360
	Nov 4 - Mar 24	141	5	9.25	1.07	10.32	15200	1475
	Nov 4 - Mar 24	141	5	12.87	1.07	13.94	13500	968

*(1) The soil on which this crop was grown is rather lighter than the average.

TOMATOES

Tests were made with tomatoes on both the sandy and clay soils. It is evident from the results of these tests that the clay soil is not particularly adapted to tomatoes and that larger yields of a better quality will be obtained on the sandy loam. The first crop on the clay soil, grown in the fall of 1918, gave a low yield of fair quality, while the crop grown in the spring of 1920 gave a moderately high yield of very poor quality. Many of the tomatoes rotted while green, and the greater part of the remainder were small and off-color when harvested. Three crops were produced on the sandy soil with good results. The spring crops were transplanted in March and were harvested in May, June and July. Fall crops were planted in September and harvested in December. The variety used was the June Pink. Some difficulty was experienced in getting good stands and much replanting was necessary in 1918. In that year the cutworms did some damage in the spring, and the fall crop was nipped by a light frost on December 2.

The results are shown in Table IX and Figure 12. It appears from these that the average best yield will be produced on the sandy soil with about 20 inches of water.

Table IX Irrigation of Tomatoes

Figure 12 Irrigation of Tomatoes on Sandy Soil

TABLE IX. IRRIGATION OF TOMATOES.

Year	Period	Season Days	Number	Depth Applied Inches	Rainfall Inches	Total Water in Inches	Yield Pounds per Acre	Yield Pounds per Ac. In.
SANDY SOIL.								
1918	Apr 17 - June 29	73	5	5.33	6.36	11.69	25030	2142
	Apr 17 - June 29	73	5	9.33	6.36	15.69	25410	1620
	Apr 17 - June 29	73	5	13.33	6.36	19.69	28012	1425
1918	Sept 25 - Nov 20	56	5	5.60	5.10	10.70	12930	1210
	Sept 25 - Nov 20	56	5	9.83	5.10	14.93	11250	755
	Sept 25 - Nov 20	56	5	14.33	5.10	19.43	12800	660
1920	Mar 2 - May 11	70	7	8.00	4.40	12.40	16550	1335
	Mar 2 - May 11	70	7	11.50	4.40	15.90	21850	1375
	Mar 2 - May 11	70	7	16.00	4.40	20.40	20350	998
CLAY SOIL								
1918	Sept 23 - Nov 14	52	4	6.50	5.10	11.60	8170*	705
	Sept 23 - Nov 14	52	4	11.00	5.10	16.10	5060	314
	Sept 23 - Nov 14	52	4	15.58	5.10	20.68	6080	294
1920	Mar 2 - May 11	70	6	6.08	4.40	10.48	11280	1075
	Mar 2 - May 11	70	6	8.75	4.40	13.15	12370	945
	Mar 2 - May 11	70	6	12.17	4.40	16.57	12318	750

* Measured yield corrected to allow for deficient stand.

