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COMPARING THE TIMING OF THE LAST EFFECTIVE BOLL POPULATIONS IN UNR AND CONVENTIONAL COTTON

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Abstract

Effective late-season management with COTMAN, the COTton MANagement system developed at the University of Arkansas, requires accurate identification of the last effective boll population. A nonirrigated cotton study was conducted at the University of Arkansas Northeast Research and Extension Center at Keiser on Sharkey silty clay (Chromic Epiaquerts) to compare ultra narrow row (UNR) to conventional, 38-inch (CONV) production. White flowers were tagged throughout the bloom period and bolls were mapped at harvest. Nodes above white flower (NAWF) at first flower averaged 8.5 and 6.5 for the CONV and UNR plots, respectively, lower than the 9.25 for the COTMAN target development curve (TDC). NAWF=5 averaged 67 and 62 DAP for the CONV and UNR plots, respectively, less than the 80 DAP for the COTMAN TDC. Significantly more flowers per acre were associated with UNR for $1 \leq$ NAWF ≤ 3, and with CONV for $6 \leq$ NAWF ≤ 8. UNR plots yielded more than CONV, with 51% of UNR yield associated with NAWF = 3 and 4; 31% of CONV yield was associated with other than first position bolls. Findings will be compared with similar data from other locations to determine whether a different target development curve is required for UNR cotton.

Introduction

Discussions with producers, landlords and gin owners indicate that many would like to be able to produce cotton on land that has not been historically considered "cotton ground." Whether it is allowing another rotation alternative, increased rent or more gin customers, practically everyone would like to expand the land available for cotton production. In a world of six-row cotton pickers, the reduced equipment requirements for ultra narrow row (UNR) cotton may represent the only feasible system for smaller producers to grow cotton. Even if discounts for stripper-harvested cotton continue, the economics may favor UNR cotton over nonirrigated soybean or grain sorghum production.

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., irrigation, PGR, etc.) may soon be linked to observations from COTMAN.

COTMAN relies on empirical data obtained from wide-row cotton that may not accurately reflect the boll population of UNR cotton. 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 significantly to yield. However, Gwathmey et al. (1999) reported that the current COTMAN cutout reference (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. Exploratory 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, 2001). A typical UNR curve has a low peak and an abrupt cutout, relative to wide-row cotton in the same environment. The area under the UNR curve is less than proportional to yield. This suggests that NAWF=5 does 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, previous observations of 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.

Objective

This study is part of a multi-state project whose overall objective 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 2001.

Materials and Methods

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 2001 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 per ft, while UNR plots were flat planted with a John Deere 750 grain drill and a seeding rate of 2.7 seed per ft. Planting date was 29 May, with imidicloprid- (Gaucho) treated seed. Nitrogen was aerially applied at 128 lb N/acre as urea on both treatments on 2 July.

At first flower, 15 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 24 August.

Plots were defoliated 20 September with a tank mix of 10 oz. product/acre tribufos (Def) and 2.0 lb a.i./acre ethephon (Prep). The tagged bolls were hand picked and the seedcotton was air-dried before weighing. Plots were machine harvested on 9 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.

All data were analyzed using the Statistical Analysis System (SAS). F-tests were considered significant at the 0.05 level of probability. The Fisher's Least Significant Difference test was used for mean separation.

Results and Discussion

White flowers were first observed in CONV on 21 July, 53 days after planting (DAP), and in UNR on 23 July, 55 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 29 May for planting, after temperatures were warmer than typical for cotton planted earlier in the growing season.

A total of 862 flower tags were recovered, with 545 from CONV plots and 317 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 and declined faster (Table 1). Regression analysis indicated a NAWF at first flower of 8.5 for the CONV plots and 6.5 for UNR. The rate of decline (slope) was not significantly different between treatments. The days from planting to NAWF=5 were 67 and 62 DAP for CONV and UNR, respectively, much less than the 80 DAP associated with the COTMAN TDC. However, drought stress probably affected the days to NAWF=5 and possibly the NAWF at first flower.

