PROJECT 13030 GLM

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

Quarterly Report for the Period
October, November, December, 1973

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PROGRESS REPORT

WRRI-308 Project 13030 GLM
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1973

1. Growing and Harvesting the 1973 Cotton.

Cotton was harvested by hand picking five center rows in each surface irrigated plot (a total of 100 feet), and four center rows in each trickle irrigated plot (a total of 240 feet). All surface irrigated plots were first harvested on October 8 and harvested for the second time on November 26. Trickle plots T3 and T6 were first harvested on October 9. Trickle plots T1, T2, T4, and T5 were treated with paraquat to reduce vegetative growth and advance maturation. These plots were harvested for the first time on October 24. All trickle plots were harvested for the second time on November 27. After harvesting the cotton, the remaining stalks and the non-harvested plants were pulled out of the soil and removed from the plot area. Samples of the cotton were analyzed for quality in the Cotton Fiber Laboratory at New Mexico State University.

Cotton yields from the first and the second harvest, and the total yields are presented in Table 1 for all plots. The mean yield of the first plus the second harvests is 2.39 bales/acre for the surface plots and 2.34 bales/acre for the trickle plots. These yields are considerably above the average yield at the Experimental Farm (about 1.75 bales/acre), and about twice the average yield in the Mesilla Valley (1.0 - 1.25 bales/acre). The quality data for the first and second harvest are presented in Tables 2 and 3.

Table 1. Yields of surface-, and trickle irrigated plots in bales/acre of lint cotton (1973).

Plot No.	1c harvest Oct.8/24	2c harvest Nov.26/27	1c + 2c harvest
	Surface irrigated plots		
1	1.19	1.30	2.49
2	1.64	1.36	3.00
3	1.37	1.06	2.43
5	1.26	1.30	2.56
6	1.46	1.12	2.58
7	1.42	1.12	2.54
8	1.49	1.09	2.58
9	1.09	0.98	2.07
10	1.57	1.00	2.57
11	1.17	1.02	2.19
12	1.29	0.96	2.25
13	1.55	0.68	2.23
14	1.47	1.17	2.64
15	1.38	1.08	2.46
16	1.33	0.96	2.29
17	1.72	0.90	2.62
18	1.19	1.03	2.22
20	1.92	1.00	2.92
21	0.99	1.30	2.29
22	1.16	1.06	2.22
23	1.18	1.07	2.25
24	1.17	0.84	2.01
25	0.99	0.96	1.95
26	1.18	0.80	1.98
27	1.21	1.04	2.25
29	1.35	0.97	2.32
30	1.78	0.80	2.58
Mean	1.35	1.04	2.39
St. Dev.	0.24	.16	.26
	Trickle irrigated plots		
T1	2.14	0.36	2.50
T2	2.17	0.40	2.57
T3	1.13	1.09	2.22
T4	1.50	0.64	2.14
T5	1.90	0.40	2.30
T6	1.53	0.76	2.28
Mean	1.73	0.61	2.34
St. Dev.	0.41	0.28	.17

Table 2. Quality data from the first harvest of cotton of plots irrigated by surface and trickle irrigation.

