Comparing the Last Effective Boll Populations in UNR and Conventional Cotton

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RESEARCH PROBLEM

Identification of the last effective boll population allows informed decisions for termination of insecticide and application of harvest aids. However, the current COTMAN cutout reference (i.e., NAWF=5) indicates physiological cutout (Oosterhuis et al., 1999) may need to be changed for ultra-narrow-row (UNR) cotton. This study is part of a multi-state project the overall objective of which is to determine the main-stem node number of the last effective boll population in UNR cotton as grown in a range of typical field environments, compared to wide-row cotton in those environments. This report describes the study conducted in northeast Arkansas in 2002.

BACKGROUND INFORMATION

A great deal of research has gone into COTMAN, the COTton MANagement system developed at the University of Arkansas (Danforth and O’Leary, 1998). Comparison with a target development curve (TDC) indicates when the crop is under stress. Identification of the last effective boll population allows informed decisions for termination of insecticide and application of harvest aids. Additional decisions (e.g., regarding irrigation, plant growth regulators, etc.) may soon be linked to observations from COTMAN.

COTMAN relies on empirical data obtained from wide-row cotton (i.e., 30- to 40-inch row spacing) that may not accurately reflect the boll population of UNR cotton (i.e., row spacing <~15 inches). Research in Arkansas indicated that the last effective boll population is set in wide-row cotton when there are five nodes above the highest first-position white flower (NAWF=5) (Bourland et al., 1992). Bolls set above this position (i.e., NAWF<5) are usually too small or too late in maturing to contribute signifi-

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cantly to yield. However, Gwathmey et al. (1999) reported that the current COTMAN cutout reference (i.e., NAWF=5) might need to be changed for UNR cotton. UNR cotton is typically much shorter, with fewer main-stem nodes and fewer bolls per plant than wide-row cotton. Studies with COTMAN in UNR cotton have produced crop development curves that differ markedly from wide-row cotton and from the COTMAN TDC (Gwathmey et al., 1999; Vories and Glover, 2002). A typical UNR curve has a low peak and an abrupt cutout, relative to wide-row cotton in the same environment. This suggests that NAWF=5 may not represent the last effective boll population in UNR, which may be set relatively higher on the plant than with wide rows.

Effective late-season management with COTMAN requires accurate identification of the last effective boll population. In addition to the observations with UNR cotton, other studies have indicated that growth curves and cutout for low nitrogen and mepiquat chloride-treated cotton differ from the TDC (Oosterhuis et al., 1999, 2001). In addition, growth curves for conventional cotton (unpublished data) suggest that the natural stresses resulting from growing in clay lead to a development curve different from the COTMAN TDC. Such observations have led to suggestions that a different NAWF value for cutout might be appropriate on those soils. The relatively small amount of cotton produced on such soils has precluded development of a separate TDC. However, if UNR cotton is going to expand cotton acreage, it must do so by allowing production of cotton on soils previously considered “marginal” cotton ground.

RESEARCH DESCRIPTION

A field study was conducted at the Northeast Research and Extension Center (NEREC) at Keiser on nonirrigated cotton (*Gossypium hirsutum* L. cv. PM 1218 BG/RR) in 2002 on Sharkey silty clay (Chromic Epiaquerts). The experimental design consisted of a randomized complete block with two systems, conventional cotton produced on 38-inch rows (CONV) and ultra-narrow-row cotton produced on 7.5-inch rows (UNR), with six replications. Plots were approximately 50 ft wide by 600 ft long. The CONV plots were planted on beds with a John Deere 1700 planter at a seeding rate of 5 seed/ft, resulting in 49,000 plants/acre; UNR plots were flat planted with a John Deere 750 grain drill and a seeding rate of 2.7 seed/ft, resulting in 105,000 plants/acre. Planting date was 21 May, with imidicloprid- (Gaucho) treated seed. Nitrogen was aerially applied at 125 lb N/acre as urea on both treatments on 25 June.

At first flower, 16 typical plants per plot were flagged for subsequent flower tagging, with all first-position flowers tagged every other day with date and NAWF. White flowers were tagged with the current day’s date; pink flowers were tagged with the previous day’s date. Tagging continued until 11 August. The tagged bolls were hand picked and the seedcotton was air-dried before weighing. Plots were machine harvested on 17 October. Eight rows from CONV were spindle picked, while an equivalent width (~25 ft) from UNR was harvested with a cotton stripper with a platform header.
RESULTS AND DISCUSSION

White flowers were first observed in CONV on 12 July, 52 days after planting (DAP), earlier than the 60 DAP for first flower on the COTMAN TDC (Table 1). The faster flowering was likely the result of waiting until 21 May for planting, after temperatures were warmer than typical for cotton planted earlier in the growing season. White flowers were first observed in UNR on 17 July, 57 DAP. The five-day delay in flowering was probably due to the flat planting for UNR.