The relationship between first-position white flower (hereafter called flower) number per plant and the associated NAWF was quite different between treatments (Figure 1). No significant differences were observed for NAWF ≤ 3; however, significantly more flowers were observed for CONV for $4 \leq$ NAWF ≤ 8. No flowers were observed in UNR for NAWF ≥ 9. Flowers per plant can be misleading due to the great difference in stand densities between treatments (Table 2); therefore flowers per acre (Figure 2) may be more indicative. For $1 \leq$ NAWF ≤ 3, there were more flowers per acre for UNR. For $6 \leq$ NAWF ≤ 8, CONV had more flowers per acre. Peak flower numbers were associated with NAWF = 3 and 6 for UNR and CONV, respectively.

Of the 862 flower tags recovered, 444 were associated with whole bolls, with 314 and 130 from CONV and UNR plots, respectively. There was significantly higher retention of flowers with UNR for NAWF = 3 and 4 and with CONV for NAWF = 8 (Figure 3). Boll size was not significantly different for NAWF = 6 (Figure 4). Bolls were significantly larger for CONV for NAWF = 7 and 8.

Lint yields were significantly greater for UNR (Table 2; 620 and 540 lb/acre for UNR and CONV, respectively). Three-year average values reported by Vories et al. (2001) were used for gin turnout because those values were associated with a commercial gin with lint cleaners, 33% and 29% for CONV and UNR, respectively. However, the NAWF associated with the yield differed between treatments (Figure 5). Significantly more of the yield was associated with UNR from NAWF = 3 and 4; while more was associated with CONV from NAWF = 6 and 7. Other bolls, primarily second sympodial-position bolls, made up significantly more of the yield for CONV (31% and 17% for CONV and UNR, respectively).

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.

Conclusions

- NAWF at first flower averaged 8.5 and 6.5 for the CONV and UNR plots, respectively, lower than the 9.25 for the COTMAN TDC.
- NAWF=5 averaged 67 and 62 DAP for the CONV and UNR plots, respectively, less than the 80 DAP for the COTMAN TDC.
- Significantly more flowers per acre were associated with UNR for $1 \leq NAWF \leq 3$, and with CONV for $6 \leq NAWF \leq 8$.
- UNR plots yielded more than CONV, with 51% of UNR yield associated with NAWF = 3 and 4; 31% of CONV yield was associated with other than first position bolls.
- Findings will be compared with similar data from other locations to determine whether a different target development curve is required for UNR cotton.

Acknowledgment

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References

Bourland, F.M., D.M. Oosterhuis and N.P. Tugwell. 1992. Concept for monitoring cotton plant growth and development using main-stem node counts. J. Prod. Agric. 5:532-538.

Danforth, D.M. and P.F. O'Leary (ed.). 1998. COTMAN expert system version 5.0. Ark. Agric. Exp. Sta., Fayetteville, AR. 198 p.

Gwathmey, C.O., C.E. Michaud, R.D. Cossar, and S.H. Crowe. 1999. Development and cutout curves for ultra-narrow and wide-row cotton in Tennessee. p. 630-632. *In* Proc. Beltwide Cotton Conf., 3-7 Jan. 1999, Orlando, FL. Nat. Cotton Council, Memphis, TN.

Vories, E.D. 2001. Defining the COTMAN target development curve for ultra-narrow row cotton on clay soil. Report of Research to Cotton Inc., Project No. 00-836. 9 pp.

Vories, E.D., T.D. Valco, K.J. Bryant and R.E. Glover. 2001. Three-year comparison of conventional and ultra narrow row cotton production systems. Applied Engineering in Agric. 17(5) (in press).

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 2001.

	NAWF Equation[b]		**First Flower**[c]		**NAWF=5**[c]
Treatment[a]	**slope**	**intercept**	**DAP**	**NAWF**	**DAP**
CONV	-0.260	22.3	53	8.5	67
UNR	-0.224	18.8	55	6.5	62
LSD (0.05)[d]	N.S.	2.9			
TDC[e]	-0.2125	22	60	9.25	80

[a] CONV produced in 38-inch rows, UNR produced in 7.5-inch rows
[b] NAWF = slope*DAP + intercept; DAP = days after planting
[c] First Flower: DAP observed for plots; NAWF @ first flower and DAP @ NAWF=5 calculated from NAWF equation
[d] Fisher's least significant difference for comparing treatment means at alpha=0.05
[e] TDC = COTMAN Target Development Curve

Table 2. Stand density and lint yield from ultra narrow row cotton study at the Northeast Research and Extension Center at Keiser in 2001.

