April 1974 WRRI Report No. 038

13030 GLM Quarterly Progress Report

QUALITY AND QUANTITY OF RETURN FLOW AS INFLUENCED BY TRICKLE AND SURFACE IRRIGATION

January, February, and March 1974

PROJECT 13030 GLM

QUALITY AND QUANTITY OF RETURN FLOW AS INFLUENCED BY TRICKLE AND SURFACE IRRIGATION

Quarterly Report for the Period
January, February, March, 1974

Peter J. Wierenga, Associate Professor
Ted C. Patterson, Assistant Professor

Department of Agronomy and Agricultural Engineering
New Mexico State University
Las Cruces, New Mexico 88003

Progress Report

WRRI-308 13030 GLM

January, February, March

1974

Progress during the last three months has been as planned. Accomplishments for the quarter are outlined below.

1. Preparation of field plots

All field plots were prepared for the 1974 crop year. Cotton stalks were manually pulled out of the soil and removed from the plots. On February 25 all surface irrigated plots were preirrigated with 15 cm of water. The soil inside the plots was rather dry and showed much cracking. A preirrigation with 15 cm water was found necessary to adequately cover the 7.3 x 7.3 m^2 plots. During the last week of March the top soil inside the surface irrigated plots was loosened to a depth of 5 cm with a rotatiller. On April 1 cotton was planted in the loosened dry top soil and covered with fine sand, to facilitate emergence. The plots were irrigated on April 19, after the soil temperature had reached the level of 59°F (15°C), with 10 cm water to enable the cotton to germinate. Except for the surface treatment with the rotatiller no tillage was done on the plots. Although this procedure is different from what the farmers in the area do, the small size of the plots makes it impossible to use standard farming practices.

The trickle plots were preirrigated with 10 cm water during the last week of March. The structure of the soil in the trickle plots was in excellent shape and therefore no rotatilling or any other form of tillage was applied. The cotton was planted on the same rows as the year before. No sandcapping was applied. The good soil structure found on the trickle irrigated plots after a 10 cm preirrigation is surprising. The previous year we also noted a very good soil structure after preirrigation.

The favorable effect of trickle irrigation on soil structure may be a major benefit of applying water through a trickle irrigation system on soils in the Mesilla Valley. Furthermore, if we again obtain a high yield from the trickle irrigated plots, this may indicate that minimum or no tillage may be used on trickle irrigated cotton. This would mean rather extensive savings in water and energy with full control over the amount of return flow through the use of a trickle irrigation system. However, continued experiments are necessary to demonstrate the long term effects of no tillage and trickle irrigation on cotton to make any firm conclusions.

Before preirrigation of the field plots all water meters were removed from the field and recalibrated. Two water meters on the trickle plots had to be replaced. All the tubing leading from the tensiometers inside the plots to the mercury manometers outside the plots was removed and will be replaced after germination of the cotton. The suction lines from the suction cups to the collection bottles will also be replaced. Several tricklers in the trickle lines had to be replaced.

2. Soil physical properties at the test site.

a) Percent water at 15 bar pressure. Continued progress was made in assessing the physical properties of the soil at the experimental site. In order to determine the percent of available water within each plot the water content at 15 bar pressure was determined at 20 cm depth intervals for all plots.

Table 1 presents these data for the surface irrigated plots and Table 2 for the trickle irrigated plots. Samples in the trickle plots were taken in the rows and in between the rows. The mean and standard deviations from the mean are also presented for each depth in Tables 1 and 2. The data in Tables 1 and 2 clearly show the large variation in soil physical properties in the soil at the experimental site. Examples of unusual layering are found in plots 24 to 27. In plot 26 for example the sand layer is found below the 160 cm. The first two rows are relatively uniform with the sand layer found at about 80 cm or less below the soil surface. The mean and standard deviations from the mean for the first 20 plots are also presented in Table 1. It is clear that the standard deviations from the mean improve considerably by eliminating the data from the third row of plots.

The data in Table 2 also show wide variations in the water contents at 15 bar pressure, especially in the subsoil.

b) Mechanical analysis. The mechanical composition of the soil inside plot 4 was determined with the pipette method. The analyses were made for three locations inside the plot. The results are presented in Table 3. Each number is the average of three. The data in Table 3 confirm the layered nature of the soil at the experimental site. The high clay content in the 40-65 cm layer may explain the relatively low permeability of this layer measured in a separate experiment.

3. Consumptive use.

The agreement with the Bureau of Reclamation was extended for the present project year. Under the agreement the project will participate in the Irrigation Management Services of the Bureau of Reclamation. The Bureau will perform the computer calculations for scheduling irrigations for the various

Table 1

Water contents, in % dry weight, at 15 bar pressure for 27 surface irrigated plots

