days after both the first and second irrigations, irrigated for 8 days after the third, and no water after the fourth. The average intake rate, obtained by metering water onto the plot, for the extended periods of irrigation was 0.385 ft./day (total depth of water applied/days of application).

For yield purposes, 2 strips of 4 rows were harvested 2 rows in from either edge of the plot. For comparison a strip of four rows on either side of the plots was harvested. The off-plot strips were 5 or more rows away and were not influenced by treatment of the plot. Thus 2 samplings for yield were obtained from the plot area and 2 from the adjacent field area.

Yield and quality—Table 1 shows the yield of seed cotton for the two samples from each location. The data indicates slightly lower total yields on-plot as compared to off-plot, but the differences are not statistically significant.

Both on- and off-plot samples graded Middling with staple lengths of 1-3/32 inches.

Growth and maturity—A depression in the growth was also noticed in the solid-block cotton under prolonged irrigation at the beginning of the season. This may have been caused by the lack of nitrogen or a lack of soil aeration as evidenced by yellowing of the leaves; however, the cotton plants recovered during the period between the first and second excessive irrigations and the yellowing of the leaves was barely perceptible in comparison to the off-plot cotton. Ten days after the first 15-day irrigation the number of blooms per plant were approximately the same for both the on- and off-plot plants. Yellowing of the leaves occurred again during the second 15-day irrigation and recovery of green color was not complete when the last 8-day replenishment irrigation was applied.

After this last prolonged irrigation the on-plot cotton leaves were very yellow and no bolls were open. The off-plot cotton had 3 to 4 open bolls per plant. Ten days later the on-plot cotton showed a few open bolls.

Root development of the plants receiving no extra water was similar to the plants receiving 38 days of extra water (as shown in Figure 2). The whitened areas (on-plot cotton root) are enlarged lenticels and were found predominantly on roots of plants subjected to prolonged irrigation.

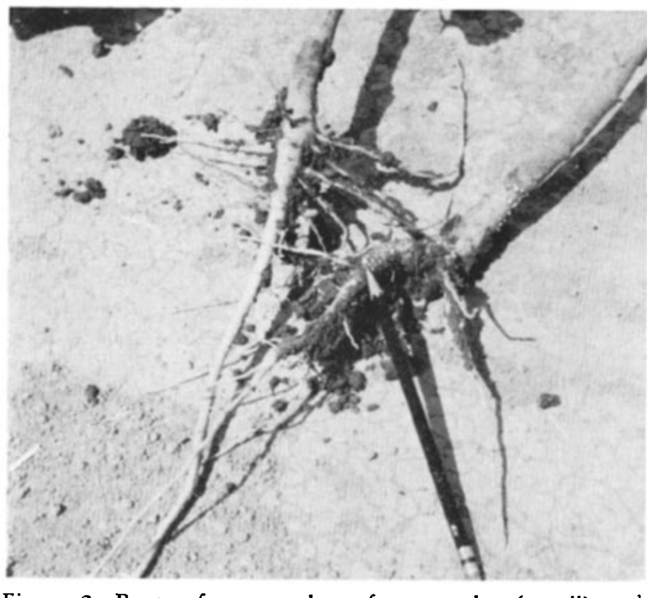

Figure 2—Roots of cotton plants from on-plot (pencil) and off-plot.

Conclusions

Prolonged irrigations produced no significant differences in crop yields of Acala 4–42 cotton compared to the usual irrigations practiced by the farmer, even though some early season growth depression occurred and maturity was delayed. Therefore, cotton may lend itself to a replenishment irrigation program. However, further studies with cotton and other crops over more than one season are needed if replenishment irrigation is to become an important means of ground water recharge.—E. E. HASKELL, JR., *and* W. C. BIANCHI, *Geologist and Research Soil Scientist, Southwest Branch, Soil and Water Conservation Res. Div., ARS, USDA, Fresno, Calif.*

DISTRIBUTION OF NET RADIATION WITHIN SORGHUM PLOTS[1]

THE amount of evapotranspiration from any locality is governed primarily by those factors affecting water and heat supply to soil and plant surfaces.[2] The net radiation, the difference between incoming and outgoing radiant energy, is the principle source of heat. This experiment was initiated to determine if row width and plant population influence the total net radiation and its distribution between the grain sorghum crop and the soil.