Treatment[a]	Parameter Value
	Stand Density (thousand plants/acre)
CONV	41
UNR	115
LSD(0.05)	11
	Lint Yield (lb/acre)[c]
CONV	540
UNR	620
LSD(0.05)	80

[a] CONV produced in 38-inch rows and spindle picked, UNR produced in 7.5-inch rows and stripped

[b] Fisher's least significant difference for comparing treatment means at alpha=0.05

[c] Gin turnout of 33% for CONV and 29% for UNR, based on 3-year average reported by Vories et al. (2001)

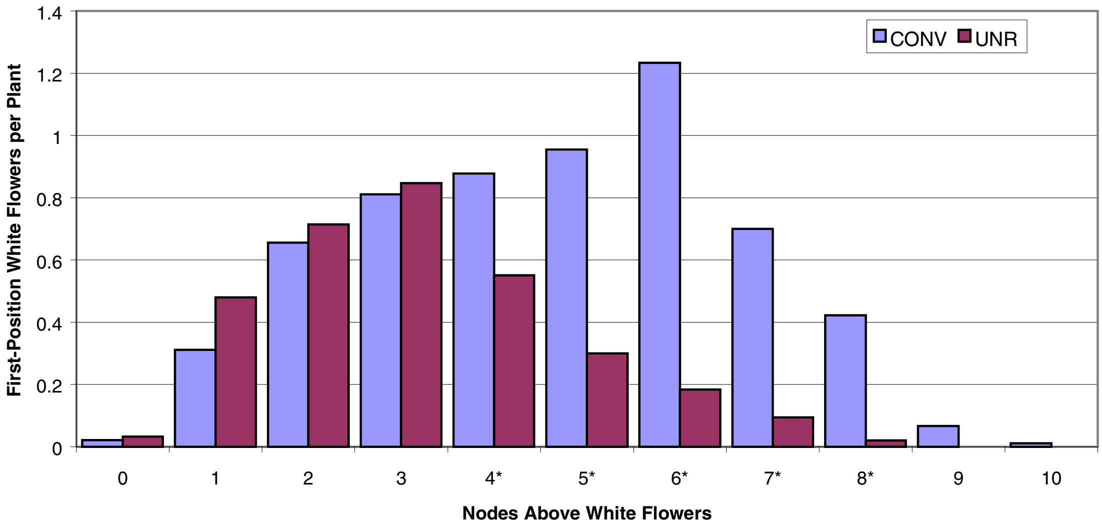

Figure 1. First-position white flowers per plant by nodes above white flower from ultra narrow row cotton study at the Northeast Research and Extension Center at Keiser in 2001. CONV produced in 38-inch rows and UNR produced in 7.5-inch rows. Nodes with "*" represent a significant difference between treatments at alpha = 0.05.

