UTILIZATION OF WATER IN A SEMI-ARID REGION

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ABSTRACT

A five-year study in the Southern High Plains (annual rainfall of 16 inches) using combinations of bare micro-watershed and growing bed widths resulted in increased crop yields on the growing beds as the proportion of micro-watershed was increased. However, yields for the entire area (including both bed and shed) decreased. Limited work indicated the possibility of also cropping the shed areas and it was concluded that this would be a more practical way of utilizing micro-watersheds. Grain sorghum and sunflowers were successful dryland crops on both beds and sheds while wheat was more suitable as a crop on the sheds rather than on the beds. The use of an antitranspirant (atrazine) gave promising results on grain sorghum but further work is needed.

Key words: micro-watershed, antitranspirant, semi-arid cropping, rainwater utilization, dryland cropping

UTILIZATION OF WATER IN A SEMI-ARID REGION

OBJECTIVES

1. Develop a system of water concentration whereby the normal rainfall of the High Plains area would be sufficient for dependable dryland cropping thereby resulting in more efficient utilization of rain water.

2. Determine the size and shape of micro-watersheds and growing beds needed for most efficient water utilization and to develop a formula relating the optimum combination of watershed and growing bed to the average rainfall pattern and soil conditions of an area.

ACHIEVEMENT OF OBJECTIVES

The completed and continuing studies have established a base for further work in developing a system for more efficient utilization of rainfall in a semi-arid region. It was concluded that it was not practical to maintain bare micro-watershed areas but that they should be cropped in wide enough patterns to utilize modern large farm equipment. However, the shed areas must be kept small enough to minimize the amount of soil that must be moved during initial land shaping, both from the standpoint of costs and from the standpoint of lowered fertility in severely cut areas. It was established that during years of normal or greater rainfall, crop yields on the growing beds between shed areas could approach those of irrigated crops in the area. It was further established that the use of antitranspirants may play an important role in dryland agriculture once the details of methods, time, and rates of application have been worked out. Grain sorghum and sunflowers were successful crops on both sheds and growing beds. Winter wheat and barley, while good crops for the shed areas, were less suitable for the growing bed areas. Sugarbeets, while very drought resistant once established, was not a suitable crop because of difficulty in obtaining stands. Soybeans, corn, and cotton may have potential as crops on the growing bed areas but further work is needed. Potentially, micro-watersheds combined with a system of trickle irrigation on the growing beds offers a method of maximum utilization of very limited amounts of irrigation water.

PROCEDURES

The use of micro-watersheds to increase crop yields under semi-arid conditions is a relatively uncharted area of research and as the results of the initial studies became available, new studies were initiated in order to explore new approaches having greater economic potential. It was necessary to develop and adapt farming equipment to the requirements of each particular study.

1. A study involving four crops, five widths of micro-watersheds, five widths of growing bed, five rates of nitrogen application, and five levels of plant population was established in fall, 1970, and spring, 1971. Crops were winter wheat, winter barley, sunflowers, and grain

sorghum. On the 1972 grain sorghum crop, and thereafter, one variable involved use of atrazine spray as an antitranspirant rather than plant population as a variable. Watershed width on each side of a growing bed varied from 0 to 80 inches with growing beds varying from 40 to 160 inches. The central composite design used involved 250 plots. Aluminum access tubes were installed to a depth of six feet in seven small grain plots, four sunflower plots, and four grain sorghum plots and the use and accumulation of water was monitored by means of a neutron probe.

2. Another study involved the use of herbicides atrazine and propazine at two rates of each for control of weeds on the watershed areas. The crops seeded were wheat, barley, sunflowers, and sugarbeets. A randomized block design with 80 plots was used. This study was terminated after three years.

3. A third study involving eight dryland crop rotations was started in fall, 1970. A randomized block design with four replications and 15 treatments was used. This study was terminated after three years because part of the plots were subject to inundation during periods of heavy rainfall. Also, some plots were heavily infested with Texas blueweed.

4. A study was initiated in the fall, 1971, in which ridges (13 feet on either side of the peak) were established on the contour with a 13 foot level area between each set of two ridges. The ridged area was alternately in wheat and in stubblemulch fallow. Runoff water from the heavier rains was caught and held on the level areas on which a crop of grain sorghum was grown each year. Variables studied involved four rates of Cycocel (a growth regulator reported to increase root growth) sprayed on the wheat crop and four rates of atrazine as an antitranspirant on the grain sorghum. Four replications were used. During the second cropping season, atrazine as an antitranspirant was applied on the wheat. This study was terminated after two years at which time a larger study was established on the area that had been in wheat and barley in experiment 1.

5. A study was established in the spring of 1973 on grain sorghum planted on 80 inch beds between 80 inch ridges. The variable was to have been 5 levels of oil sprayed on the ridges with the purpose of enhancing the runoff and water infiltration. However, the dry beds resulted in very irregular stands and the study was abandoned to be continued later.

6. A study was started in fall, 1973, in which 80-inch growing beds were situated between 240-inch ridges. This was established in the area which originally had the winter wheat and winter barley of experiment 1. Extreme drought up to August, 1974, resulted in no harvestable crops during 1974 on either growing beds or sheds. The ridges have winter wheat in rotation with sorghum and fallow on one set and sunflowers and fallow on the other set. Four rates of atrazine (as an antitranspirant) were applied to the wheat in spring, 1975. Atrazine, as antitranspirant, will be applied to the sunflowers and sorghum on the ridges in July, 1975. Corn, soybeans,

sorghum, sunflowers, and sugarbeets have been planted in spring, 1975, on the growing beds between the ridges. Good stands of all crops except sugarbeets have been obtained. Atrazine, as an anti-transpirant, will be applied as a variable on the above mentioned crops.

7. A field trial was established in spring, 1974, on corn. Ridges 120 inches wide were established on the contour and two rows of corn were planted 40 inches apart on either side of the furrow between the ridges. This left 80 inches of ridge between rows which was to be sprayed with various levels of oil in an effort to increase runoff from the ridges and infiltration into the corn root zone. Extreme drought precluded obtaining a stand of corn in 1974 and the work was postponed until spring, 1975, when a good stand was secured. Other variables used were nitrogen, stand, and antitranspirant applied in a central composite experimental design.

8. In fall, 1974, a preliminary study was established in which a 120 inch growing bed was established between 360 inch contoured ridges. On one section of the growing bed a 12 foot length of porous tubing has been installed at a depth of 8 inches to study the possibilities of applying very limited amounts of irrigation water to the growing beds. Winter wheat was planted on the slope on one side of the growing bed in the fall and grain sorghum was planted in spring, 1975, on the opposite slope and on the growing bed. A series of 8 aluminum access tubes were installed at 20 inch intervals across the growing bed to study the pattern of use of water by intruding wheat roots into the growing bed. In fall, 1975, this experiment will be expanded to compare various patterns of strip cropping on the ridges along with antitranspirant use on both growing beds (irrigated and non-irrigated) and the cropped ridges.