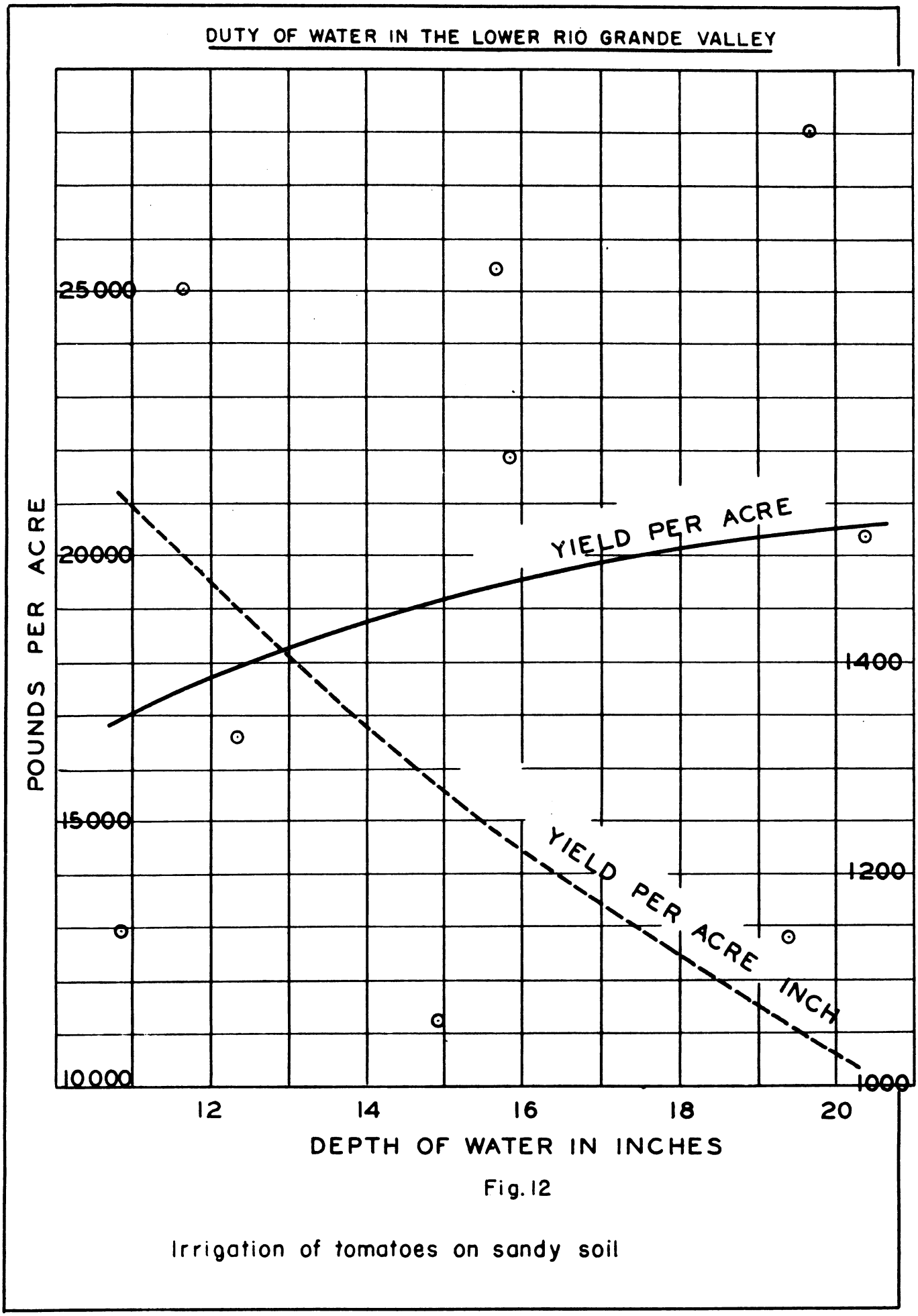


Fig. 12

Irrigation of tomatoes on sandy soil

OTHER CROPS.

Tests with various other crops were made on both types of soil, and the results of these tests are shown in Table X. The majority of the experiments extended over only one season, and those which were carried on for a longer period were affected to such an extent by accidental variations that it was considered inadvisable to attempt to draw any conclusions as to the proper duty.

TABLE X Irrigation of Other Crops

TABLE X. IRRIGATION OF OTHER CROPS.

Year	Irrigation Period	Season Days	Number	Depth Applied Inches	Rainfall Inches	Total Water in Inches	Yield Pounds per Acre	Yield Pounds per Ac. In.
CARROTS ON SANDY SOIL								
1918-19	Oct 16 - Nov 20	35	3	5.00	9.43*(1)	14.43	12800	890
	Oct 16 - Dec 17	62	4	8.00	9.43	17.43	11650	670
	Oct 16 - Dec 17	62	4	10.00	9.43	19.43	13200	680
GARDEN PEAS ON CLAY SOIL								
1914-15	Nov 14 - Nov 14	1	1	.87	7.30	8.17	1660	203
	Nov 14 - Feb 17	95	5	1.76	7.30	9.06	1375	152
	Nov 14 - Feb 17	95	5	6.97	7.30	14.27	1150	81
COW PEAS ON SANDY SOIL								
1920	May 4 - June 22	49	2	4.58	4.30	8.88	5850*(2)	660
	May 4 - June 22	49	2	5.46	4.30	9.76	6930	715
	May 4 - June 22	49	2	6.33	4.30	10.63	6400	602
SORGHUM HAY ON SANDY SOIL								
1919	Mar 5 - Aug 19	167	3	6.38	23.95	30.33	20400	675
	Mar 5 - Aug 19	167	3	9.39	23.95	33.34	21200	640
	Mar 5 - Aug 19	167	3	11.75	23.95	35.70	24300	682
	Mar 5 - Aug 19	167	3	13.75	23.95	37.70	23000*(3)	610
SORGHUM HAY ON CLAY SOIL								
1919	Mar 8 - Aug 19	164	3	7.88	23.95	31.83	19300	610
	Mar 8 - Aug 19	164	3	10.00	23.95	33.95	21300	628
	Mar 8 - Aug 19	164	3	12.22	23.95	36.17	23350*(3)	645
SNAP BEANS ON SANDY SOIL								
1918	Aug 28 - Nov 1	65	5	8.50	2.78	11.28	3530	315
	Aug 28 - Nov 1	65	5	13.00	2.78	15.78	5575	361
	Aug 28 - Nov 1	65	5	17.17	2.78	19.95	5500	276
SNAP BEANS ON CLAY SOIL								
1918	Sept 11 - Nov 14	64	4	5.25*(4)	2.78	8.03	4280	534
	Sept 11 - Nov 14	64	4	8.50	2.78	11.28	3470	308
	Sept 11 - Nov 14	64	4	11.75	2.78	14.53	3880	267
1920	Mar 24 - May 11	48	5	5.00	2.32	7.32	4760	650
	Mar 24 - May 11	48	5	9.50	2.32	11.82	3610	305
	Mar 24 - May 11	48	5	14.00	2.32	16.32	2200	135