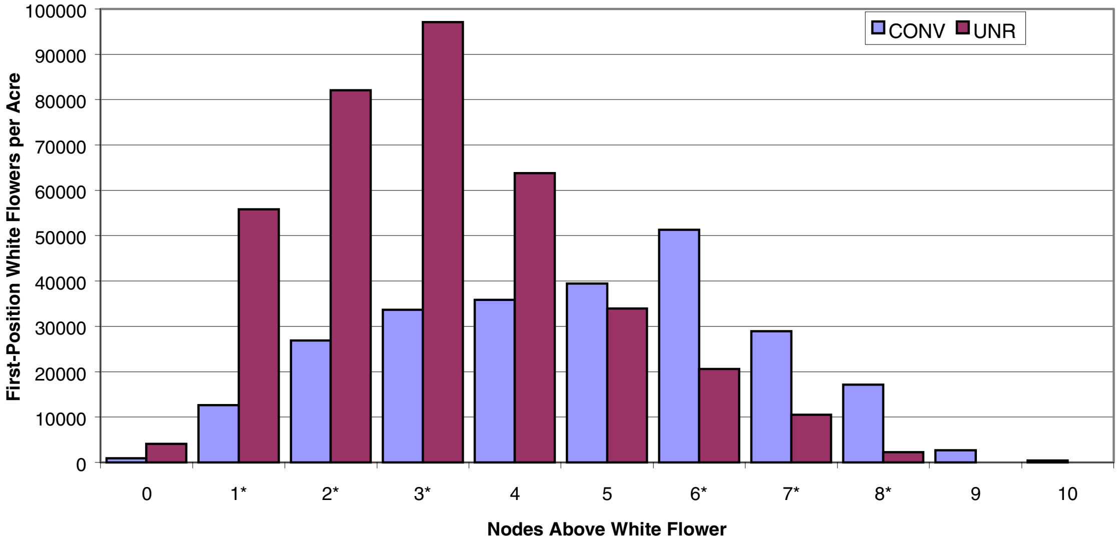

Figure 2. First-position white flowers per acre by nodes above white flower from ultra narrow row cotton study at the Northeast Research and Extension Center at Keiser in 2001. CONV produced in 38-inch rows and UNR produced in 7.5-inch rows. Nodes with "*" represent a significant difference between treatments at alpha = 0.05.

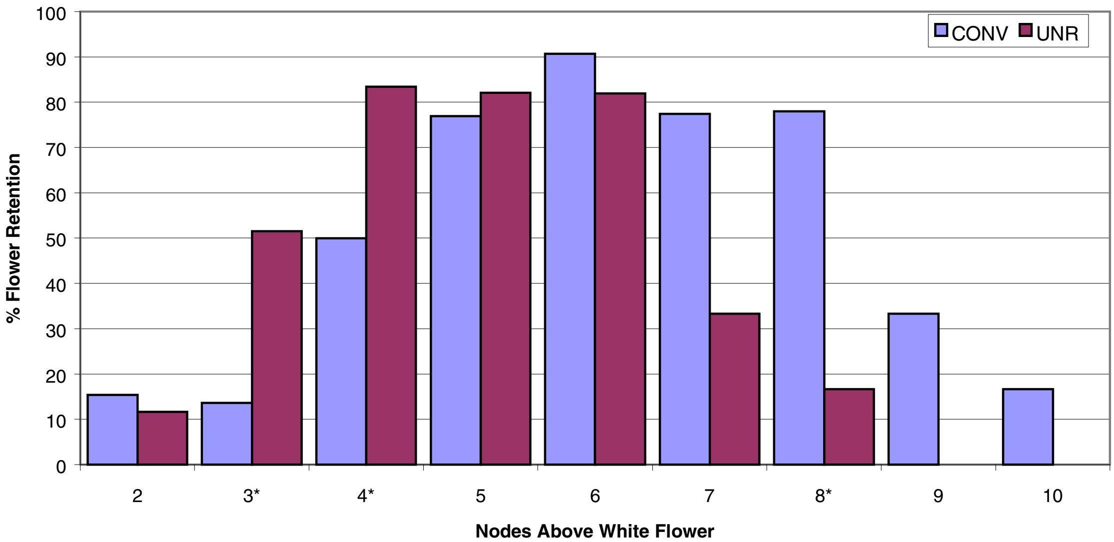

Figure 3. First-position white flower retention by nodes above white flower from ultra narrow row cotton study at the Northeast Research and Extension Center at Keiser in 2001. CONV produced in 38-inch rows and UNR produced in 7.5-inch rows. Nodes with "*" represent a significant difference between treatments at alpha = 0.05.