RESULTS, DISCUSSION, AND CONCLUSIONS

The rainfall pattern at the Plains Branch Station from 1951 to the present (Table 1) has definite cycles averaging 32 months when the 12-month accumulated rainfall is calculated at monthly intervals. The lows average 10 inches and the highs average 22 inches with the midpoint at 16 inches, very close to the long term average rainfall. Examination of rainfall data at Clovis, N. M. (14 miles south of the Plains Branch Station) indicates similar cycles over the long term going back to 1911. The rainfall pattern during the five years of this study closely approached this long term pattern with lows in 1971 and 1974 and a high in 1973. Total rainfall was 83.37 inches with an average of 16.67. Thus, 1972 and 1973 were relatively good crop years, 1971 was poor, and 1974 was a complete failure due to inability to establish the spring crops in the very dry topsoil. With increasing rainfall, small grains yielded well in 1975 and the spring crops are very promising (as of August).

1. In general, increasing proportion of bare watershed (Tables 2-9) decreased yield of all crops considering the total area of sheds plus growing beds. However, crop yields of the growing bed areas, during

years of normal or greater rainfall, approached that of irrigated crops in the area. Thus, it appears that bare watersheds were not practical, but cropping the watersheds offers the possibility of obtaining almost normal dryland production on the shed area while getting considerably enhanced yields on the growing bed areas. Grain sorghum and sunflowers were good crops on the growing bed areas with sunflowers being somewhat better economically in dry years and about equal in the years with greater than normal moisture (assuming sunflowers worth about three times as much as sorghum per pound of grain). Winter wheat and winter barley on the growing beds were not benefited as much by having adjacent watershed area, probably because of relatively light rainfall and little chance for runoff during their main growing season. Antitranspirant application (atrazine) increased grain sorghum yields substantially and has considerable potential as a means of increasing rain-water efficiency under dryland conditions (Fuehring, H. D., 1975. Yield of dryland grain sorghum as affected by antitranspirant, nitrogen, and contributing micro-watershed. Agron. J. 67:255-257). It was concluded that cropped micro-watersheds combined with use of antitranspirants gives promise of increasing dryland crop yields in a semi-arid region.

Soil moisture was monitored down to a depth of 5 feet under the growing beds (Tables 10-18). Differences among treatments were not very large considering total water use by years. The increases in yield from the growing beds associated with the larger proportion of contributing watershed were attributed to greater lateral spread of the root system which resulted in an increased supply of water and nutrients. The growing beds with adjacent micro-watersheds tended to be dried out less completely by the root systems than beds without contributing micro-watershed, thus, having less seasonal water stress and consequently greater yields.

2. Atrazine and propazine applied as herbicide sprays to bare watershed areas controlled most weeds and did not appreciably affect the yields of winter wheat, winter barley, and sunflowers growing on adjacent beds (Table 19).

3. Several dryland rotations (without watersheds) resulted in little yield difference among treatments (Table 20). Herbicide treatments for weed control during fallow periods were reasonably effective.

4. Plots were established with two-thirds watershed area and one-third (13 feet wide) growing beds. Three rows of grain sorghum were grown on the beds but the center row (receiving no runoff water) was much poorer in yield than the outer rows. It was concluded that two rows on beds no wider than 8 to 10 feet would be more effective. Results with antitranspirant on the grain sorghum (Table 21) were inconclusive as were results with Cycocel (a growth regulator) and an antitranspirant on wheat grown on the watershed ridges. After the first year, very satisfactory yields of wheat were obtained on the ridges, indicating that cropping the shed areas was feasible.

5. An experiment set up to explore the use of low rates of cheap oil

to enhance water runoff on ridges was abandoned (before applying the oil) because of poor stands.

6. A study on 80-inch growing beds combined with 120-inch cropped watershed areas on either side resulted in no yields on either area in 1974 due to extreme drought. The following fall was considerably wetter than normal and excellent wheat yields were obtained on the shed areas in 1975 (Table 22). Low rates of atrazine (applied as an antitranspirant) on the wheat tended to decrease yields with increasing levels. After the wet fall, good 1975 summer crops of sorghum and sunflowers have been established on the watershed ridges and crops of grain sorghum, sunflowers, soybeans, and corn have been started on the growing beds.

7. A system of oiled ridges was established in 1974 with corn as a crop but extreme drought resulted in a crop failure. The crop was planted again in 1975 and looks very promising.

8. A small preliminary study with 15-foot cropped slopes on either side of a 10-foot growing bed was established in fall, 1974. Wheat yields on the upper slope were excellent (2400 lb/A). However, yields on the lower part of the slope (where topsoil was removed) were only about half of those on the upper part of the slope (where additional topsoil was deposited). On these plots, about nine inches of soil was removed at the base of the slope and deposited at the top of the slope, resulting in relatively steep slopes. This indicates that transport of soil was excessive and should be considerably curtailed in future work. This will result in less cost for land shaping and less disturbance of crop yield at the base of the slope due to removal of fertility. The June 20 soil moisture data (Table 23) indicates some use of moisture by wheat at a lateral distance of 10 inches but only slight use at 30 inches.

9. It was concluded that cropped micro-watersheds in combination with use of antitranspirants offers considerable potential for increasing the efficiency of dryland cropping in semi-arid regions. Much work remains to be done with regard to details before definite recommendations can be made.

PUBLICATIONS

1. Fuehring, H. D., 1975. Yield of dryland grain sorghum as affected by antitranspirant, nitrogen, and contributing micro-watershed. Agron. J. 67:255-257.

Table 1. Monthly change in the 12-month accumulated rainfall. Plains Branch Station, Clovis, New Mexico. 1951-1975.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
	inches											
1951	18	18	19	19	21[H]	20	15	13	12	13	13	13
1952	13	12	12	14	12	13	9	10	11	9	10	10
1953	10	10	11	8	9	7[L]	10	11	10	12	11	10
1954	10	10	10	10	11	11	9	11	11	12	12	12
1955	12	11	11	11	12	13	17	15	17[H]	15	15	15
1956	15	16	16	15	15	16	13	13	10[L]	13	13	12
1957	12	12	13	14	17	16	17	19	20	20	20	20
1958	22	22	22	22[H]	20	20	18	17	22	19	19	20
1959	18	18	17	16[L]	16	21	22	24	19	20	20	21
1960	22	23	23	23	21	19	27	25	26	28	29	28
1961	28	27	30	29	30[H]	29	21	22	23	19	21	20
1962	20	20	18	19	18	17	16	14	15	15	13	13
1963	13	13	12	11[L]	13	20	20	23[H]	21	20	21	20
1964	20	21	21	21	20	13	10	8[L]	11	10	11	11
1965	11	11	11	12	12	14	14	15[H]	12	13	11	11
1966	12	11	11	10	10[L]	12	13	14	13	13	13	13
1967	13	13	13	13	12	11	15	13	13	14	13	14
1968	15	15	16	16	16[H]	13	9[L]	11	11	11	12	11
1969	10	11	10	11	17	18	20	19	19	23	23	24[H]
1970	24	23	23	22	15	17	16	16	17	13	13	12
1971	12	12	12	13	13	10[L]	11	12	11	12	15	15
1972	15	15	15	14	15	18	21	20	21	23	22	21
1973	22	23	24	27	27[H]	24	23	22	20	18	17	16
1974	16	16	14	11	10	10	7[L]	13	13	18	18	18
1975	18	19	19	21	21	21	23					

H high for period
L low for period

Table 2. Regression coefficients (based on coded levels of variables) for effects of watershed width, growing bed width, N application, and plant population on seed yield (considering total area of watershed plus growing bed) of sunflowers.

