Some Growth Factors Affecting the Survival of Cotton Bolls

By Jack Fleischer

As part of the cotton forecasting research reported by Hendricks and Huddleston elsewhere in this issue, intensive studies are conducted in an attempt to make more accurate predictions of the quantity of immature fruit on the plants, as of a given date, which will develop to maturity and contribute to final yield. Those studies are concerned with tracing life histories of individual bolls and trying to find out how various factors affect probabilities of survival of those bolls. Mr. Fleischer, whose institution is cooperating in these studies, here reports on one phase of the problem.

The problem of forecasting yield throughout the growing season is essentially a question of forecasting the number of bolls produced, making allowances, when necessary, for fruit still to be formed, and for fruit damaged by weevil, disease, and other causes.

For the August 1 forecast, it is necessary to count the fruit on the plant and to make an allowance for blooms and small bolls still to be added between August 1 and September 1. Apparently this can be done successfully by (1) taking observations on the stage of maturity of the plants, as reflected by the various categories of fruit found to be present on that date, and (2) making use of known relationships between the categories of fruit present and the ultimate total fruit load that the plant is able to carry.

For a forecast as of September 1 or any later date, it is necessary only to count the blooms and bolls already on the plants and to make necessary allowance for the losses that will probably occur between that date and harvest time.

In an effort to learn something about factors that may affect the growth and survival of cotton bolls, which would be useful in making a cotton forecast as of August 1, a detailed study was carried out on a subsample of cotton fields in the Eighth Crop Reporting District of North Carolina in 1955. The procedure consisted of tagging small cotton bolls 1 as of August 1 with different colored tags according to the position of the bolls on the plants.

On about September 1 these bolls (now large), thus identified, were counted again to learn how many still remained on the plants. At the same time other large bolls, not previously tagged, were tagged with different colored tags to identify the age of the bolls. New small bolls on the plants were marked with still other tags. At harvest, bolls from which cotton was picked in each of the categories were counted and relationships were established between the number of bolls harvested and the number of bolls tagged at specified dates during the growing season.

The identifying tags and the bolls to which they apply are listed below:

1. Medium white tag—Small bolls present August which were backed up 2 by one or more other small bolls.
2. Medium red tag—Small bolls present August 1 which were backed up by one or more squares.
3. Medium yellow tag—Small bolls present August 1 which were not backed up by either another small boll or square.
4. Large white tag—Open bolls present September 1, not previously tagged.
5. Large yellow tag—Open bolls present September 1, not previously tagged.
6. Small white tag—Small bolls present September 1, backed up by one or more other small bolls.
7. Small red tag—Small bolls present September 1, backed up by one or more squares.
8. Small yellow tag—Small bolls present September 1, not backed up by another small boll or square.

Each hill of cotton on which the tagging was done was the first full hill beyond 10 feet of the first row of a randomly selected 10-foot double-row plot. There were 3 such hills per field and 100 fields, giving a sample of 300 hills. Because blank areas in a field never had a chance to come into the sample, no expansions to universe levels were made.

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1. Any boll smaller than 1 inch in diameter was considered a small boll.

2. "Backed up by another boll" is defined as having another boll farther out toward the end of the branch.
from these data. The object of tagging was to find out whether there were significant differences in the behavior of the several categories and to investigate the contribution of each category to final yield.

The Tagging Counts

On August 1 there were 1398 small bolls, including blooms, on the 300 hills of cotton. Of these, 11 percent were backed up by one or more other small bolls (medium white tag), 65 percent were backed up by one or more squares (medium red tag), and 24 percent were not backed up by either another small boll or a square (medium yellow tag). On September 1, 79 percent of the small bolls counted as of August 1 remained on the plants, but the breakdown by categories was 92 percent of those with medium white tags, 83 percent of those with medium red tags, and 62 percent of those with medium yellow tags. Of the small bolls present on August 1 and still on plants September 1, 91 percent were harvested. The relative numbers by categories were 88 percent with white tags, 92 percent with red tags, and 91 percent with yellow medium tags.