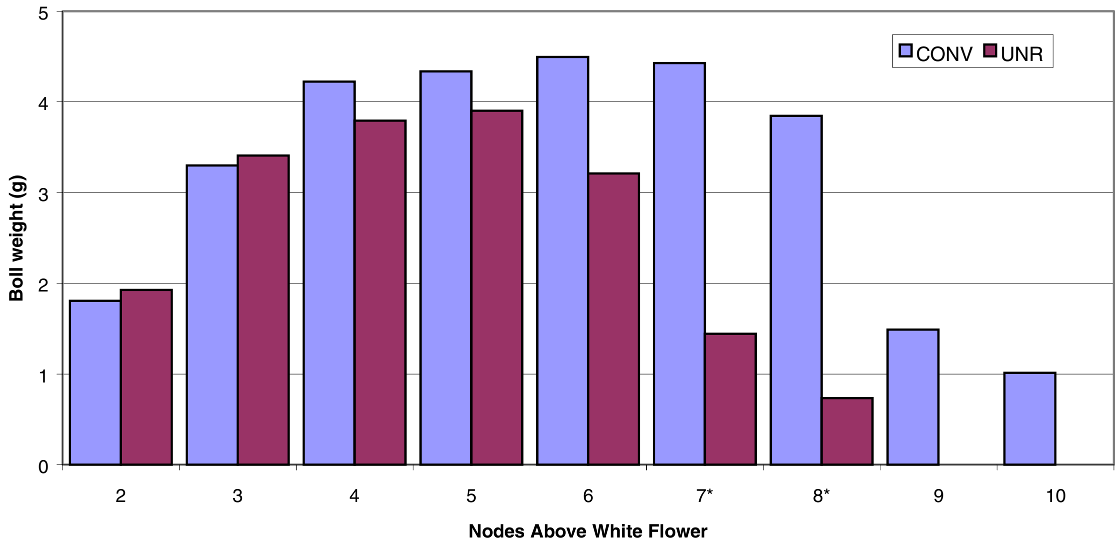

Figure 4. Boll weight for first-position white flowers by nodes above white flower from ultra narrow row cotton study at the Northeast Research and Extension Center at Keiser in 2001. CONV produced in 38-inch rows and UNR produced in 7.5-inch rows. Nodes with "*" represent a significant difference between treatments at alpha = 0.05.

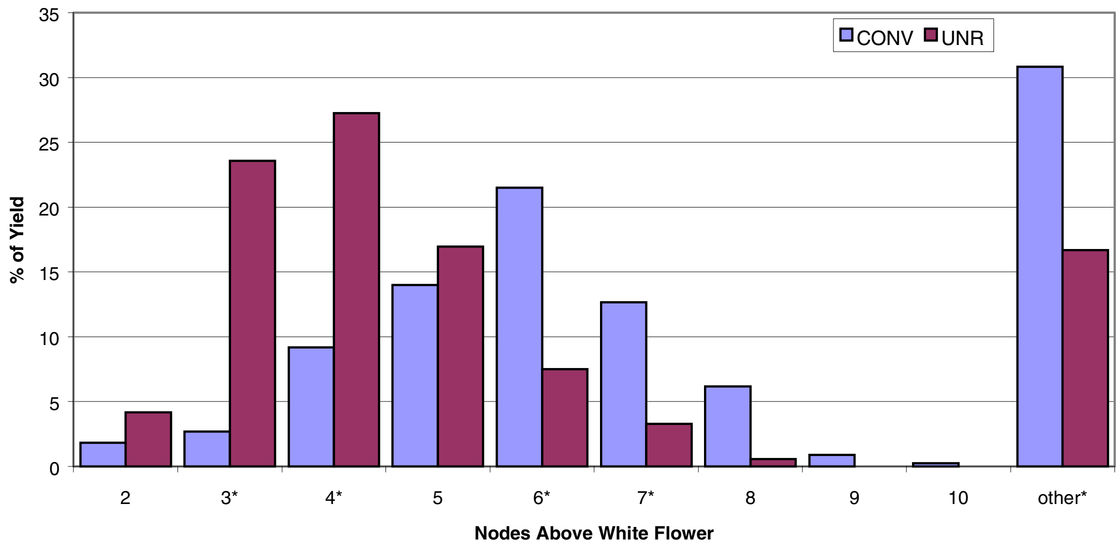

Figure 5. Distribution of yield by nodes above white flower from ultra narrow row cotton study at the Northeast Research and Extension Center at Keiser in 2001. CONV produced in 38-inch rows and UNR produced in 7.5-inch rows. "Other" bolls were collected from somewhere other than first sympodial position. Nodes with "*" represent a significant difference between treatments at alpha = 0.05.