Regression Coefficients	Year			
	1971	1972	1973	1971-73
	lb/A			
Mean	405	991	849	748
Linear[1]				
W	-69	-128**	-206**	-134
G	43	90**	133**	89
N	26	-8	197**	72
R	63	43	28	45
Error ±	38	21	30	
Quadratic				
W-W	-27	-17	43	0
G-G	1	34	55	30
N-N	-25	-16	41	0
R-R	-45	-19	26	-13
Error ±	55	31	43	
Interaction				
WG	-38	6	22	-3
WN	-4	-11	-13	-9
WR	-37	-2	-11	-17
GN	27	-17	27	12
GR	60	45	-56	16
NR	49	-28	-3	6
WGN	-7	-13	-49	-23
WGR	-19	27	26	11
WNR	-19	32	28	14
GNR	-2	14	69	27
Error ±	46	26	36	
C.V., %	40.5	15.3	20.5	
R^2	0.68	0.76	0.78	

*, ** statistically significant at the 5 and 1% levels, respectively

[1] W = watershed width, G = growing bed width, N = nitrogen applied and R = plant population

Table 3. Regression coefficients (based on coded levels of variables) for effects of watershed width, growing bed width, N application, and antitranspirant application on grain yield (considering total area of watershed plus growing bed) of sorghum.

Regression Coefficients	Year		
	1972	1973	1972-73
	lb/A		
Mean	2579	3154	2866
Linear[1]			
W	-640**	-577**	-609**
G	497**	119**	307**
N	-23	46	12
A	31	19	25
Error ±	33	26	28
Quadratic			
W-W	76	-120**	-22
G-G	-45	6	-26
N-N	19	-82*	-31
A-A	6	-89*	-41
Error ±	48	37	40
Interaction			
WG	-90*	162**	36
WN	65	8	37
WA	-27	-16	-21
GN	29	5	18
GA	-53	-4	-29
NA	60	29	45
WGN	66	29	48
WGA	34	20	27
WNA	-141*	-30	-86*
GNA	28	21	24
Error ±	40	32	34
C.V., %	12.2	8.9	13.9
R^2	0.97	0.92	0.95

*, ** statistically significant at the 5 and 1% levels, respectively

[1] W = watershed width, G = growing bed width, N = nitrogen applied and A = antitranspirant applied

Table 4. Regression coefficients (based on coded levels of variables) for effects of watershed width, growing bed width, N application, and seeding rate on grain yield (considering total area of watershed plus growing bed) of wheat.

Regression Coefficients	Year			
	1971	1972	1973	1971-73
	lb/A			
Mean	212	565	1021	599
Linear[1]				
W	-76*	-105**	-227**	-136
G	-9	-15	131**	36
N	36	24	-31	10
R	40	47	-49	13
Error ±	35	32	21	
Quadratic				
W-W	35	-1	-21	4
G-G	69	55	-11	38
N-N	-52	-40	-31	-41
R-R	-5	17	2	5
Error ±	51	46	30	
Interaction				
WG	-29	5	17	-2
WN	5	59	17	27
WR	-4	-29	50	25
GN	20	109*	-10	40
GR	15	-3	9	7
NR	-9	15	42	16
WGN	-44	-20	50	-5
WGR	12	45	22	26
WNR	1	-9	41	11
GNR	-10	12	17	6
Error ±	43	39	25	
C.V., %	93.3	36.7	14.9	
R^2	0.68	0.89	0.96	

*, ** statistically significant at the 5 and 1% levels, respectively

[1] W = watershed width, G = growing bed width, N = nitrogen applied and R = seeding rate

Table 5. Regression coefficients (based on coded levels of variables) for effects of watershed width, growing bed width, N application, and seeding rate on grain yield (considering total area of watershed plus growing bed) of barley.

Regression Coefficients	Year			
	1971	1972	1973	1971-73
	lb/A			
Mean	123	719	904	582
Linear[1]				
W	-17	-167**	-184**	-123
G	6	41	92*	46
N	14	-2	15	9
R	25*	75*	47	49
Error ±	12	35	32	
Quadratic				
W-W	-7	-2	31	7
G-G	-5	11	32	13
N-N	-27	-45	0	-24
R-R	-12	-27	-22	-20
Error ±	17	51	47	
Interaction				
WG	-8	83	39	38
WN	-8	-28	0	-12
WR	-4	-43	-9	-17
GN	9	51	24	28
GR	19	34	29	27
NR	12	46	52	37
WGN	-15	4	14	1
WGR	-2	-20	-8	-10
WNR	-5	25	34	18
GNR	16	-22	38	11
Error ±	15	43	50	
C.V., %	112.1	36.9	23.9	
R^2	0.71	0.96	0.92	

*, ** statistically significant at the 5 and 1% levels, respectively

[1] W = watershed width, G = growing bed width, N = nitrogen applied and R = seeding rate

Table 6. Effect of proportion of total area in growing bed (balance in bare micro-watershed) on grain yield (calculated on basis of total area or on area of growing bed) of crops for three years.

Area in bed	Yield for bed plus shed				Yield of growing bed only			
	1971	1972	1973	Average	1971	1972	1973	Average
%	pounds per acre							
Grain sorghum								
25	142	1437	1797	1126	568	5748	7188	4504
33	41	1826	1759	1209	123	5478	5277	3627
50	202	2566	2976	1950	404	5132	5952	3900
67	414	3321	3208	2314	621	4982	4812	3471
75	338	3839	3367	2515	451	5117	4488	3352
100	321	4162	3925	2803	321	4162	3925	2803
Sunflowers								
25	205	668	540	449	820	2672	2160	1796
33	170	756	717	548	510	2268	2151	1644
50	291	978	1008	750	582	1956	2016	1500
67	284	1275	1247	935	426	1913	1871	1403
75	538	1163	1315	1006	717	1551	1753	1341
100	335	1296	1574	1068	335	1296	1574	1068
Wheat								
25	167	468	549	395	668	1872	2196	1579
33	133	271	479	294	399	813	1437	882
50	232	605	1047	602	464	1210	2094	1204
67	307	678	1103	696	461	1017	1655	1044
75	351	648	1331	777	468	864	1775	1036
100	687	987	1407	1027	687	987	1407	1027
Barley								
25	46	362	601	337	184	1448	2404	1346
33	34	312	599	315	102	936	1797	945
50	70	692	945	569	140	1384	1890	1138
67	63	706	1123	630	95	1059	1685	945
75	105	815	1167	696	140	1087	1556	928
100	173	1048	1538	919	173	1048	1538	919

Table 7. Grain yield of crops as affected by application of nitrogen (1971, 1972, 1973 average).