Plot No.	% lint	2.5% Span	Uniformity Ratio	MIC	Strength	Elongation
		Surface irrigated plots				
1	37.9	115	44.3	3.6	7.0	25.0
2	38.3	121	47.1	4.2	6.5	25.0
3	36.0	115	46.1	3.9	5.8	24.8
5	38.1	119	44.5	3.8	5.5	22.4
6	37.9	114	43.0	3.3	7.0	26.0
7	36.9	115	44.3	4.4	6.8	25.7
8	36.3	116	44.8	4.0	6.8	24.9
9	37.1	113	44.2	3.7	6.5	23.2
10	38.8	113	46.0	4.2	6.8	22.8
11	34.9	112	44.4	3.8	6.3	25.8
12	37.3	115	44.3	3.9	6.0	24.8
13	38.5	112	45.5	4.2	6.0	24.9
14	37.4	116	46.6	4.0	6.8	25.1
15	38.0	115	44.3	3.9	6.8	26.0
16	35.1	119	46.2	4.0	6.8	25.7
17	36.7	117	43.6	4.0	5.8	24.0
18	36.7	114	44.7	4.2	6.3	26.2
20	36.9	115	45.2	3.7	6.3	22.9
21	36.8	114	43.9	3.8	5.8	24.7
22	36.2	111	44.1	4.2	6.3	24.8
23	35.6	119	46.2	3.9	6.8	26.4
24	36.4	113	45.1	3.8	6.0	24.1
25	35.6	115	43.5	3.5	6.0	22.5
26	36.5	117	45.3	4.1	5.8	24.7
27	36.2	118	44.9	3.8	6.0	26.1
29	35.9	117	48.7	3.7	6.3	25.8
30	38.5	117	47.0	3.7	6.3	26.2
Mean	36.9	115.4	45.1	3.9	6.3	24.8
St. Dev.	1.1	2.4	1.3	.2	.43	1.2
		Trickle irrigated plots				
T1	37.7	119	44.5	4.0	7.3	24.1
T2	36.6	120	45.0	3.9	6.0	22.7
T3	38.0	119	45.4	3.6	5.8	24.2
T4	37.1	116	42.2	3.2	6.3	25.6
T5	37.9	117	43.6	3.0	6.0	25.2
T6	37.1	120	42.5	3.8	6.5	25.3
Mean	37.4	118.5	43.9	3.6	6.3	24.5
St. Dev.	0.6	1.6	1.3	0.4	0.5	1.1

Table 3. Quality data from the second harvest of cotton of plots irrigated by surface and trickle irrigation.

Plot No.	% lint	2.5% Span	Uniformity Ratio	MIC	Strength	Elongation
		Surface irrigated plots				
1	35.3	116	44.0	3.4	5.0	23.1
2	38.1	117	46.2	3.9	5.3	23.1
3	36.5	122	45.1	4.0	5.5	24.9
5	38.6	119	45.4	3.7	5.0	21.6
6	39.0	126	42.1	3.8	5.8	23.3
7	36.4	113	44.2	3.6	6.0	22.8
8	36.3	116	44.0	3.7	5.5	24.4
9	35.5	116	45.7	3.9	5.0	21.1
10	36.7	119	47.9	3.7	5.5	22.6
11	36.8	121	43.8	4.4	5.8	24.2
12	36.3	115	46.1	3.5	5.8	23.0
13	37.8	115	43.5	4.0	5.5	22.0
14	37.2	117	46.2	4.1	5.5	22.2
15	37.6	116	44.0	3.9	5.3	20.0
16	32.9	114	43.0	3.6	1.0	23.7
17	37.0	116	45.7	3.5	5.5	23.8
18	35.7	116	43.1	3.0	5.5	24.4
20	41.1	117	43.6	3.6	5.3	22.3
21	36.4	115	46.1	3.9	5.8	23.1
22	41.3	116	45.7	3.9	5.8	23.4
23	37.1	119	44.5	4.3	5.3	24.2
24	37.3	114	46.5	3.6	5.5	21.8
25	38.6	113	46.9	4.0	6.8	22.9
26	34.1	121	47.1	3.9	5.3	23.0
27	35.6	117	43.6	3.6	6.0	24.3
29	35.5	115	41.7	3.1	5.8	23.4
30	35.3	117	44.4	3.0	5.5	23.5
Mean	36.9	117.0	44.8	3.7	5.6	23.0
St. Dev.	1.8	2.9	1.56	0.3	0.4	1.1
		Trickle irrigated plots				
T1	35.9	119	44.5	2.9	6.3	22.5
T2	37.2	121	45.5	3.0	5.8	22.0
T3	38.7	114	44.7	3.4	5.3	22.6
T4	37.2	113	46.0	3.3	6.0	21.1
T5	36.4	113	43.4	2.7	5.3	19.7
T6	38.9	116	44.8	3.1	6.0	20.9
Mean	37.4	116.0	44.8	3.1	5.8	21.5
St. Dev.	1.2	3.3	0.89	0.3	0.4	1.1

The yield and quality data were analyzed statistically in cooperation with the Department of Experimental Statistics at New Mexico State University. Table 4 presents the effects of irrigation efficiency on the yield and quality of cotton from the surface irrigated plots.

