Growth and Yield of Cotton

V. T. Walhood and B. Counts

Only one year’s study of one soil type and in research development toward informing to yield and quality of cotton.

Irrigation treatments in studies on yield yield.

Detailed growth measurements of cotton—under the various irrigation treatments in the experiments—indicate the extent to which the plant can be manipulated by varying the time and amount of water available.

Plant height measurements were made weekly during the season, and flowering and fruiting measurements were made daily, as shown in the graph on page 8. Flowers were tagged beginning with the first on June 21 and continuing to August 19. Flowers in this period accounted for 99% of the total yield and amount of water available.

Vegetative growth is a factor in limiting the fruiting of most plants; however, excess foliage—plant height—to the amounts of fruit is usual for cotton. In Treatment A where moisture was a limiting factor in growth, the plants were 28.7” tall and produced 573 bolls on 40 row feet. The different levels of growth are shown in the two-column table on page 11. Increasing the soil moisture—Treatment C—increased the plant height 23% and yield 18% over A. High moisture levels by frequent irrigations—Treatments B and C—gave increases in plant height up to 41% greater than Treatment A, while yields were not increased above those obtained in Treatment C, as shown in the table in column 1, page 10.

Flowering was correlated with the number of irrigations up to 12; further irrigations did not increase the number of flowers produced during the season. This correlation is plotted in the graph at the lower right of this page. While the plots receiving less frequent irrigations produced a smaller number of total flowers, the tendency was toward earlier blooms. The flowering rate in Treatment A was limited by plant size. Treatment C produced more flowers the first 30 days than B, and more than E for 35 days.

There was no difference in number of bolls set in Treatments B, C, and E, which outyielded A, as illustrated in the graph in column 2 on this page. Above seven irrigations boll set was not increased in number. Boll in Treatment A was limited by low flower production and plant growth. Although boll production was equal in B, C, and E, Treatment C produced 80% of the boll crop approximately six days ahead of Treatments B and E. This may be a reflection of its earlier flower production.

Within an environment extending over the summer season, cotton plants have been found to be very uniform in flower retention percentages. Only by extremes in cultural practices do percentages vary over 10%. Luxurious amounts of nutrients and water tend to reduce, and water stresses tend to increase, retention percentages. In this study less frequent irrigations resulted in more efficient flower retention; the moisture stress in Treatment A resulted in 42% flower retention, and Treatment C retained 34%, B 29%, and E 31%. The increased retention of flowers in A was not sufficient to make up for the low number of blooms in that treatment; in C, however, the increase in retention was sufficient to maintain maximum boll set even though it had 11-15% fewer flowers than Treatments B and E.

The largest bolls were produced by Treatment B, followed closely by C and E, while bolls from Treatment A were six to 11% smaller than other treatments.

The cotton plant grown under the prevailing cultural practices in the San Joaquin Valley of California is high yielding and luxuriant in growth. It has a tendency toward prolonged foliage retention, and lodging occurs. Chemical defoliation, hand, and mechanical harvesting are difficult under such conditions.

Characteristic fruiting phenomena for Concluded on page 11

Number of flowers opening daily and number of flowers retained to become bolls on 40 row feet of cotton from different irrigation treatments at Shafter, 1954. Irrigation dates indicated by arrows.

Accumulated number of bolls set on 40 row feet of cotton from different irrigation treatments at Shafter, 1954.
is also dependent upon certain other fiber characteristics that enable the closely twisted fibers to resist slippage.

Nep counts are based on the number per 100 square inches of card web. These are small tangled knots of fibers that show up as specks in cotton yarn and cloth. The chief cause of neps is considered to be a high proportion of thin wall fibers. Relative freedom from this condition is highly desirable since neppy yarns absorb dyes unevenly and detract from yarn appearance.

The yarn appearance index is based on the relative smoothness of the yarn and freedom from neps and other foreign materials.

The effect of various irrigation frequencies on these fiber and yarn properties is presented in the two-column table on page 10. Not until the extremes in irrigation frequency are considered does any appreciable effect on these properties become noticeable. Treatment E, the most frequently irrigated treatment, had the longest fiber and the weakest yarn. Treatment A, the least frequently irrigated treatment, had the shortest fiber, the highest grade, lowest nep count, and the best appearance index. The short fiber and low nep count are due to severe stress for water, but the increase in grade and appearance index is probably due to the absence of very small trash particles that were not readily separated in cleaning the fiber. The low nep count for Treatment A probably was partly responsible for the increased yarn appearance index.