	Nitrogen, pounds per acre				
	20	35	50	65	80
	grain, pounds per acre				
Wheat	494	566	691	600	468
Barley	536	531	586	578	449
Sunflowers	833	710	820	749	784
Sorghum	1969	1839	2055	1831	1971

Table 8. Effect of seeding rate (plant population) on yield of crops (1971, 1972, 1973 average except sorghum for 1971 only).

Wheat		Barley		Sunflowers		Sorghum	
Seeding rate	Yield	Seeding rate	Yield	Plants per acre	Yield	Plants per acre	Yield
lb/A		lb/A			lb/A		lb/A
20	656	30	419	6,600	646	30,000	166
30	565	45	503	9,900	685	40,000	164
40	639	60	582	13,200	834	50,000	235
50	601	75	606	16,500	774	60,000	264
60	668	90	594	26,400	875	70,000	297

Table 9. Grain yield of sorghum (calculated from the regression equation, (Table 3) as affected by antitranspirant and nitrogen application at three levels of contributing watershed (1972-73).

Watershed	Nitrogen	Atrazine, lb/A					
		Bed plus shed			Bed only		
		0.067	0.133	0.200	0.067	0.133	0.200
%	lb/A	grain, lb/A					
0	65	3578	3902	4145	3578	3902	4145
	50	3886	3995	4022	3886	3995	4022
	35	4132	4025	3836	4132	4025	3836
50	65	2736	2847	2175	5473	5694	5751
	50	2800	2866	2850	5601	5733	5701
	35	2802	2824	2763	5604	5647	5526
80	65	1247	1095	860	6235	5473	4301
	50	1157	1155	1071	5785	5776	5357
	35	1004	1153	1220	5022	5767	6101

Table 10. Moisture change in soil profile under sunflowers with no contributing micro-watershed. 1971-1975.

1971 crop	July 27	Aug. 2	Aug. 12	Sep. 7	Oct. 12			Period
Rain, inches		1.42	2.87	0.29	2.24			6.82
Depth, feet	----------Soil moisture, % by volume----------							
1	27.0	27.8	37.4	33.5	33.0			
2	21.7	22.0	28.3	27.1	26.4			
3	19.5	20.1	19.3	20.1	20.0			
4	22.6	22.7	22.0	22.4	22.0			
5	25.7	25.4	25.0	25.2	23.8			
Soil change, inches		0.23	2.27	-0.76	-0.40			1.34
Total change, inches		-1.19	-0.60	-1.05	-2.64			-5.48
1972 crop	Dec. 16	Apr. 11	May 17	Jan. 30	July 26	Sep. 15	Oct. 17	
Rain, inches	3.39	0.33	1.11	3.85	6.06	7.62	0.07	22.43
Depth, feet	----------Soil moisture, % by volume----------							
1	35.8	33.8	34.1	34.4	36.9	35.3	34.2	
2	30.4	28.6	27.8	29.0	30.7	29.0	27.2	
3	25.7	26.5	25.7	27.0	26.1	21.1	23.0	
4	26.5	28.7	28.8	29.9	27.7	24.6	26.0	
5	27.6	30.8	30.8	31.4	29.5	26.9	26.8	
Soil change, inches	2.66	0.17	-0.13	0.55	0.05	-1.78	-0.02	1.50
Total change, inches	-0.73	-0.16	-1.24	-3.30	-6.01	-9.40	-0.09	-20.93
1973 crop	May 23	June 27	Aug. 2	Aug. 30				
Rain, inches	11.65	0.78	5.10	0.82				18.35
Depth, feet	-----Soil moisture, % by volume------							
1	35.5	29.8	27.7	26.7				
2	30.6	25.4	21.7	21.1				
3	29.0	27.1	20.1	17.4				
4	31.0	31.3	24.8	19.1				
5	33.0	33.7	28.2	22.5				
Soil change, inches	2.70	-1.87	-3.10	-1.94				-4.21
Total change, inches	-8.95	-2.65	-8.20	-2.76				-22.56

continued

Table 10. Continued

1974, no crop	May 24	Sep. 5				Period
Rain, inches	3.29	9.60				12.89
Depth, feet	Soil moisture, % by volume					
1	26.6	36.1				
2	21.1	29.9				
3	20.3	27.4				
4	24.6	29.5				
5	25.2	28.2				
Soil change, inches	1.32	4.56				5.88
Total change, inches	-1.97	-5.04				-7.01
1975 crop	Feb. 11	May 9	June 17	July 16	Aug. 14	
Rain, inches	8.58	2.26	1.29	1.51	2.28	15.92
Depth, feet	---------Soil moisture, % by volume----------					
1	34.9	34.0	33.6	28.6	26.5	
2	29.2	29.0	28.4	23.6	21.9	
3	28.7	28.9	28.5	21.4	18.5	
4	32.9	32.9	32.7	28.0	21.1	
5	35.1	34.8	34.1	31.3	24.8	
Soil change, inches	1.09	-0.20	-0.30	-3.13	-2.53	-5.07
Total change, inches	-7.49	-2.46	-1.59	-4.64	-4.81	-20.99

Table 11. Moisture change in soil profile under sunflowers with 50% of area in contributing micro-watershed. 1971-1975.

1971 crop	July 27	Aug. 2	Aug. 12	Sep. 7	Oct. 12			Period
Rain, inches		1.42	2.87	0.29	2.24			6.82
Depth, feet	----------Soil moisture, % by volume----------							
1	28.6	29.3	37.2	31.8	33.0			
2	24.4	23.9	23.1	25.1	26.5			
3	21.4	21.5	21.3	22.4	21.9			
4	23.8	23.2	23.2	23.6	23.2			
5	25.1	24.6	24.2	24.1	23.1			
Soil change, inches		-0.06	1.37	-0.56	0.16			0.91
Total change, inches		-1.48	-1.50	-0.85	-2.08			-5.91
1972 crop	Dec. 16	Apr. 11	May 17	June 30	July 26	Sep. 15	Oct. 17	
Rain, inches	3.39	0.33	1.11	3.85	6.06	7.62	0.07	22.43
Depth, feet	----------Soil moisture, % by volume----------							
1	35.0	34.6	34.0	32.9	37.0	36.7	35.0	
2	31.0	30.0	30.0	31.3	32.8	32.1	30.7	
3	30.3	29.9	31.0	33.3	31.8	30.7	31.4	
4	27.6	31.1	31.7	33.1	31.5	30.9	32.3	
5	26.0	30.4	31.2	33.2	30.9	29.8	31.6	
Soil change, inches	2.78	0.71	0.19	0.65	0.14	-0.47	0.00	4.00
Total change, inches	-0.61	0.38	-0.92	-3.20	-5.92	-8.09	-0.07	-18.43
1973 crop	May 23	June 27	Aug. 2	Aug. 31				
Rain, inches	11.65	0.78	5.10	0.82				18.35
Depth, inches	-----Soil moisture, % by volume------							
1	36.0	31.7	32.1	29.7				
2	32.2	27.6	25.1	24.3				
3	34.8	32.7	27.9	26.9				
4	34.9	34.3	31.7	29.2				
5	35.0	35.1	31.3	29.7				
Soil change, inches	1.37	-1.63	-1.58	-1.14				-2.98
Total change, inches	-10.28	-2.41	-6.68	-1.96				-21.33

