Effects of Irrigation on the Gro

amounts and timing of applications influence lint grade and staple length

The following preliminary reports cover
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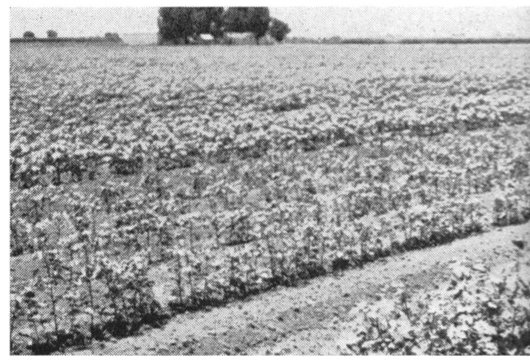

Response of cotton to dry and to w
growth (

Studies on the irrigation of cotton—the relation of soil moisture to growth, physiological development, and yield of the plant—were started in 1954 at the U. S. Cotton Field Station at Shafter.

Changes in the variety of cotton grown, in cultural practices, and information on irrigation practice gained since the last extensive investigations on irrigation prompted the new studies.

The soil used in the tests is Hesperia sand loam of recent alluvial origin, well drained and alkali free. At field capacity it will hold approximately 4″ of available water in the surface 3′.

The soil was preirrigated in early March and the cotton planted April 7. The temperature was above normal for April 1954, so the seeds germinated readily and there was rapid growth during the seedling stage. The stand was approximately 39,000 plants per acre.

The soil was moderately nematode infested, and it was soon evident they interfered with normal root development. Much nematode injury occurred in the seedling stage, when the tap root had reached a depth of 8″ to 10″. This usually resulted in the development of a branched system without a strong deep tap root and caused a retarded growth in depth early in the season. However, as the season progressed, the plants showed an improved root development and extraction of available soil moisture to a depth of 3′, with some moisture used from the 4′ and 5′ depths.

Water consumed by the plant was calculated from the soil moisture record. When the plants were small and the temperature cool, moisture use was very small, only a few hundredths of an inch a day. As the plants developed in size—with increasingly warmer temperatures—the rate of use increased to approximately 0.15″ per day for June, 0.20″ for the first part of July, and 0.30″ or more in later July and through August, with a rapid decline in September.

The total use for treatments having a good vegetative growth was approximately 22″ of water for the season. The August temperatures in 1954 were below normal, and these moisture records may not reflect the consumptive use in a normal or warmer season.

In this first year's work, the main irrigation treatments—each consisting of four randomized plots—were identified as *A*, *B*, *C*, *D*, and *E*. Some of the data collected from these irrigation treatments are given in the table in the first column on page 10.

Treatment *C* utilized the irrigation water most efficiently. To the 26.2″ applied, approximately 4″ of available water from the preirrigation should be added. The difference between the 22″ consumptive use by the plant and that applied is the loss by deep percolation. Most of this loss occurred in the early part of the growing season when the plants were small and had a limited root system. Treatment *A* also used the water efficiently, but yields were reduced.

Treatments *B*, *D*, and *E* showed no signs of water stress, but Treatment *C*—prior to each irrigation—showed definite signs as evidenced by a distinct color change of the foliage and occasional transient wilting the afternoon before irrigation. This observed color change in foliage is due primarily to the lack of new terminal growth. Comparison of mature leaves from Treatment *C* with those of the wetter plots showed no difference in plant color.