Four RS 610 grain sorghum plots with north-south orientations were selected for this experiment. Treatments were as follows:

1. 20-inch rows with 105,000 plants per acre
2. 20-inch rows with 13,000 plants per acre
3. 40-inch rows with 105,000 plants per acre
4. 40-inch rows with 13,000 plants per acre.

"Economical" net radiometers, as described by Suomi and Kuhn,[3] were used to measure the net radiation. On each plot 1 radiometer was placed approximately 1 foot above the crop. In the row beneath the foliage 3 radiometers were connected in parallel; 1 was situated in the center of the row and 1 was placed to each side of the row near the sorghum stalks. The bottom windows of the lower radiometers were 1 foot above the soil surface. All radiometers were connected to a recorder and radiation data were recorded 24 hours per day.

The upper radiometers measured the total net radiation absorbed by both crop and soil; the lower radiometers measured that net radiation absorbed by the soil alone. The difference between upper and lower net radiation was absorbed by the crop. Similar procedures were used by Aubertin and Peters[4] and Tanner and associates[5] to measure the net radiation in cornfields. Aubertin and Peters suggested that separate measurements of the net radiation absorbed by the crop and by the soil make possible individual estimates of transpiration and evaporation.

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[1] Contribution from the Soil and Water Conservation Research Division, ARS, USDA, and the Kansas Agricultural Experiment Station. Department of Agronomy Contribution No. 767.

[2] Tanner, C. B. Factors affecting evaporation from plants and soil. J. Soil and Water Cons. 12(5):221–227. 1957.

[3] Suomi, V. E., and Kuhn, P. M. An economical net radiometer. Tellus. 10:160–163. 1958.

[4] Aubertin, G. M., and Peters, D. B. Net radiation determinations in a cornfield. Agron. J. 53:269–272. 1960.

[5] Tanner, C. B., Petersen, A. E., and Love, J. B. Radiant energy exchange in a cornfield. Agron. J. 52:373–379. 1960.

Table 1—Daily net radiation absorbed on sorghum plots at two plant population rates.

Days, 1961	Daily net radiation absorbed, cal./cm.^{2}/day											
	20-inch row width						40-inch row width					
	105,000 plants/A.			13,000 plants/A.			105,000 plants/A.			13,000 plants/A.		
	Tot.	Crop	Soil	Tot.	Crop	Soil	Tot.	Crop	Soil	Tot.	Crop	Soil
7-29	358	258	100	368	144	224	379	268	111	382	180	202
7-30	377	282	95	388	194	194	393	259	134	401	177	224
7-31	339	249	90	345	179	166	380	250	130	381	161	220
8-1	240	173	67	237	101	136	254	142	112	260	114	146
8-5	390	288	102	382	151	231	398	320	78	393	200	193
8-7	377	291	86	350	154	196	368	275	93	374	161	213
8-8	365	279	86	314	128	186	349	254	95	374	179	195
8-9	204	141	63	200	60	140	216	163	53	208	119	89
8-10	381	279	102	355	157	198	377	279	98	376	168	208
Mean	337	249	88	327	141	186	346	246	100	350	162	188

Table 1 gives the total daily net radiation absorbed in each treatment and the amounts absorbed by the crop and the soil.

The results of an analysis of variance showed that only the row width significantly influenced the total net radiation absorbed by both plants and soil in each treatment. The significance level was 0.001 ($F = 20.24$; d.f. = 1, 24). From the average of the means, the net radiation measured above plots with 40-inch rows was 16 cal./cm.^{2}/day or 4.8% greater than above plots with 20-inch rows.

Analysis of variance on the net radiation absorbed by soil showed that only the plant population significantly influenced this measurement. The significance level was 0.001 ($F = 159.35$; d.f. = 1, 24). Those soils with low plant population absorbed, on the average, 93 cal./cm.^{2}/day more than did those with high populations.

Only the plant population significantly influenced the net radiation absorbed by the crop. The level of significance was 0.001 ($F = 170.28$; d.f. = 1, 24). From the average of the means, the high plant populations absorbed 96 cal./cm.^{2}/day more than did the low populations.

For the 9 days of measurement on plots of equal plant populations, the soil absorbed 55.3% of the total net radiation absorbed on plots with 13,000 plant per acre and 27.5% of the total absorbed on plots with 105,000 plants per acre. These percentages indicate that even with extremely high plant populations considerable radiant energy is available at the soil surface for evaporation.