continued

Table 11. Continued

1974, no crop	May 24	Sep. 5				Period
Rain, inches	3.29	9.60				12.89
Depth, feet	Soil moisture, % by volume					
1	29.3	36.4				
2	25.5	33.5				
3	30.3	36.8				
4	31.2	36.8				
5	31.2	37.5				
Soil change, inches	0.90	4.44				5.34
Total change, inches	-2.39	-5.16				-7.55
1975 crop	**Feb. 11**	**May 9**	**June 17**	**July 16**	**Aug. 14**	
Rain, inches	8.58	2.26	1.29	1.51	2.28	15.92
Depth, feet	Soil moisture, % by volume					
1	34.7	35.8	34.2	30.3	30.6	
2	31.4	31.4	30.9	26.9	26.5	
3	33.7	34.0	34.2	30.6	26.9	
4	34.8	34.6	34.7	32.7	28.8	
5	35.0	35.2	35.3	33.3	30.0	
Soil change, inches	-1.46	0.23	-0.28	-2.09	-1.31	-4.91
Total change, inches	-10.04	-2.03	-1.57	-3.60	-3.59	-20.83

Table 12. Moisture change in soil profile under sunflowers with 75% of area in contributing micro-watershed. 1971-1975.

1971 crop	July 27	Aug. 2	Aug. 12	Sep. 7	Oct. 12			Period
Rain, inches		1.42	2.87	0.29	2.24			6.82
Depth, feet	----------Soil moisture, % by volume----------							
1	26.8	27.8	37.2	32.3	33.1			
2	22.2	22.9	30.0	28.7	29.0			
3	19.5	19.5	19.9	22.9	22.6			
4	22.4	22.5	21.7	23.4	23.6			
5	23.9	23.9	22.8	24.9	23.4			
Soil change, inches		0.28	2.36	-0.22	-0.01			2.41
Total change, inches		-1.14	-0.51	-0.51	-2.25			-4.41
1972 crop	Dec. 16	Apr. 18	May 17	June 30	July 26	Sep. 15	Oct. 17	
Rain, inches	3.39	0.33	1.11	3.85	6.06	7.62	0.07	22.43
Depth, feet	----------Soil moisture, % by volume----------							
1	35.6	32.8	34.7	31.7	36.9	36.0	34.8	
2	30.6	27.4	30.0	29.8	32.4	31.8	30.6	
3	27.1	24.6	27.5	29.2	27.3	28.5	27.8	
4	30.1	33.5	30.8	33.1	30.8	31.4	32.1	
5	27.0	34.2	29.1	30.5	29.0	29.9	30.7	
Soil change, inches	2.39	0.06	0.10	0.08	0.72	0.10	-0.26	3.19
Total change, inches	-1.00	-0.27	-1.01	-3.77	-5.34	-7.52	-0.33	-19.24
1973 crop	May 23	June 27	Aug. 2	Aug. 30				
Rain, inches	11.65	0.78	5.10	0.82				18.35
Depth, feet	-----Soil moisture, % by volume------							
1	36.0	30.7	35.1	29.7				
2	31.5	27.3	30.6	25.8				
3	30.3	28.4	25.4	23.0				
4	35.0	33.9	30.9	28.7				
5	32.4	32.6	30.2	27.9				
Soil change, inches	1.18	-1.79	0.18	-2.38				-2.81
Total change, inches	-10.47	-2.57	-4.92	-3.20				-21.16

continued

Table 12. Continued

1974, no crop	May 24	Sep. 5				Period
Rain, inches	3.29	9.60				12.89
Depth, feet	Soil moisture, % by volume					
1	29.3	35.4				
2	25.8	32.1				
3	25.9	32.7				
4	29.6	36.4				
5	28.7	35.9				
Soil change, inches	0.48	4.33				4.81
Total change, inches	-2.81	-5.27				-8.08
1975 crop	Feb. 11	May 9	June 17	July 16	Aug. 14	
Rain, inches	8.58	2.26	1.29	1.51	2.28	15.92
Depth, feet	----------Soil moisture, % by volume----------					
1	34.3	34.6	33.1	29.8	29.8	
2	30.1	30.5	30.0	25.5	26.0	
3	29.6	29.8	29.5	25.2	22.5	
4	34.2	34.2	33.9	31.6	26.5	
5	33.4	32.6	33.0	31.8	28.2	
Soil change, inches	-1.37	0.02	-0.35	-2.06	-1.31	-5.07
Total change, inches	-9.95	-2.24	-1.64	-3.57	-3.59	-20.99

Table 13. Moisture change in soil profile under sorghum with no area in contributing micro-watershed. 1971-1975.

1971 crop	July 27	Aug. 2	Aug. 12	Sep. 7	Oct. 12			Period
Rain, inches		1.42	2.87	0.29	2.24			6.82
Depth, feet	----------Soil moisture, % by volume----------							
1	36.2	34.6	37.8	33.4	30.0			
2	31.8	30.6	33.9	31.7	26.6			
3	28.7	28.4	28.3	29.4	27.7			
4	30.6	30.5	29.7	31.5	30.1			
5	24.7	24.7	24.8	25.4	23.9			
Soil change, inches		-0.49	0.88	-0.64	-1.79			-2.04
Total change, inches		-1.91	-1.99	-0.93	-4.03			-8.86
1972 crop	Dec. 16	Apr. 11	May 17	June 30	July 26	Sep. 15	Oct. 17	
Rain, inches	3.39	0.33	1.11	3.85	6.06	7.62	0.07	22.43
Depth, feet	----------Soil moisture, % by volume----------							
1	36.5	35.1	35.7	36.0	38.2	36.8	30.6	
2	31.3	31.5	32.2	34.2	36.0	32.1	26.9	
3	27.6	29.9	30.5	33.4	37.8	31.2	27.8	
4	30.7	33.6	35.0	36.2	40.2	35.7	32.4	
5	24.8	27.9	28.2	29.5	35.4	29.1	25.9	
Soil change, inches	1.90	0.77	0.47	0.94	2.33	-2.81	-2.93	0.67
Total change, inches	-1.49	0.44	-0.64	-2.91	-3.73	-10.43	-3.00	-21.76
1973 crop	June 27	Aug. 2	Aug. 30	Sep. 21	Oct. 29			
Rain, inches	12.43	5.10	0.82	1.63	0.57			20.55
Depth, feet	----------Soil moisture, % by volume----------							
1	35.7	31.0	28.5	28.8	28.1			
2	33.8	31.4	24.6	24.2	24.1			
3	34.0	32.8	27.0	26.5	26.2			
4	37.3	36.9	32.5	31.0	28.8			
5	31.0	30.6	26.5	24.4	23.6			
Soil change, inches	3.68	-1.37	-2.98	-0.49	-0.41			-1.57
Total change, inches	-8.75	-6.47	-3.80	-2.12	-0.98			-22.12