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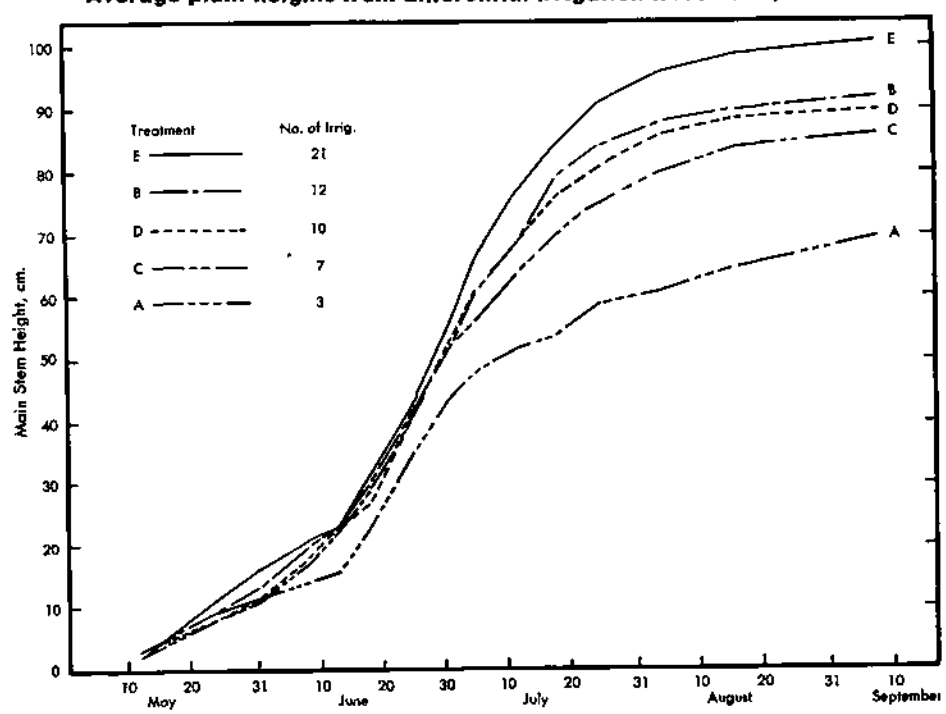
Average plant heights from differential irrigation treatments, 1954.



IRRIGATION

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IRRIGATION

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The checking of new terminal growth—so-called change in color—appears to be the key to soil moisture stress because yields were not reduced. If this approach can be developed to a practical application, it will integrate many factors of soil and climate, such as varying soil type, hardpans, claypans, nematodes, saline conditions, and varying seasonal temperatures.

The difference in yields for the four wetter treatments is small and is not statistically significant. Even the slight checking in growth immediately before each irrigation—Treatment *C*—did not reduce yields. The yields for the wettest treatment—*E*—were slightly less than for Treatments *B*, *C*, and *D*, but not significantly so. The only significant reduction in yield occurred in the dry Treatment *A*.

Cotton Irrigation Experiments—1954

	Treatments				
	A	B	C	D	E
Number of irrigations*	3	12	7	10	21
Water applied, inches*	15.4	33.9	26.2	30.0	52.5
Yield lint, bales/acre	2.15	2.97	2.90	2.92	2.81
Trash, %	8.1	8.3	8.2	8.3	8.1
Picker efficiency, %	93.9	95.1	94.0	95.6	95.3

* Does not include the preirrigation.

The plots were machine-picked on November 9. The plants had been killed by frost and no chemical defoliant was used. Under this condition there was no essential difference in per cent trash or in picker efficiency for any of the irrigation treatments.

The effect of these various irrigation practices on vegetative production for the growing season was obtained by measuring main stem height at periodic intervals. The results of these measurements are given in the graph on page 8. The vegetative height was in the same order as the increase in frequency of irrigation. Treatment *A* produced the smallest plants. At the first irrigation June 14, there was less growth than for the other treatments. Although the plants grew rapidly after this irrigation, they did not recover the loss in growth due to the two weeks of water stress, and the next two periods of drought caused a wider discrepancy between *A* and the other treatments.

Treatment *C* with temporary checking of growth before irrigations was not affected by the first two irrigations, but after the third on July 6, a difference between this treatment and the wetter ones began to appear. The frequently irrigated Treatment *E* showed a marked increase in height which was also evident from a general observation of the plots. As noted in the table in column 1, the yields did not follow the vegetative growth of the plant.

Final plant heights and weight of the stalks, leaves and cotton removed, are reported in the table in column 2 for each irrigation treatment.