Plot No.	Depth (cm) 0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160
1	31.6	32.8	35.9	28.0	8.5	2.1	1.5	1.2
2	22.6	23.1	30.1	13.5	2.5	1.8	1.6	1.5
3	23.1	22.4	28.2	24.8	2.9	1.7	1.4	1.3
5	22.5	22.2	24.2	12.1	3.7	1.5	1.0	1.5
6	26.8	27.8	33.1	21.6	3.4	1.5	1.8	1.3
7	25.7	23.6	26.9	21.6	3.6	1.8	1.6	2.5
8	28.5	29.2	33.6	27.1	5.6	4.3	1.7	1.3
9	28.1	31.4	36.7	34.9	12.4	5.3	3.1	1.8
10	31.3	31.8	34.7	23.7	5.7	1.8	1.9	1.5
11	28.7	25.2	29.8	29.5	9.3	1.3	1.1	1.6
12	28.3	24.2	30.0	31.6	2.6	1.2	0.9	1.6
13	31.8	32.7	38.0	21.6	4.5	1.7	1.4	1.3
14	25.2	30.3	32.7	18.6	3.3	0.9	1.6	1.0
15	29.2	30.4	29.9	17.3	2.9	1.1	0.7	0.8
16	24.1	23.4	22.8	12.7	4.6	1.9	1.3	2.0
17	31.2	31.0	30.6	20.2	4.4	1.9	1.9	1.7
18	28.3	27.1	28.0	28.9	6.5	1.3	1.1	1.2
20	27.5	25.2	26.6	24.4	7.0	2.0	1.5	1.7
21	29.3	29.2	25.7	7.4	14.1	25.7	12.3	3.6
22	30.7	31.1	15.2	8.3	7.1	15.9	16.3	2.2
23	33.6	32.8	26.3	6.9	10.1	16.2	9.7	3.1
24	27.8	26.3	27.7	18.3	14.3	23.6	8.3	3.0
25	22.7	27.0	12.6	15.7	9.3	29.8	24.5	3.8
26	30.2	26.1	33.0	35.8	35.8	19.1	22.0	17.7
27	28.9	29.9	31.1	28.8	10.1	20.5	9.1	10.4
29	25.0	27.4	31.0	33.7	15.1	6.8	6.7	8.6
30	31.7	32.4	33.6	37.1	10.5	2.9	3.3	1.6
Mean plots 1-30	27.9	28.0	28.8	22.4	8.1	7.2	5.2	3.0
St. Dev. plots 1-30	3.2	3.5	5.5	8.8	6.8	9.1	6.6	3.7
Mean plots 1-20	27.5	27.4	30.7	22.9	5.2	2.0	1.5	1.5
St. Dev. plots 1-20	3.1	3.8	4.2	6.5	2.7	1.1	0.5	0.4

Table 2

Water contents, in % dry weight, at 15 bar pressure for the six trickle irrigated plots

Plot No.	Depth (cm) 0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160
1 row	28.6	29.3	28.5	7.5	10.1	15.5	5.3	10.4
1 center	28.7	28.5	23.1	15.8	21.7	12.0	4.7	6.9
2 row	23.3	20.8	22.5	6.6	9.4	11.6	4.3	5.6
2 center	21.5	21.9	12.0	5.9	11.3	17.9	4.0	6.0
3 row	21.7	22.9	13.9	4.4	4.7	9.2	6.2	3.2
3 center	35.2	36.6	30.5	8.1	16.7	21.0	8.8	6.0
4 row	35.1	36.0	25.2	11.4	5.0	8.6	3.8	1.7
4 center	24.5	23.4	27.7	11.5	10.6	17.8	6.8	9.0
5 row	31.7	21.7	31.8	18.0	15.5	16.6	8.9	2.2
5 center	30.6	30.7	24.9	15.2	16.3	15.9	8.3	10.0
6 row	30.1	25.8	18.5	7.1	9.8	12.0	10.0	5.5
6 center	21.0	23.7	15.9	6.4	10.6	17.4	10.1	8.7
Mean	27.7	26.8	22.9	9.8	11.8	14.6	6.8	6.3
St. Dev.	5.2	5.5	6.5	4.5	5.0	3.9	2.4	2.9

Table 3

Particle size distribution of soil within plot 4.

Depth	% Sand	% Clay	% Silt	Texture
10-20	21.8	43.3	34.9	Clay
20-35	18.2	41.9	39.9	Silty Clay
40-50	2.1	50.7	47.2	Silty Clay
55-65	4.9	52.6	42.5	Silty Clay
70-80	56.4	6.4	37.2	Sandy Loam
85-95	94.7	1.0	4.3	Sand
115-125	93.0	2.1	4.9	Sand
145-155	94.6	1.6	3.8	Sand

irrigation treatments. The project will furnish the climatic data the Bureau needs in its calculations of consumptive use. These include wind speed at 2 m in miles/day, relative humidity, maximum and minimum air temperatures and incoming radiation in langley's/day.

4. Monitoring of the Del Rio Drain and Deep Wells.

Monitoring of the Del Rio Drain and of the deep wells was continued during the past three months. The complete results will be presented in the annual report. One water stage recorder on the Del Rio Drain was lost due to vandalism. A new one was ordered to replace it.

The sampling system for the deep wells was rebuilt. The hand pump system was replaced by a system based upon the use of vacuum. It is expected that this will result in better samples with less fluctuation between samples.

5. Visitors.

Below is a list of people who visited the project during the past three months:

Dr. V. V. Rendig (California)
Dr. D. R. Nielsen (California)
Dr. J. van Schilfgaarde, Director U.S. Salinity Laboratory, Riverside (California)
W. F. Spencer (California)
Dr. Parker Pratt (California)
C. E. Evans (Colorado)
Marvin E. Jensen (Idaho)
Lu Calpouzos (Idaho)
Bill Larsen (Montana)
Kurt Feltner (Montana)
J. C. Engibous (Washington)
J. Roberts (Washington)
John Davis (Oregon)
Robert D. Burman (Wyoming)
R. A. Young (Nevada)

Dr. George Vachand, Institut de Mecanique, University of Grenoble, France
Dr. S. A. Gavande and 4 graduate students, Universidad Autonoma de Cohabuila, Saltillo, Mexico
Dr. L. R. Webber, University of Guelph, Ontario, Canada