TABLE X. IRRIGATION OF OTHER CROPS

Year	Irrigation Period	Season Days	Number	Depth Applied Inches	Rainfall Inches	Total Water in Inches	Yield Pounds per Acre	Yield Pounds per Ac.In.
SPINACH ON SANDY SOIL								
1918	Nov 20 - Dec 17	28	2	3.08	8.60	11.68	6380	545
	Nov 20 - Dec 17	28	2	4.25	8.60	12.85	5600	435
	Nov 20 - Dec 17	28	2	6.00	8.60	14.60	5450	374
SPINACH ON CLAY SOIL								
1918	Oct 22 - Nov 14	23	2	5.50	5.20	10.70	4500	420
	Oct 22 - Nov 14	23	2	6.00	5.20	11.20	3550	318
	Oct 24 - Nov 14	23	2	7.00	5.20	12.20	3940	322
1914-15		0	0	0.00	7.15	7.15	11100	1550
	Jan 25 - Mar 1	35	4	2.64	7.15	9.79	18100	1850
	Jan 25 - Mar 1	35	4	5.99	7.15	13.14	18500*(5)	1410
SWEET PEPPERS ON SANDY SOIL								
1919	Mar 24 - July 16	114	4	5.00	14.17	19.17	10500*(6)	550
	Mar 24 - July 16	114	4	8.00	14.17	22.17	11070	500
	Mar 24 - July 16	114	4	11.00	14.17	25.17	8720	350
1919	Sept 2 - Nov 26	85	3	3.00	8.88	11.88	2580*(7)	217
	Sept 2 - Nov 26	85	3	6.00	8.88	14.88	3190	215
	Sept 2 - Nov 26	85	3	9.00	8.88	17.88	2750	154
1920	May 4 - Aug 5	93	6	7.00	4.15	11.15	2100*(8)	188
	May 4 - Aug 5	93	6	12.00	4.15	16.15	3380	209
	May 4 - Aug 5	93	6	17.00	4.15	21.15	3540	168
SWEET PEPPER ON CLAY SOIL								
1919	Mar 27 - July 16	111	4	8.17	14.17	22.34	6990	314
	Mar 27 - July 16	111	4	10.67	14.17	24.84	10300	415
	Mar 27 - July 16	111	4	14.67	14.17	28.84	10300*(9)	355
1919	Sept 2 - Nov 26	85	3	3.00	8.88	11.88	2360	199
	Sept 2 - Nov 26	85	3	5.50	8.88	14.38	2560	178
	Sept 2 - Nov 26	85	3	8.00	8.88	16.88	2170*(7)	130
1920	May 6 - Aug 5	91	6	7.25	4.15	11.40	2440	215
	May 6 - Aug 5	91	6	11.13	4.15	15.28	3480	228
	May 6 - Aug 5	91	6	16.00	4.15	20.15	2440*(8)	122

TABLE X. IRRIGATION OF OTHER CROPS

Year	Period	Irrigation Season Days	Irrigation Number	Irrigation Depth Applied Inches	Rainfall Inches	Total Water in Inches	Yield Pounds per Acre	Yield Pounds per Ac.In.
BROOM CORN ON CLAY SOIL								
1919	May 28 - Aug 12	76	2	5.92	12.95	18.87	693	36.8
	May 28 - Aug 12	76	2	6.25	12.95	19.20	752	39.2
	May 28 - Aug 12	76	2	9.19	12.95	22.14	695*(10)	31.4
BROOM CORN ON SANDY SOIL								
1918	Mar 12 - Sept 10	182	7	8.50	9.70	18.20	1317	72.5
	Mar 12 - Sept 10	182	7	13.00	9.70	22.70	1427	63.0
	Mar 12 - Sept 10	182	7	17.50	9.70	27.20	1525	56.2
1919	May 28 - Aug 19	83	2	4.00	12.95	16.95	1183	70.0
	May 28 - Aug 19	83	2	6.00	12.95	18.95	1207	64.0
	May 28 - Aug 19	83	2	8.00	12.95	20.95	1239	59.2

* (1) Much of this rainfall came at inopportune times.
* (2) Cured hay. Planted May 7; cut July 23.
* (3) Three cuttings.
* (4) Amount of first irrigation partly estimated to omit water which ran off plots through deep cracks.
* (5) Plots only 51 square feet in area and results indicate what can be done under the best conditions.
* (6) Yields for this test were estimates based on the measured yield and the area as determined by an actual count of the plants. Deficient stand due chiefly to red-headed grub worm.
* (7) The crop for this test was produced on the cut-back plants of the spring crop, which usually produce a small yield. The yield was further reduced by a freeze on December 10.
* (8) Due to excessively hot and dry weather this crop did no good after the middle of June.
* (9) Heavy wind and rain on May 8 stripped plants.
* (10) Yields of broom corn shown include the brush from two cuttings.