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THE STUDY OF IRRIGATING COTTON IN THE HILL SECTIONS OF MISSISSIPPI

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This bulletin is a progress report on cotton irrigation studies conducted by the Mississippi Agricultural Experiment Station. Results reported are those during the dry, moderate, and wet years of the 1950's. They indicate some of the hazards, potentials, and excellent results of irrigation.

Weather records at Mississippi State University indicate a non-uniform pattern of rainfall during the growing season. Some years rainfall has been excessive. causing serious crop damage. At other times droughts have ruined crops. Only 31.32 inches of rainfall occurred during 1952. During 1958, the total rainfall was 52.68 inches with 25.96 inches occurring during the most important growing season. The lack of a uniform rainfall pattern makes it hard to predict the economical use of irrigation. Table 1 shows the variation in rainfall during the experiments reported here.

In the hill area, excessive runoff occurs when rainfall is of a high intensity. Therefore, moisture stored in the soil for crop use is not necessarily the gross amount of rainfall, but decreases by the amount of runoff. Some factors affecting the amount of runoff are: Condition of the soil at the time of the rain, length of time the high intensity rainfall continued, stage of growth of the crop being produced, and natural infiltration of the soil.

Irrigation Studies at State College

Cotton has been generally classed as a dry weather plant. Several factors lead to this impression, During wet seasons, insects are hard to control, plants make vegetative instead of productive growth, and lint is damaged by boll rot, especially if plants grow excessively. During dry years, better percentage of lint turnout is obtained and the lint is of higher quality,

Although cotton is classed as a dry weather plant, farmers know from experience that deficient moisture during the growing season will result in decreased yields. To be assured of a cotton crop during dry seasons, many farmers are turning to irrigation, thus stabilizing their production.

Tests are being conducted[2] on cotton in the hill sections to determine the effects of irrigation: On various varieties, with various levels of nitrogen, with deep tillage, by mechanical impoundment of water in the furrows to prevent runoff, and on mechanization practices.

To determine when to irrigate, tensiometers are used to measure water tension in the soil. The irrigation schedule is based on 800 cm of water tension at a depth in which a major part of the roots are located.

Variety and Irrigation: This test was begun at State College in 1952[3] and was continued through 1959. The purpose was to determine if any varieties are particularly responsive to irrigation. The test was planted on Houlka fine sandy loam from 1952 through 1957, and on Kaufman fine sandy loam from 1957 through 1959.

Shallow Kaufman fine-sandy loam produced a significant increase from irrigation in 1957 while the deep Houlka fine sandy loam produced no significant increases. Yields have been very good in the deeper soil, but little response to irrigation was received, except during the ex-

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[3]"Twelve Varieties of Cotton Used in Irrigation Test," R. L. Dickinson and J. F. O'Kelly, Mississippi Farm Research, January, 1953.

tremely dry years. Yields were not as high in the shallow soil, but a greater response to irrigation was received due to the lower water holding capacity. This indicates the importance of soil types in measuring response to irrigation.

Yields are shown for the varieties in Table 2.

Yields are not given for the years in which no significant increases were obtained for irrigation. The yield differences do not show a significant variety-irrigation interaction.

Fertilization and Irrigation: Large increases in yield with irrigation probably

Table 1. Rainfall during growing season and total rainfall for each year, 1950-1959

Inches

Year	April	May	June	July	August	September	Total of year
1950	1.95	4.50	2.41	8.51	9.53	6.86	67.37
1951	4.08	4.47	5.98	3.15	3.25	3.40	63.43
1952	2.27	3.20	.29	2.06	2.74	1.21	31.32
1953	6.57	6.29	2.59	5.26	1.82	.72	48.58
1954	3.40	3.71	.81	3.75	1.87	1.23	40.08
1955	5.56	4.25	2.35	7.42	1.35	.82	41.76
1956	6.19	3.94	2.45	2.41	2.37	.63	51.35
1957	3.60	2.36	8.56	1.40	.08	6.50	51.97
1958	7.05	4.70	7.15	6.98	2.68	4.47	52.68
1959	5.89	8.01	2.06	1.20	2.25	4.53	46.22

Table 2. Variety tests with irrigation.

	1952		1954		1957		1959	
Varieties	Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated
	Lbs. of lint per acre							
Plains	997	720	892	699	651	506	837	702
Coker Wilt	923	633	931	642	570	471		
Bob Shaw 1-A	915	645	754	582				
Delfos 9169	914	792	856	682	510	423	886	671
Delfos 7343	893	720	867	662				
Stoneville 2-B	891	705	790	674				
Empire	886	641	758	638	610	549	874	678
Fox	874	636	790	615	557	473		
Hi Bred	863	669	920	672	620	494		
Deltapine 15	860	669	798	663				
Arkot 2-1	842	687						
Wilds	665	533	653	552				
Acala 4-42			990	730	490	466		
Des 1000					674	528		
Dixie King					640	495	895	713
Deltapine SL					619	486	789	616
Auburn 56					626	518	938	759
Stoneville 7					561	522	936	728
Pope							664	550
Coker 100A, WR							967	791
Rex							862	703
Fox 4							801	648
Des 1007							779	707
Average	875	671	833	651	594	494	852	689
No. of irrigations	5		4		2		2	
Amt. of water (in.)	6.0		8.3		5.0		4.0	
Soil type	Houlka fine sandy loam		Houlka fine sandy loam		Kaufman fine sandy loam		Kaufman fine sandy loam	

require an increase in the rate of nitrogen. The purpose of this test is to determine the nitrogen rate that would give the best yield increase with irrigation. It was initiated in 1953 and is still being conducted.