Table 4. Effects of irrigation efficiency on yield (treatment means for 1^c and 2^c harvests and total mean yields for 1^c plus 2^c harvests) and quality (treatment means) of cotton in surface plots.

Irrigation efficiency %	Yield bales/acre	Lint %	2.5% Span	Uniformity Ratio	MIC	Strength	Elongation
			1^c harvest				
80	1.38	36.9	1.17	45.4	3.8*	24.5	6.3
90	1.33	37.0	1.15	45.3	3.9*	25.3	6.5
100	1.35	36.9	1.15	44.6	4.0*	24.8	6.2
			2^c harvest				
80	1.13	37.5	1.17	44.6	3.7	22.8	5.7
90	1.02	36.5	1.18	44.8	3.7	23.2	5.4
100	0.96	36.7	1.16	45.1	3.7	23.1	5.6
			1^c amd 2^c harvests combined				
80	2.51	37.2	1.17	45.0	3.8	23.7	6.0
90	2.35	36.7	1.17	45.1	3.8	24.2	5.9
100	2.31	36.8	1.16	44.8	3.9	23.9	6.0

As was the case during the 1972 growing season, irrigation efficiency did not significantly affect the yield of the surface irrigated plots. The average yield from the lowest efficiency plots was again highest, but the differences were not large enough to be statistically significant.

For the first harvest there was a significant effect (5% level) of irrigation efficiency on micronaire. The 100% efficiency treatment produced the highest micronaire, which is just the opposite of what was found the previous year. In 1972 the 100% irrigation efficiency resulted in the lowest micronaire.

Table 5 presents the effects of water depletion on yield and quality of cotton from the surface irrigated plots. No significant differences in yield were found between plots irrigated when 25, 50 or 75% of the available moisture was depleted. Plots irrigated when 50% of the available water was deplated had the highest yield, but differed not significantly from those irrigated when 25 and 75% of the available water was depleted. The year before plots irrigated when 75% of the available water was depleted had the highest yield, although differences in yield in 1972 were not statistically significant.

Table 5. Effects of water depletion on yield(treatment means for 1^c and 2c harvests and total mean yields for 1^c and 2^c harvests) and quality (treatment means) of cotton in surface plots.

Depletion %	Yield bales/acre	Lint %	2.5% Span	Uniformity Ratio	MIC	Strength	Elongation
			1^c harvest				
25	1.33	37.2	1.15	45.8	4.0	24.6	6.3
50	1.44	37.1	1.16	44.7	3.8	24.4	6.3
75	1.29	36.4	1.15	44.9	3.9	25.4	6.4
			2^c harvest				
25	1.01	36.3	1.17	45.6	3.6	22.7	5.5
50	1.05	37.3	1.16	44.6	3.6	22.9	5.5
75	1.04	37.1	1.18	44.2	3.9	23.5	5.7
			1^c and 2^c harvests combined				
25	2.34	36.7	1.16	45.7*	3.8*	23.7	5.9
50	2.49	37.2	1.16	44.7*	3.7*	23.7	5.9
75	2.33	36.8	1.16	44.5*	3.9*	24.5	6.1

* Significant differences at the 5% level

The effects of water depletion on quality were small. There were some significant differences in uniformity ratio and micronaire. The 50% depletion treatment had the lowest micronaire. In 1972, however, the 50% depletion treatment had the highest micronaire.