continued

Table 13. Continued

1974, no crop	May 24	Sep. 5				Period
Rain, inches	1.09	9.60				10.69
Depth, feet	Soil moisture, % by volume					
1	27.7	37.0				
2	25.2	35.1				
3	27.8	33.6				
4	31.4	36.1				
5	25.3	28.6				
Soil change, inches	0.77	4.51				5.28
Total change, inches	-0.32	-5.09				-5.41
1975 crop	Feb. 11	May 9	June 17	July 16	Aug. 14	
Rain, inches	8.58	2.26	1.29	1.51	2.28	15.92
Depth, feet	Soil moisture, % by volume					
1	36.5	36.2	35.3	30.2	29.0	
2	33.8	34.2	33.3	27.8	25.5	
3	33.2	33.5	33.3	31.9	28.6	
4	38.1	37.9	37.3	37.2	34.3	
5	32.0	31.8	31.4	31.8	28.4	
Soil change, inches	0.36	-0.01	-0.41	-1.70	-1.88	-3.64
Total change, inches	-8.22	-2.27	-1.70	-3.21	-4.16	-19.56

Table 14. Moisture change in soil profile under sorghum with 50% of area in contributing micro-watershed. 1971-1975.

1971 crop	July 27	Aug. 2	Aug. 12	Sep. 7	Oct. 12			Period
Rain, inches		1.42	2.87	0.29	2.24			6.82
Depth, feet	----------Soil moisture, % by volume----------							
1	35.7	36.9	39.8	28.6	33.9			
2	30.6	30.3	36.3	27.1	28.9			
3	27.9	27.5	33.2	26.8	28.6			
4	37.1	37.2	38.5	33.9	38.0			
5	33.4	33.8	33.4	30.1	34.1			
Soil change, inches		0.19	2.03	-4.84	2.35			-0.27
Total change, inches		-1.23	-0.84	-5.13	0.11			-7.09
1972 crop	Dec. 16	Apr. 11	May 17	June 30	July 26	Sep. 15	Oct. 17	
Rain, inches	3.39	0.33	1.11	3.85	6.06	7.62	0.07	22.43
Depth, feet	----------Soil moisture, % by volume----------							
1	38.3	36.9	37.6	37.6	39.2	37.7	32.7	
2	33.7	32.4	32.4	34.2	35.4	33.5	26.3	
3	32.4	30.6	31.0	33.0	33.7	30.8	27.6	
4	40.0	39.9	40.7	41.9	42.7	40.9	39.7	
5	35.0	37.1	36.4	37.9	39.7	37.5	36.0	
Soil change, inches	2.17	-0.38	0.18	0.78	0.83	-1.32	-2.47	-0.21
Total change, inches	-1.22	-0.71	-0.93	-3.07	-5.23	-8.94	-2.54	-22.64
1973 crop	June 27	Aug. 2	Aug. 30	Sep. 21	Oct. 29			
Rain, inches	12.43	5.10	0.82	1.63	0.57			20.55
Depth, feet	----------Soil moisture, % by volume----------							
1	35.4	34.8	29.6	29.6	28.6			
2	32.9	29.6	25.3	24.6	24.2			
3	31.8	31.3	26.3	25.5	25.4			
4	40.8	41.2	38.1	36.5	35.3			
5	36.0	37.0	34.3	32.7	31.5			
Soil change, inches	1.86	-0.40	-2.75	-0.56	-0.53			-2.38
Total change, inches	-10.57	-5.50	-3.57	-2.19	-1.10			-22.93

continued

Table 14. Continued

1974, no crop	May 24	Sep. 5				
Rain, inches	1.09	9.60				10.69
Depth, feet	Soil moisture, % by volume					
1	27.7	38.4				
2	24.5	34.7				
3	28.6	33.8				
4	37.5	41.5				
5	34.0	38.6				
Soil change, inches	0.79	4.80				5.59
Total change, inches	-0.30	-4.80				-5.10
1975 crop	Feb. 11	May 9	June 17	July 16	Aug. 14	
Rain, inches	8.58	2.26	1.29	1.51	2.28	15.92
Depth, feet	Soil moisture, % by volume					
1	36.2	36.7	36.7	30.6	30.9	
2	32.3	32.6	32.6	28.1	25.7	
3	32.3	32.1	31.7	30.6	28.6	
4	41.6	41.1	41.0	41.4	39.9	
5	39.7	40.2	40.4	40.2	37.8	
Soil change, inches	-0.72	0.10	-0.04	-1.75	-0.95	-3.36
Total change, inches	-9.30	-2.16	-1.33	-3.26	-3.23	-19.28

Table 15. Moisture change in soil profile under sorghum with 75% of area in contributing micro-watershed. 1971-1975.

1971 crop	July 27	Aug. 2	Aug. 12	Sep. 7	Oct. 12			Period
Rain, inches		1.42	2.87	0.29	2.24			6.82
Depth, feet	Soil moisture, % by volume							
1	35.7	35.0	38.7	33.0	32.2			
2	30.9	30.5	33.5	31.5	28.5			
3	28.8	27.4	27.4	29.3	28.1			
4	34.0	33.9	33.5	34.8	33.5			
5	32.4	32.3	32.4	32.8	31.1			
Soil change, inches		-0.36	0.98	-0.83	-1.01			-1.22
Total change, inches		-1.78	-1.89	-1.12	-3.25			-8.04
1972 crop	Dec. 16	Apr. 11	May 17	June 30	July 26	Sep. 15	Oct. 17	
Rain, inches	3.39	0.33	1.11	3.85	6.06	7.62	0.07	22.43
Depth, feet	Soil moisture, % by volume							
1	37.7	36.3	36.5	36.9	38.7	37.1	31.8	
2	34.2	32.1	32.5	35.4	37.0	34.9	28.0	
3	31.3	32.2	32.6	35.7	37.3	36.0	32.8	
4	35.2	37.7	38.8	41.7	44.2	42.2	40.0	
5	32.5	34.5	35.1	37.6	39.7	38.7	36.4	
Soil change, inches	2.42	0.14	0.34	1.44	1.26	-1.06	-2.70	1.84
Total change, inches	-0.97	-0.19	-0.77	-2.41	-4.80	-8.68	-2.77	-20.59
1973 crop	May 23	June 27	Aug. 2	Aug. 30	Sep. 21	Oct. 29		
Rain, inches	11.65	0.78	5.10	0.82	1.63	0.57		20.55
Depth, feet	Soil moisture, % by volume							
1	37.9	34.6	38.4	31.0	31.5	30.0		
2	34.5	33.2	35.4	27.0	26.8	25.4		
3	35.4	34.9	35.9	31.6	31.0	30.3		
4	42.5	42.1	42.4	40.4	39.6	38.4		
5	39.2	38.2	38.3	36.3	36.5	35.4		
Soil change, inches	2.82	-0.97	1.12	-3.34	-0.08	-0.79		-1.24
Total change, inches	-8.83	-1.75	-3.98	-4.16	-1.71	-1.36		-21.79