Under the conditions of this experiment it is evident that total net radiation absorbed under cropped conditions is only slightly influenced by row spacing. The division of this energy between crop and soil appears to be strongly dependent on the plant population. There was no evidence of a significant influence by the row width-plant population interaction on the total net radiation.—S. A. Bowers, R. J. Hanks, *and* F. C. Stickler, *Soil Scientists (Physics), USDA, and Associate Professor of Agronomy, Kansas State University, Manhattan, Kans., respectively.*

A SMALL SIRUP PAN DEVELOPED AT MERIDIAN, MISSISSIPPI, 1960[1]

FOR several years the standard experimental sirup pan used at the U. S. Sugar Crops Field Station, Meridian, Miss., required 40 pounds of juice and was heated with steam. Both quantitative and qualitative data from this equipment were excellent but its use was limited by the amount of juice required for each test. Consequently, a normal day's "run" for sorgo was only 7 samples and for sugarcane about 12 samples. Thus, the number of sirup samples that could be processed during the year was extremely limited. Also, the approximately 100 pounds of stalks required to furnish 40 pounds of juice made it necessary to delay sirup evaluations until sorgo lines were included in the agronomic nurseries and sugarcane selections were in line tests in 1/200-acre plots.

A smaller pan requiring less juice was constructed at Meridian in the fall of 1960. It is 18 inches long by 13.5 inches wide by 11.5 inches high. The ½-inch brass steam coil is 35 inches long (Figure 1). Only about 10 pounds of juice is required for each sirup sample.

The small pan was compared directly with the standard pan. Comparative samples (10 pounds for the small pan and 40 pounds for the standard pan) were drawn from the same lot of juice and processed into sirup at the same time in the 2 pans. Eight such comparisons, involving several different varieties of sorgo, were available and used.

Table 1 includes the results of this comparative study. The average percent of sirup was only 0.7% less for the small pan than for the standard. Variety comparisons were excellent in both cases, as indicated by the highly significant variance due to samples. The correlation coefficient for percent sirup was +0.9477, which is highly significant and indicates excellent agreement between the pans.

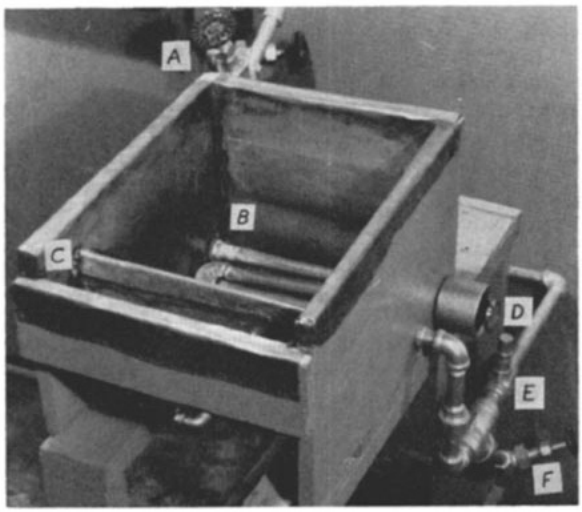

Figure 1—Small sirup pan, showing: A, steam control valve; B, steam coil; C, skimming trough; D, thermometer; E, Steam trap; and, F, steam exhaust valve.

Table 1—Comparison data from standard and small experimental sirup pans.

Sample number	Brix	Percent sirup		Percent skimmings		Finishing temp. °C.	
		Standard pan	Small pan	Standard pan	Small pan	Standard pan	Small pan
1	19.3	20.5	19.0	7.5	8.0	110	110
2	17.5	21.0	18.0	8.0	8.0	109	109
3	19.7	21.5	21.0	5.5	7.0	110	109
4	20.2	29.8	29.0	8.5	10.0	104	105
5	17.1	18.8	19.0	6.5	7.0	110	109
6	14.0	15.8	17.0	6.0	5.0	110	110
7	16.5	19.2	18.0	7.0	6.0	110	110
8	19.6	22.0	22.0	7.0	8.0	108	108
Aver.		21.1	20.4	7.0	7.4	108.9	108.8

Variance analyses:

Source of variation	D. F.	Mean squares	
		Sirup	Skimmings
Samples	7	30.33**	2.78*
Pans	1	1.95	0.56
S × P	7	0.80	0.49
Total	15		
r_{xy}		+0.9477**	+0.7583*

* 5% level of significance. ** 1% level of significance.

[1] Cooperative investigations of the Crops Research Division, ARS, USDA, and Mississippi Agricultural Experiment Station. Received May 24, 1962.