Table 6 presents the effects of soil water tension on yield and quality of trickle irrigated cotton. The 0.2 bar tension treatment was irrigated whenever the soil water tension at 6 inches below the trickle line reached 0.2 bar. The 0.6 bar tension treatment was irrigated whenever the soil water tension at 6 inches below the trickle line reached 0.6 bar. Both treatments received approximately the same amount of water, but the 0.6 bar treatment was irrigated less frequently. The most frequently irrigated plots (0.2 bar treatment) had the highest yield, but the difference between the two treatments was not statistically significant.

Table 6. Effects of soil water tension on yield(treatment means for 1^c and 2^c harvests and total means for 1^c plus 2^c harvests) and quality (treatment means) of cotton in trickle plots.

Tension bars	Yield bales/acre	Lint %	2.5% Span	Uniformity Ratio	MIC	Strength	Elongation
			1^c harvest				
0.2	1.95	37.3	1.20	44.0	3.9*	24.0	6.6
0.6	1.51	37.4	1.17	43.7	3.3*	25.0	6.0
			2^c harvest				
0.2	0.51	37.1	1.18	44.9	3.0	21.8	6.0
0.6	0.71	37.7	1.13	44.7	3.1	21.1	5.5
			1^c and 2^c harvests combined				
0.2	2.46	37.2	1.19	44.5	3.5	22.9	6.3
0.6	2.22	37.5	1.15	44.2	3.2	23.1	5.8

* significant differences at the 5% level.

Soil water tension and frequency of irrigation had very little effect on the quality of the cotton harvested. The cotton from the first harvest had a higher micronaire at the 0.2 bar (wet) treatment, but this effect was not significant when both harvests were combined.

2. Soil Salinity

a. Surface irrigated plots

Saturation extracts were prepared from samples taken at 20 cm depth intervals to 160 cm below the soil surface at two locations within each of the 27 plots. The samples were taken during the last three weeks in December 1973, and the first week of January 1974. The electrical conductivity of the saturation extracts of each of these samples was measured in the laboratory. The results are presented in Table 7.

Table 7. Electrical conductivities of saturation extracts (mmhos/cm) of surface irrigated plots (December, 1973).

Plot No.	Depth (cm) 0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160
1	1.20	1.88	3.98	6.92	6.20	2.56	1.50	2.32
2	1.78	2.22	6.64	5.92	3.92	2.22	2.62	2.56
3	2.92	2.46	5.86	6.32	5.56	2.66	2.32	2.22
5	1.75	1.00	5.12	5.88	2.16	1.28	1.16	1.30
6	1.08	1.68	2.08	5.88	2.58	1.06	0.98	0.90
7	1.06	2.58	3.68	5.48	5.80	2.08	2.00	1.60
8	1.70	2.24	4.06	6.76	8.40	2.78	2.16	2.58
9	1.88	2.06	4.50	6.78	7.80	3.80	2.36	1.88
10	2.12	3.46	5.92	6.54	5.90	3.20	4.26	3.74
11	3.04	3.12	7.30	6.58	6.26	4.44	3.24	1.98
12	1.98	2.56	7.94	7.76	5.72	2.34	2.25	6.48*
13	2.44	3.00	6.91	7.26	6.48	3.72	3.52	3.16
14	0.81	2.40	4.31	4.72	4.78	1.22	1.14	1.82
15	1.86	2.20	3.94	5.00	5.20	2.08	1.96	1.96
16	1.72	1.74	5.76	6.04	3.82	2.02	1.42	1.12
17	2.02	2.88	5.53	7.20	6.96	3.24	2.08	1.78
18	2.80	4.84	5.70	6.56	4.52	2.42	2.22	1.92
20	2.98	3.80	6.56	7.26	7.50	3.76	1.68	1.68
21	1.96	1.88	3.40	4.12	3.52	3.44	3.42	1.40
22	1.46	1.74	1.84	2.96	2.12	2.26	1.88	1.10
23	1.40	1.90	2.36	2.82	3.14	2.24	1.82	0.84
24	2.00	2.16	3.80	8.48	2.02	3.08	1.92	1.50
25	3.52	4.90	4.78	5.64	5.64	5.54	5.30	6.88
26	3.70	4.44	4.88	5.08	4.70	4.90	4.68	3.50
27	2.46	3.18	5.96	6.38	5.50	6.26	2.08	1.22
29	1.66	1.94	3.72	7.02	8.30	8.47	6.54	6.98
30	2.20	2.80	3.48	5.92	8.64	6.96	3.64	2.62
Mean	2.06	2.63	4.81	6.05	5.30	3.33	2.62	2.48
St.Dev.	.73	.97	1.58	1.31	1.95	1.78	1.38	1.71

General mean, all depths and treatments 3.66 mmhos/cm.