The effect of the intermediate irrigation frequencies on these yarn and fiber properties is insignificant, and it would appear that if extremes in the frequency of irrigation are avoided, the grower will not materially affect fiber quality.

The timing of the last irrigation as affecting fiber and yarn properties is apparently insignificant when the crop as a whole is considered. Lint samples for these tests were taken from machine-picked cotton. However, damage to many late bolls was quite evident where the water was cut off on the earliest dates, and the results of fiber tests made on lint from these late bolls did show some reduction in fiber length. These pinched bolls constituted such a small fraction of the total crop that they did not measurably affect these fiber and yarn properties.

J. R. Stockton is Assistant Specialist in Irrigation, University of California, Davis.

L. D. Doneen is Professor of Irrigation, University of California, Davis.

The above progress report is based on Research Project No. 918.

COTTON

Continued from page 9

the Shafter region are: J. Flowering beginning in late June and reaching a high rate, with usually 90% of the total flowers produced by early August in approximately 50 days. After that time, flowering is reduced to a slow rate or ceases altogether by early September. 2. Boll setting proceeds rapidly early in the season but is reduced to a slow rate after 45 days. The rapid decrease in boll set is called the cutout, and when it occurs, the vegetative and fruiting buds do not develop. However, the large number of bolls retained preceding the cutout continue to grow. Basic causes of cutout and the physiological shedding throughout the season are not fully understood, except that they are related to the fruiting-vegetative status of the plant. Growth resumes when the bolls mature.

This study was made on the three treatments G, B2, and I. A number of measurements were made on the cotton plant to evaluate the timing of the last irrigation. The treatments were timed to correspond to varying degrees of cutout. Treatment G—last irrigation August 10—was timed for the early part of the cutout, with the last irrigation August 31; and Treatment I—last irrigation September 27—when complete cutout occurred.

The last irrigation at beginning of cutout, Treatment G—August 10—reduced yields 15% below Treatments B2 and I, and the continuation of irrigation to September 27 did not increase yield. As far as fruit production is concerned, cutout occurred toward the end of August.

Natural defoliation of 80% had occurred by September 20 in Treatment G; 20% in B2 and negligible in Treatment I when plants were still being irrigated on September 20. Moisture stresses occurred sooner following the last irrigation August 10 than for the other two treatments, due to higher temperatures in August than in September.

The continuation of irrigation after cutout commenced in August 31 or September 27 resulted in a range of lodging from some to much. Lodging was absent in Treatment G, with the last irrigation on August 10. Plant heights were nearly the same for all treatments at harvest.

Boll opening was hastened in proportion to the timing of the last irrigation. Treatment G showed 87% of the bolls opened—2.31 bales—while Treatment B2 had 78%—2.31 bales—and Treatment I had 50%—1.51 bales—opened.

Ample soil moisture and lack of sunlight were probably responsible for the slow opening of the mature bolls in the late irrigated plots with dense foliage and where extensive lodging occurred by September 20.


B. Counts is Agronomist, U.S.D.A., U.S. Cotton Field Station, Shafter.

The above progress report is based on Research Project No. 1582.

The Effect of Different Levels of Growth, Flower Production, Boll Retention, and Boll-Leaf Ratios in Cotton at Shafter, 1955.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant height, inches</th>
<th>Number of flowers</th>
<th>Number of bolls</th>
<th>Percent retention</th>
<th>Number leaves per boll</th>
<th>Bolls per lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>28.7</td>
<td>1364</td>
<td>573</td>
<td>42.0</td>
<td>4.9</td>
<td>68</td>
</tr>
<tr>
<td>C</td>
<td>35.0</td>
<td>1876</td>
<td>639</td>
<td>36.1</td>
<td>4.8</td>
<td>61</td>
</tr>
<tr>
<td>B</td>
<td>37.4</td>
<td>2211</td>
<td>639</td>
<td>26.9</td>
<td>5.1</td>
<td>61</td>
</tr>
<tr>
<td>E</td>
<td>40.6</td>
<td>2124</td>
<td>631</td>
<td>30.4</td>
<td>...</td>
<td>64</td>
</tr>
</tbody>
</table>

The Effect of Time of Last Irrigation on Natural Defoliation, Boll Opening, and Lodging at Shafter, 1955.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Natural Defoliation—%</th>
<th>Boll Opening—%</th>
<th>Lodging</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>Aug. 10 ... 80 80 80</td>
<td>Aug. 10 ... 85 87 98</td>
<td>Sept. 27 50 66 84</td>
</tr>
<tr>
<td>B</td>
<td>Aug. 31 ... 0 20 20</td>
<td>Aug. 31 ... 60 78 89</td>
<td>Sept. 27 31 50 84</td>
</tr>
<tr>
<td>I</td>
<td>Sept. 27 ... 0 0 0</td>
<td>Sept. 27 ... 60 78 89</td>
<td>Sept. 27 50 66 84</td>
</tr>
</tbody>
</table>