Table 1.—Survival of cotton bolls by categories

<table>
<thead>
<tr>
<th>Tags</th>
<th>Aug. 1</th>
<th>Sept. 1</th>
<th>Harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium white</td>
<td>152</td>
<td>140</td>
<td>123</td>
</tr>
<tr>
<td>Medium red</td>
<td>905</td>
<td>753</td>
<td>690</td>
</tr>
<tr>
<td>Medium yellow</td>
<td>341</td>
<td>210</td>
<td>192</td>
</tr>
<tr>
<td>Subtotal</td>
<td>1,398</td>
<td>1,103</td>
<td>1,005</td>
</tr>
<tr>
<td>Large white</td>
<td>109</td>
<td>96</td>
<td>86</td>
</tr>
<tr>
<td>Large yellow</td>
<td>2,301</td>
<td>1,942</td>
<td>1,679</td>
</tr>
<tr>
<td>Small white</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Small red</td>
<td>41</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Small yellow</td>
<td>149</td>
<td>21</td>
<td>145</td>
</tr>
<tr>
<td>Subtotal</td>
<td>198</td>
<td>26</td>
<td>178</td>
</tr>
<tr>
<td>Grand total</td>
<td>1,398</td>
<td>3,771</td>
<td>3,079</td>
</tr>
</tbody>
</table>

Only 72 percent of the August 1 small bolls were eventually harvested. This group of bolls represented 33 percent of all the bolls that were finally harvested.

Large open bolls present on September 1 which were not previously tagged were almost entirely harvested (106 out of 109). This group represented only 3 percent of the total number of bolls finally harvested.

Because most of the 1955 cotton crop in North Carolina matured between August 1 and September 1, most of the bolls were not yet in the bloom stage by August 1, but were large bolls by September 1. There were 2,361 of these large bolls on the plants by September 1, and 82 percent of them made cotton. This group represented 63 percent of all the bolls eventually harvested.

The final group of bolls tagged on September 1 were small bolls as of that date. Only 13 percent of these eventually made cotton; 12 percent were backed up by one or more squares (small red tag), and 14 percent were not backed up by either another small boll or square. None of the bolls backed up by one or more small bolls (small white tag) made cotton. Only 26 of all the small bolls on September 1 eventually made cotton—less than 1 percent of the total bolls harvested.

Analysis of Results

The three categories of small bolls present August 1 were tested for differences by means of a chi-square test. The criterion used was numbers of tagged bolls that did or did not make cotton. A chi square of 55.607 with 2 degrees of freedom indicates highly significant differences among the three categories. The two categories of small bolls present August 1 that were backed up by (1) one or more other small bolls or (2) one or more squares were tested for differences. A chi-square value of 1.605 with one degree of freedom indicates no significant difference. Small bolls present August 1 might just as well have been placed into only two categories instead of three: (1) Those backed up by one or more other small bolls or one or more squares were tested for differences. A chi-square value of 1.605 with one degree of freedom indicates no significant difference. Small bolls present August 1 might just as well have been placed into only two categories instead of three: (1) Those backed up by one or more other small bolls or one or more squares and (2) those small bolls not backed up by either another small boll or square.

A chi-square test for the same three categories of small bolls present September 1 resulted in a chi square of 1.360 with 2 degrees of freedom. This is not significant; it indicates no detectable differences among the three categories. All small bolls around September 1 could have been put into one category.

Large bolls present September 1 were tested for differences among three categories: (1) Large bolls that were not yet blooms by August 1; (2) large bolls that were small bolls on August 1; and (3) large open bolls that were large unopen bolls on August 1. A chi square of 60.067 with 2 de-
degrees of freedom indicates highly significant differences among the three categories. Another test for a possible difference between the latter two categories resulted in a chi square of 4.880 with one degree of freedom. This is significant at about the 3 percent level.

These tests show that the use of three categories would be necessary. Large bolls present August 1 could be marked with tags different from those used on small bolls; those remaining on the plants by September 1 would then be large open bolls. With this category already tagged, only those large bolls present September 1, which were not previously tagged, could be tagged as a separate category.

In summary, five categories appear adequate for classifying bolls according to probability of survival:

1. Small bolls present August 1, backed up by either one or more other small bolls or one or more squares.
2. Small bolls present August 1, not backed up by either another small boll or square.
3. Large bolls present August 1.
4. Large bolls present September 1, not previously tagged.
5. All small bolls present September 1.

This experiment was performed during only one growing season and in only one crop reporting district of North Carolina. To evaluate the consistency of these results, information is needed for more years and for different locations.

As mentioned previously, 63 percent of the bolls that made cotton were squares on August 1. Hence any prediction equation developed for an August 1 yield forecast must include a square count in addition to boll counts.