continued

Table 15. Continued

1974, no crop	May 24	Sep. 5				
Rain, inches	1.09	9.60				10.69
Depth, feet	Soil moisture, % by volume					
1	30.1	38.3				
2	27.1	35.8				
3	30.5	37.4				
4	38.9	45.2				
5	35.4	41.4				
Soil change, inches	0.30	4.82				5.12
Total change, inches	-0.79	-4.78				-5.57
1975 crop	Feb. 11	May 9	June 17	July 16	Aug. 14	
Rain, inches	8.58	2.26	1.29	1.51	2.28	15.92
Depth, feet	Soil moisture, % by volume					
1	36.7	36.8	36.3	34.4	33.4	
2	33.1	33.5	33.5	32.3	30.7	
3	35.6	34.8	34.8	34.8	34.7	
4	41.7	41.8	41.9	42.2	41.6	
5	38.0	38.2	38.2	38.5	38.3	
Soil change, inches	-1.66	0.00	-0.07	-0.65	-0.48	-2.86
Total change, inches	-10.24	-2.26	-1.36	-2.16	-2.76	-18.78

Table 16. Moisture change in soil profile under small grain with no contributing micro-watershed. 1971-1972.

1971 crop	Mar. 29	Apr. 16	May 21	July 27	Period
Rain, inches		1.15	0.20	2.39	3.74
Depth, feet	------Soil moisture, % by volume-----				
1	31.2	31.4	31.2	31.4	
2	25.0	24.6	24.3	24.3	
3	29.1	29.1	28.7	28.7	
4	28.2	28.3	27.8	27.8	
5	26.7	26.9	26.5	26.7	
Soil change, inches		0.02	-0.23	0.06	-0.15
Total change, inches		-1.13	-0.43	-2.33	-3.89

1972 crop	Aug. 12	Oct. 14	Dec. 16	Apr. 11	July 11	
Rain, inches	4.31	5.46	4.39	0.33	5.85	20.34
Depth, feet	----------Soil moisture, % by volume----------					
1	36.8	33.8	35.3	30.7	29.8	
2	27.8	26.2	29.5	24.5	21.1	
3	29.4	27.0	27.6	28.2	24.1	
4	27.7	30.3	35.2	33.9	27.5	
5	26.3	23.7	33.4	26.6	24.1	
Soil change, inches	1.43	-1.02	2.48	-2.35	-2.12	-1.58
Total change, inches	-2.88	-6.48	-1.91	-2.68	-7.97	-21.92

Table 17. Moisture change in soil profile under small grain with 50% of area in contributing micro-watershed. 1971-1972.

1971 crop	Mar. 29	July 27					Period
Rain, inches		3.74					3.74
Depth, feet	Soil moisture, % by volume						
1	30.4	29.8					
2	23.6	23.9					
3	21.7	21.8					
4	21.5	23.6					
5	23.1	24.5					
Soil change, inches		0.36					0.36
Total change, inches		-3.38					-3.38

1972 crop	Aug. 12	Oct. 14	Dec. 16	Apr. 11	May 16	July 11	
Rain, inches	4.31	5.46	4.39	0.33	1.11	4.74	20.34
Depth, feet	Soil moisture, % by volume						
1	38.3	33.1	34.4	27.7	25.5	28.5	
2	30.6	26.6	27.6	22.8	19.8	19.0	
3	23.4	22.9	24.9	22.5	19.2	18.8	
4	19.7	19.8	23.6	22.8	21.0	21.6	
5	22.8	23.4	25.6	26.0	24.3	23.6	
Soil change, inches	1.85	-1.39	1.24	-2.11	-1.57	0.38	-1.60
Total change, inches	-2.46	-6.85	-3.15	-2.44	-2.68	-4.36	-21.94

Table 18. Moisture change in soil profile under small grain with 75% of area in contributing micro-watershed. 1971-1972.

1971 crop	Mar. 29	Apr. 16	May 21	July 27	Period
Rain, inches		1.15	0.20	2.39	3.74
Depth, feet	------Soil moisture, % by volume-----				
1	33.4	33.7	32.4	33.9	
2	26.6	26.5	25.5	26.7	
3	20.5	20.4	19.6	21.3	
4	25.4	25.7	25.9	26.9	
5	29.3	29.0	28.9	29.8	
Soil change, inches		0.02	-0.43	0.86	0.45
Total change, inches		-1.13	-0.63	-1.53	-3.29

1972 crop	Aug. 12	Oct. 24	Dec. 16	Apr. 11	May 16	July 11	
Rain, inches	4.31	5.46	4.39	0.33	1.11	4.74	20.34
Depth, feet	----------Soil moisture, % by volume----------						
1	37.2	34.8	35.9	32.8	30.4	34.9	
2	33.6	29.6	31.6	27.4	24.7	29.4	
3	30.3	24.2	27.2	24.6	22.9	23.8	
4	32.0	30.0	29.8	33.5	30.6	30.9	
5	30.2	31.2	34.2	34.2	33.9	33.6	
Soil change, inches	3.16	-1.76	1.07	-0.94	-1.34	1.48	1.67
Total change, inches	-1.15	-7.22	-3.32	-1.27	-2.45	-3.26	-18.67

Table 19. Effect of herbicides sprayed on the ridges on grain yield[1] of crops on adjacent growing beds. 1971-1973.

Treatment	Amount lb/A		Sunflowers	Wheat	Barley	3 Crops
			lb/A			
Check	0	1971	380	479	192	
		1972	928	672	701	
		1973	901	918	784	
		Average	736	690	559	662
Propazine	1.25	1971	289	408	203	
		1972	935	591	617	
		1973	773	855	763	
		Average	666	618	528	604
Propazine	2.50	1971	370	351	176	
		1972	958	763	736	
		1973	1027	918	759	
		Average	785	677	557	673
Atrazine	1.25	1971	444	436	169	
		1972	1034	663	727	
		1973	913	999	794	
		Average	797	699	563	686
Propazine	2.50	1971	410	384	159	
		1972	961	734	701	
		1973	929	904	756	
		Average	767	674	539	660

[1] Yields calculated on basis of entire area which was half growing bed and half micro-watershed

Table 20. Effect of dryland rotations on yield of crops. 1972-1973.