Soil samples were also taken at the beginning of the planting season, e.g. during the first two weeks of May 1973. The latter samples were taken after all plots had been preirrigated with 16 inches of water. From these samples saturation extracts were prepared, and the electrical conductivity determined. A complete analysis of cations and anions was also made. The results of these detailed analyses will be presented in a future report. The electrical conductivities of the saturation extracts of the samples taken in May, 1973 are presented in Table 8.

Table 8. Electrical conductivities of saturation extracts (mmhos/cm) of surface irrigated plots (May, 1973).

Plot No.	Depth (cm) 0-20	20-40	40-60	60-80	80-100--100-120		120-140	140-160
1	1.24	1.29	3.95	5.15	6.97	4.63	4.30	1.74
2	1.57	2.32	4.84	6.80	7.74	6.11	6.51	3.12
3	1.81	2.54	4.12	7.21	8.37	3.76	2.61	2.30
5	1.01	1.26	1.77	3.59	3.12	1.77	0.83	0.82
6	1.54	1.30	1.67	5.28	4.95	1.42	1.95	1.29
7	1.06	1.32	2.19	5.25	5.50	2.80	2.50	2.17
8	1.64	1.53	2.70	6.66	10.00	8.86	3.96	3.40
9	2.05	1.92	2.84	7.73	8.56	9.27	5.70	2.97
10	1.68	1.96	4.19	7.48	9.66	5.31	3.06	4.00
11	2.08	2.85	7.33	9.29	11.37	3.87	3.30	4.01
12	2.42	1.65	5.17	7.33	7.81	3.19	2.64	2.03
13	2.66	2.36	7.45	6.67	13.25	4.28	3.01	2.35
14	1.63	1.39	4.40	6.15	6.60	2.48	1.84	5.72
15	1.73	1.87	4.03	7.72	6.78	2.99	2.50	2.29
16	1.68	1.60	1.36	3.24	7.00	3.16	1.55	1.36
17	2.29	2.44	4.73	6.91	8.72	3.68	2.53	2.82
18	1.98	2.77	5.87	6.89	8.82	3.46	2.24	1.97
20	1.94	1.60	4.64	5.82	7.38	4.04	2.46	3.33
21	1.96	1.44	1.81	3.05	2.67	2.50	2.64	1.14
22	1.77	1.38	1.96	3.01	3.46	3.86	3.87	1.39
23	1.76	2.01	4.23	3.83	4.27	3.52	3.04	2.64
24	3.13	5.80	5.23	8.78	6.19	6.96	6.74	5.18
25	2.26	2.78	6.65	6.83	5.25	6.52	4.92	7.25
26	2.61	3.50	4.06	6.82	8.02	6.57	7.68	5.79
27	1.78	1.63	5.08	8.54	8.32	5.78	7.18	6.60
29	1.79	1.98	3.84	6.42	8.23	8.48	6.40	7.01
30	2.21	2.91	3.58	5.91	10.72	6.78	3.78	2.73
Mean	1.90	2.16	4.06	6.23	7.40	4.67	3.66	3.26
St.Dev.	0.22	0.91	2.78	2.99	6.32	2.14	1.85	1.84

General mean, all depths and treatments 4.17 mmhos/cm.

The mean salinity data for each depth and for all depths combined are presented in Table 9 for the fall of 1972 and the spring and fall of 1973.

Table 9. Mean electrical conductivities of saturation extracts (mmhos/cm) for each depth and for all depths combined for the fall of 1972, and the spring and fall of 1973.