COTTON

Continued from page 9

the Shafter region are: J. Flowering beginning in late June and reaching a high rate, with usually 90% of the total flowers produced by early August in approximately 50 days. After that time, flowering is reduced to a slow rate or ceases altogether by early September. 2. Boll setting proceeds rapidly early in the season but is reduced to a slow rate after 45 days. The rapid decrease in boll set is called the cutout, and when it occurs, the vegetative and fruiting buds do not develop. However, the large number of bolls retained preceding the cutout continue to grow. Basic causes of cutout and the physiological shedding throughout the season are not fully understood, except that they are related to the fruiting-vegetative status of the plant. Growth resumes when the bolls mature.

This study was made on the three treatments G, B2, and I. A number of measurements were made on the cotton plant to evaluate the timing of the last irrigation. The treatments were timed to correspond to varying degrees of cutout. Treatment G—last irrigation August 10—was timed for the early part of the cutout, with the last irrigation August 31; and Treatment I—last irrigation September 27—when complete cutout occurred.

The last irrigation at beginning of cutout, Treatment G—August 10—reduced yields 15% below Treatments B2 and I, and the continuation of irrigation to September 27 did not increase yield. As far as fruit production is concerned, cutout occurred toward the end of August.

Natural defoliation of 80% had occurred by September 20 in Treatment G; 20% in B2 and negligible in Treatment I when plants were still being irrigated on September 20. Moisture stresses occurred sooner following the last irrigation August 10 than for the other two treatments, due to higher temperatures in August than in September.

The continuation of irrigation after cutout commenced in August 31 or September 27 resulted in a range of lodging from some to much. Lodging was absent in Treatment G, with the last irrigation on August 10. Plant heights were nearly the same for all treatments at harvest.

Boll opening was hastened in proportion to the timing of the last irrigation. Treatment G showed 87% of the bolls opened—2.31 bales—while Treatment B2 had 78%—2.31 bales—and Treatment I had 50%—1.51 bales—opened.

Ample soil moisture and lack of sunlight were probably responsible for the slow opening of the mature bolls in the late irrigated plots with dense foliage and where extensive lodging occurred by September 20.


B. Counts is Agronomist, U.S.D.A., U.S. Cotton Field Station, Shafter.

The above progress report is based on Research Project No. 1582.

The Effect of Different Levels of Growth, Flower Production, Boll Retention, and Boll-Leaf Ratios in Cotton at Shafter, 1955.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant height, inches</th>
<th>Number of flowers</th>
<th>Number of bolls</th>
<th>Percent retention</th>
<th>Number leaves per boll</th>
<th>Bolls per lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>28.7</td>
<td>1364</td>
<td>573</td>
<td>42.0</td>
<td>4.9</td>
<td>68</td>
</tr>
<tr>
<td>C</td>
<td>35.0</td>
<td>1876</td>
<td>639</td>
<td>36.1</td>
<td>4.8</td>
<td>61</td>
</tr>
<tr>
<td>B</td>
<td>37.4</td>
<td>2211</td>
<td>639</td>
<td>26.9</td>
<td>5.1</td>
<td>61</td>
</tr>
<tr>
<td>E</td>
<td>40.6</td>
<td>2124</td>
<td>631</td>
<td>30.4</td>
<td>...</td>
<td>64</td>
</tr>
</tbody>
</table>

The Effect of Time of Last Irrigation on Natural Defoliation, Boll Opening, and Lodging at Shafter, 1955.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Natural Defoliation—%</th>
<th>Boll Opening—%</th>
<th>Lodging</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>Aug. 10 ... 80 80 80</td>
<td>Aug. 10 ... 85 87 98</td>
<td>Sept. 27 50 66 84</td>
</tr>
<tr>
<td>B</td>
<td>Aug. 31 ... 0 20 20</td>
<td>Aug. 31 ... 60 78 89</td>
<td>Sept. 27 31 50 84</td>
</tr>
<tr>
<td>I</td>
<td>Sept. 27 ... 0 0 0</td>
<td>Sept. 27 ... 60 78 89</td>
<td>Sept. 27 50 66 84</td>
</tr>
</tbody>
</table>

CALIFORNIA AGRICULTURE, JULY, 1955 11