Rotation	Crop	Treatment	Grain Yield 1972	1973	Average
			lb/Acre		
1	Wheat Sorghum Fallow	1 lb propazine/A after harvest 1 lb propazine/A at planting Stubblemulch	2230 3777	2130 3611	2180 3694
2	Wheat Fallow	Weedy	2218	2574	2399
3	Wheat Fallow	Stubblemulch	1811	2446	2129
4	Wheat Fallow	1 lb atrazine/A	2108	2507	2308
5	Wheat Fallow	2 lb atrazine/A	2270	2548	2409
6	Wheat	Continuous, clean tillage	2044	2459	2252
7	Wheat	Continuous, stubblemulch	2000	2576	2288
8	Sorghum Fallow	1.5 lb propazine/A 1.5 lb propazine/A	4272	2640	3456

Table 21. Effect of growth regulator (Cycocel) sprayed on wheat and on antitranspirant (atrazine) sprayed on wheat and sorghum. 1972-1973.

Wheat, 1972	lb/A	Sorghum, 1972	lb/A	Wheat, 1973	lb/A
Check	720	Check	3751	Check	1984
Cycocel, 1 lb/A	748	Atrazine, 30 g/A	3358	Atrazine, 8 g/A	2173
Cycocel, 2 lb/A	644	Atrazine, 60 g/A	3926	Atrazine, 16 g/A	1880
Cycocel, 3 lb/A	681	Atrazine, 90 g/A	3513	Atrazine, 20 g/A	1925
Average	698	Average	3637	Average	1991

Table 22. Yield of wheat (grain) grown on sloping sides of micro-watersheds as affected by spray application (Apr. 24) of antitranspirant (atrazine). 1975.

Treatment	Amount applied	Yield
		lb/A
On ridges (80-inch width planted, calculated on basis of 107-inch width)		
Check	0	2454
Atrazine	5 g/A	2386
Atrazine	10 g/A	2279
Atrazine	15 g/A	2240
On flat planting (planting solid)		
Check	0	2919

Table 23. Soil profile moisture change with time as affected by lateral distance from a porous tube irrigation source and lateral distance from growing wheat or sorghum. 1974-1975.

Tube No.	Lateral position from porous tubing	Lateral position from growing wheat	Lateral position from growing sorghum	Date	Aug. 2	Sep. 5	May 9	June 20	July 16	Aug. 14
				Rain, inches		6.50	10.84	1.60	1.20	2.28
	inches				Soil moisture, % by volume					
1	70	0	50	Depth, 1 ft	27.3	36.0	27.8	26.1	25.8	29.9
				2 ft	23.9	33.0	25.4	23.7	23.7	24.0
				3 ft	21.1	33.8	26.8	24.2	25.2	25.4
				4 ft	21.3	34.8	30.8	27.3	27.4	27.3
				5 ft	20.9	32.0	31.0	25.1	24.0	24.0
				Profile change, inches		7.13	-3.83	-1.94	0.22	0.78
					Soil moisture, % by volume					
2	50	10	30	Depth, 1 ft	27.7	36.4	34.6	32.5	31.4	29.7
				2 ft	23.8	33.5	29.4	28.0	26.6	26.6
				3 ft	23.8	39.1	34.3	33.3	33.0	31.1
				4 ft	22.5	35.6	32.8	30.7	30.4	28.9
				5 ft	21.2	32.5	30.6	28.1	27.7	25.7
				Profile change, inches		7.49	-1.96	-1.21	-0.48	-0.35
					Soil moisture, % by volume					
3	30	30	10	Depth, 1 ft	27.9	35.7	34.0	32.9	30.0	28.2
				2 ft	25.1	32.8	30.0	29.3	27.7	25.9
				3 ft	26.9	38.4	34.6	33.6	33.0	30.6
				4 ft	24.6	36.4	33.7	32.6	31.9	30.2
				5 ft	21.6	33.5	31.5	30.1	29.8	27.5
				Profile change, inches		6.50	-1.66	-0.58	-0.90	-1.31
					Soil moisture, % by volume					
4	10	50	10	Depth, 1 ft	27.7	35.7	33.9	33.4	30.9	27.7
				2 ft	25.8	33.2	31.0	30.2	29.6	26.2
				3 ft	26.1	35.8	32.4	31.9	31.3	28.1
				4 ft	25.6	35.8	34.7	33.0	32.7	30.6
				5 ft	22.4	34.8	31.9	31.1	31.3	29.4
				Profile change, inches		6.20	-1.49	-0.54	-0.60	-1.85

continued

Table 23. Continued

Tube No.	Lateral position from porous tubing (inches)	Lateral position from growing wheat (inches)	Lateral position from growing sorghum (inches)	Date	Aug. 2	Sep. 5	May 9	June 20	July 16	Aug. 14
				Rain, inches		6.50	10.84	1.60	1.20	2.28
					Soil moisture, % by volume					
5	10	70	10	Depth, 1 ft	31.1	36.8	35.7	33.9	32.5	30.0
				2 ft	27.4	34.9	32.4	31.8	31.2	29.8
				3 ft	29.1	38.6	35.6	34.5	34.8	31.8
				4 ft	27.8	37.8	35.1	35.3	35.2	33.0
				5 ft	23.0	34.5	31.2	31.3	31.0	29.3
				Profile change, inches		5.64	-1.57	-0.49	-0.34	-1.44
					Soil moisture, % by volume					
6	30	90	10	Depth, 1 ft	30.5	35.7	34.1	33.3	32.1	30.2
				2 ft	26.6	33.4	31.0	30.2	29.6	27.5
				3 ft	26.4	35.7	32.2	32.5	32.0	31.0
				4 ft	27.0	36.1	33.4	34.3	33.3	32.4
				5 ft	23.8	34.3	31.9	32.0	31.5	30.8
				Profile change, inches		5.22	-1.61	-0.11	-0.53	-0.90
					Soil moisture, % by volume					
7	50	110	30	Depth, 1 ft	32.2	36.7	34.7	34.3	34.6	33.2
				2 ft	29.7	34.2	32.0	31.2	31.1	30.3
				3 ft	29.7	40.0	37.0	37.0	37.2	35.6
				4 ft	27.7	36.3	33.8	33.7	34.4	32.7
				5 ft	23.7	33.8	31.3	31.4	31.1	30.2
				Profile change, inches		4.82	-1.75	-0.17	0.11	-0.85
					Soil moisture, % by volume					
8	70	130	20	Depth, 1 ft	32.8	35.7	34.7	34.2	33.7	33.2
				2 ft	28.6	34.1	31.8	31.6	31.4	31.4
				3 ft	26.3	37.8	35.2	34.9	35.0	33.7
				4 ft	29.1	36.6	34.8	34.3	34.5	34.0
				5 ft	23.2	33.1	30.9	30.9	30.5	30.5
				Profile change, inches		4.64	-1.25	-0.20	-0.12	-0.30