	Depth (cm)								
	0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	All Depths
Dec. 1972	1.84	2.95	4.96	5.23	4.88	3.38	2.65	2.25	3.52
May 1973	1.72	1.96	3.85	6.10	6.82	3.92	3.52	3.19	3.85
Dec. 1973	2.06	2.63	4.81	6.05	5.30	3.33	2.62	2.48	3.66

The mean electrical conductivities for May 1973 were corrected for the amounts of water used to make a saturation extract. It was found that the technician who ran the samples in May 1973, used approximately 9% less water to make extracts than the technician who did it the other years.

No great changes in soil salinity are obvious from the data in Table 10. Between December 1972 and May 1973 the soil salinity decreased in the upper soil profile due to extensive preirrigation with about 18 inches of water. From May 1973 to December 1973 the soil salinity in the top 60 cm of soil did increase somewhat, indicating a slight salt built up and little leaching during this period. Further statistical analysis is necessary to determine whether the increase in soil salinity from 0-60 cm is statistically significant.

Table 10 presents the effects of irrigation efficiency and percent depletion on the electrical conductivity of the saturation extracts of the samples from the surface irrigated plots.

Table 10. Treatment means of the electrical conductivity of the saturation extracts (mmhos/cm) of the surface irrigated plots (December 1973).

Efficiency percent	Depth (cm)								
	0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	All depths
80	1.92	2.40	4.71	5.83	4.69	3.22	2.75	2.74	3.53
90	2.17	2.76	4.70	6.13	5.27	3.29	2.54	2.12	3.62
100	2.08	2.74	5.03	6.18	5.94	3.49	2.56	2.59	3.83
Depletion									
25	2.08	2.90	5.27	6.54	5.30	3.52	3.11	3.38	4.01
50	2.19	2.76	4.82	6.33	6.24	3.83	2.45	2.48	3.89
75	1.90	2.23	4.35	5.27	4.36	2.66	2.29	1.59	3.08
All Treatments	2.06**	2.63**	4.81**	6.05**	5.30**	3.33**	2.62**	2.48**	3.66

** Significant differences at the 1% level.

No significant effects of either irrigation efficiency or percent depletion were found. Although the soil salinity in the 80% efficiency treatment was somewhat lower in the top 40 cm, as was to be expected, the differences were too small to be statistically significant.

Trickle plots

The analysis of the soil samples from the trickle plots have not yet been completed. These data will be included in a later report.

Evaluation of 1973 Irrigation Scheduling Method

As indicated in previous reports problems were encountered in irrigation scheduling using a relationship of ET to pan evaporation on the 1972 cotton crop. Application of excess water resulted in lower application efficiencies than had been planned for the various treatments. As indicated in the quarterly report on this project dated April 1973, the computer model for irrigation scheduling developed by Dr. Marvin Jensen in Idaho was employed for the 1973 crop year. Cooperation was established with the Bureau of Reclamation. The Bureau is currently involved in a pilot irrigation management services program in the Mesilla Valley. All climatological input for the model was collected at the project site.

The shape of the crop growth stage curve is highly influenced by the date of effective cover which must be estimated at the planting date. Based on normal growth rates this date was estimated as August 7, 1973. Due to abnormally low temperatures in April and May cotton development was retarded.

The effect on the model is apparent in Figure I. From May through July 1, predicted ET was considerably greater than that evidenced from monitoring soil moisture with neutron equipment. From early July through mid-September field data indicates slightly greater ET rates than the model. This is evidenced by the steeper slope of a line through the field data than the slope of the accumulated ET from the model.

Although considerably more analyses is yet required to completely verify the adequacy of the method, preliminary indications are quite favorable. Had a date of effective cover of September 1 been used, the verification would have shown much closer agreement of computed and measured use.

Sufficient data now exists to make adjustments in certain inputs which will serve to better calibrate the predictive system.

Figure 1. Computed Accumulated ET versus Field Determinations
Treatment 8 - Cotton
1973