Rates of nitrogen used were 30, 60, 90, and 120 pounds per acre with 60 pounds of P_2O_5 and 60 pounds of K_2O for the years 1953 through 1957. During 1958, the tests were revised to 60, 90, 120, and 150 pounds of nitrogen per acre with split application for the higher rates rather than applying all the fertilizer prior to planting. Both sprinkler and furrow irrigation were used to distribute the water on the plots.

There were increases due to irrigation in 1953 and 1954, which were dry years. The effects of fertilization and irrigation for these two years are shown in Table 3. In the moderate and wet years that followed, the small increases in yield were not significant.

Deep Tillage: This test was designed to determine the effect of deep tillage (cultivation) on cotton production and irrigation requirements.

Treatments with and without irrigation carried out in 1957 and 1959 were: (1) Conventional cultivation; (2) deep cultivation; (3) conventional cultivation with front sweeps next to row and deep chiseling in the furrow. (4) Deep cultivation with front sweeps next to row and deep chiseling in the furrow. Rain prevented the test from being accomplished in 1958. The use of sub-surface sweeps in the furrows was tried but discontinued due to excessive disturbance to the plant. More water could be applied to the chiseled land before runoff occurred.

Tall irrigated cotton may cause an insect control problem.

Results are shown in Table 4.

It appears that deep tillage with irrigation may affect production adversely if wet periods occur during the growing season, as in 1957 and 1959.

More information is needed and the test will be continued but moved to a soil with less water holding capacity.

Mechanical Impoundment: The purpose of this test is to determine the feasibility of using check dams in middles to

Table 3. Fertilization test with irrigation.

	30 lbs. N per acre		60 lbs. N per acre		90 lbs N per acre		120 lbs N per acre	
	Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated
	Lbs. of lint per acre							
1953	1167	1155	1203	1007	1083	983	1178	813
1954	1030	784	1100	731	1019	830	998	882

Table 4. Tillage and irrigation test.

Treatment	1957 Irrigated	1957 Not Irrigated	1959 Irrigated	1959 Not Irrigated
	Lbs. of lint per acre			
Conventional cultivation	688	749	678	489
Deep cultivation	639	660	636	628
Conventional cultivation and chiseling	742	696	553	595
Deep cultivation and chiseling	702	740	480	641

Table 5. Cotton yields using check dams.

Treatment	Satisfactory rate of application	Irrigated	Not Irrigated	Irrigated	Not Irrigated
		Yields in lbs. lint per acre			
Check dam	1.40 in./hr.	567	371	664	598
Conventional	.38 in./hr.	604	420	696	552

increase the application rate of water by sprinklers. Treatments were as follows: (1) Irrigated, conventional furrow; (2) irrigated, check dam furrow; (3) Non-irrigated, conventional furrow; and (4) Non-irrigated, check dam furrow.

The test was conducted in 1957 and 1959 on Ora fine sandy loam with a very impervious subsoil. The sandy topsoil gave a fairly high intake rate early in the irrigation period, but tended to seal off quickly which lowered the infiltration rate.

Due to the check dams, 2.2 inches could be applied at the rate of 1.4 inches per hour before runoff occurred. Only 0.7 inches could be applied at .72 inches per hour in the irrigated conventional furrow area before runoff occurred. Run-off rate from the conventional furrow was measured and subtracted from the application rate, giving the infiltration rate of .38 inches per hour.

This shows that check dams allow a more rapid rate of application without high rate of runoff.

Irrigation and Mechanization Practices: When ground-operated rigs are used for insect control on irrigated fields, the insect control program often must be changed in order for it to fit the irrigation program. This is due to the inability of the poison machine to operate in wet fields and to the poison being washed off by irrigation. One program must wait on the other. The operator can decide whether to spray with a quick kill poison prior to irrigation, or irrigate and then apply the insecticides as soon as a machine can maneuver in the field.

Late cultivation, as well as insect control, with conventional equipment is often prevented in irrigated fields by dense vegetative growth, especially in fields of high nitrogen rates. Irrigated cotton obtained a height of 6.4 feet in 1955. In 1959, test plots became grassy after the second irrigation. Boll laden limbs interlocked in the middles preventing a late cultivation.

Hill farmers who irrigate their cotton may need to invest in well shielded machines for late weed and insect control.

CONCLUSIONS

Cotton will respond to irrigation provided the drought period exceeds the carrying capacity of the soil. This is not a definite length of time for all soils. Soils of low water-holding capacity require more frequent applications of water. When these frequent applications are not available by rain, irrigation will increase production.

High fertilization rates, especially nitrogen, have caused some excessive vegetative growth and created a problem in applying insecticides in irrigated areas.

Soil condition at the time of irrigation has influenced the infiltration rate of the water. Cultivation prior to irrigation increases infiltration.

Check dams in the furrows allow a higher application rate.

The lack of a more uniform rainfall pattern makes it difficult to predict the economical use of irrigation.