A total of 754 flower tags were recovered, with 451 from CONV plots and 303 from UNR plots. Although NAWF on the TDC begins at 9.25 and declines at a rate of 0.2 per day, cotton in this study did not begin at as large NAWF value (Table 1). Regression analysis indicated a NAWF at first flower of 6.9 for the CONV plots and 4.7 for UNR. The value for UNR (4.7) is below the value normally associated with physiological cutout (5) and demonstrates the need for this research. In fact, only 29 of the 303 tags (<10%) recovered from UNR plots had NAWF 5, versus 47% for CONV. The rate of decline (slope) was not significantly different between treatments. The effective flowering period (period from first flower to NAWF=5) was 12 days for CONV, much less than the 20 days associated with the COTMAN TDC. However, drought stress probably affected the days to NAWF=5 and possibly the NAWF at first flower. Of the 754 flower tags recovered, 437 were associated with whole bolls, with 278 and 159 from CONV and UNR plots, respectively. Boll size was only significantly different for NAWF=4, with larger bolls for CONV (data not included).

Lint yields were not significantly different between UNR and CONV, with 555 and 519 lb/acre for UNR and CONV, respectively. Three-year average values of 33% and 29% for CONV and UNR, respectively, reported by Vories et al. (2001) were used for gin turnout because those values were associated with a commercial gin with lint cleaners. However, the NAWF associated with the yield differed between treatments (Fig. 1). Significantly more of the yield was associated with UNR from NAWF = 2, 3, and 4; while more was associated with CONV from NAWF = 5, 6, and 7. The contribution of other bolls, primarily second sympodial-position bolls, was not significantly different (33% and 25% for CONV and UNR, respectively).

The relationship between first-position white flower (hereafter called flower) number per plant and the associated NAWF was quite different between treatments (data not included). However, flowers per plant can be misleading due to the great difference in stand densities between treatments; therefore flowers per acre (Fig. 2) may be more indicative. For 1 NAWF 3, there were more flowers per acre for UNR. For 6 NAWF 7, CONV had more flowers per acre. Peak flower numbers were associated with NAWF = 2 and 5 for UNR and CONV, respectively. There was significantly higher retention of flowers with UNR for NAWF = 3 and 4 (Fig. 3).
PRACTICAL APPLICATION

Yield distribution of the plants was different between UNR and CONV, with 48% of UNR yield associated with NAWF = 3 and 4; 38% of CONV yield was associated with NAWF=5 and 6, and 33% with other than first position bolls. These data will be combined with data from similar studies at other locations to determine whether a different target development curve will be required for COTMAN with UNR cotton. However, with more of the UNR cotton’s yield coming from higher in the plant (NAWF<5), these preliminary findings suggest a different curve will be appropriate.

ACKNOWLEDGMENTS

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LITERATURE CITED

Summaries of Arkansas Cotton Research 2002

Table 1. Nodes above white flower data from tagged flowers from ultra-narrow-row cotton study at the University of Arkansas Northeast Research and Extension Center at Keiser in 2002.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>NAWF equationx</th>
<th>First flowerz</th>
<th>NAWF=5</th>
<th>Eff. flowering periodw</th>
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<tbody>
<tr>
<td></td>
<td>Slope Intercept</td>
<td>DAP NAWF DAP</td>
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<tr>
<td>CONV</td>
<td>-0.163 15.4</td>
<td>52 6.9 64</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>UNR</td>
<td>-0.158 14.0</td>
<td>59 4.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD (0.05)x</td>
<td>NS</td>
<td>60 9.25 80</td>
<td>20</td>
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</tr>
</tbody>
</table>

v Peak value < 5, so NAWF=5 and effective flowering period undefined.

w Effective flowering period = days from first flower to NAWF=5.

y NAWF = slope*DAP + intercept; DAP = days after planting.

x First flower: DAP observed for plots; NAWF@ first flower and DAP @ NAWF=5 calculated from NAWF equation.

z CONV produced in 38-inch rows, UNR produced in 7.5-inch rows.

Table: Nodes Above White Flower

<table>
<thead>
<tr>
<th>Nodes Above White Flower</th>
<th>CONV</th>
<th>UNR</th>
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<tbody>
<tr>
<td>1</td>
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<tr>
<td>Other</td>
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</table>

Fig. 1. Distribution of yield by nodes above white flower from ultra-narrow-row cotton study at the Northeast Research and Extension Center at Keiser in 2002. CONV produced in 38-inch rows and UNR produced in 7.5-inch rows. "Other" bolls were collected from somewhere other than first sympodial fruiting position. Nodes with *** represent a significant difference between treatments at alpha = 0.05.
Fig. 2. First-position white flowers per acre by nodes above white flower from ultra-narrow-row cotton study at the Northeast Research and Extension Center at Keiser in 2002. CONV produced in 38-inch rows and UNR produced in 7.5-inch rows. Nodes with * represent a significant difference between treatments at alpha = 0.05.

Fig. 3. First-position white flower retention by nodes above white flower from ultra-narrow-row cotton study at the Northeast Research and Extension Center at Keiser in 2002. CONV produced in 38-inch rows and UNR produced in 7.5-inch rows. Nodes with * represent a significant difference between treatments at alpha = 0.05.