The final plant heights are in agreement with those listed in the graph on page 8, but the weight of stalks does not follow this trend, especially the wet Treatment *E*, which produced the tallest plants but not the greatest weight. From this data and observation of the plots, it would appear that the high soil moisture condition of Treatment *E* produces a tall, spindling plant but does not increase yield.

A study of leaf area and boll set in August was made for Treatments *A*, *B*, and *C*, and the pertinent information is given in the last two items of the table in column 2. The dry Treatment *A* had smaller leaves than either *B* or *C*, and the temporary checking of terminal growth did not affect leaf size. The leaf area per boll was smaller on the dry Treatment *A* than for either of the other two treatments, indicating these smaller plants were very efficient in producing cotton.

Vegetative Measurements of the Cotton Plant

	Treatments				
	A	B	C	D	E
Final plant height, inches	28.7	37.4	35.6	36.9	40.5
Stalk weight, tons per acre	1.17	1.89	1.86	1.98	1.88
Area per leaf, sq. inches	8.7	9.5	10.1		
Leaf area per boll, sq. inch	41.1	46.1	46.5		

Three treatments—*G*, *B2*, and *I*—were used in a study of the effect of the timing of the last irrigation. All treatments followed the irrigation schedule of Treatment *B*, which is considered normal practice for the area until the final irrigation. The treatments and dates of the last irrigation are summarized in the table below.

The timing of the last irrigation had considerable effect on vegetative growth. Slightly shorter plants were obtained with a smaller stalk weight for Treatment *G*, with the last on August 10. A large degree of natural defoliation or leaf fall occurred in this treatment. Prolonging the irrigation schedule, as in Treatments *B2* and especially *I*, gave a pronounced late growth and is reflected by the increase in weight of stalks.

Results of Timing the Last Irrigation, 1954

	Treatments		
	G	B2	I
Date of last irrigation	Aug. 10	Aug. 31	Sept. 27
Number of irrigations	9	12	15
Water applied, inches	25.4	33.9	41.4
Final plant height, inches	36.2	37.4	37.8
Stalk weight, tons per acre	1.58	1.89	2.16
Yield lint, bales per acre	2.58	2.97	3.02
Trash, %	6.8	8.3	8.8
Picker efficiency, %	95.2	95.1	94.8

Lint yields were significantly reduced for Treatment *G*, but no significant differences occurred between Treatments *B2* and *I*. Treatment *G* had a smaller trash content, probably a reflection of the natural defoliation. Picker efficiency was lower for Treatment *I* and may have been influenced by the late vegetative growth and lodging of the plant. In late September this lodging was quite serious and would have hampered an early machine picking. The lodging, in part, was caused by delayed boll opening and excessive weight of green bolls and leaves.

Irrigation practice has been popularly associated with fiber quality. Soil moisture and its availability during the period of development may influence many fiber properties such as length, strength, fineness, and maturity. Since the cotton is bought on the basis of lint grade and staple length, these items will be of most interest, but the reputation that fiber from irrigated cotton makes at the spinning mills is most important in maintaining a good demand for western-grown cotton.

The effect of irrigation practices on fiber properties and spinning quality was evaluated by the following tests:

Lint grade is based on the amounts of leaf trash and other impurities and on the color of the ginned cotton. Staple length refers to the length of fibers in a sample of ginned cotton and may be influenced by certain environmental factors during the period of fiber elongation.

Yarn strength is a measure in pounds of the weight required to rupture a given size yarn. Variation in yarn strength is closely associated with fiber strength, but

Effect of Various Irrigation Frequencies on Cotton Fiber and Yarn Properties

TREATMENT	E	B	D	C	A
# Irrigations	21	12	10	7	3
Fiber Grade	M*	M*	M*	M*	SM**
Staple length, inches	1 5/32	1 1/8	1 1/8	1 1/8	1 3/32
Yarn strength, lbs.	122	124	126	129	127
Nep count	17	24	24	19	13
Yarn appearance index	95	95	95	95	105

* Middling

**Strict Middling