Ultra-Narrow-Row Systems of No-Till Cotton Production: Research Progress in Tennessee

C. Owen Gwathmey and Robert M. Hayes
University of Tennessee

Abstract: Recent progress in production technology warrants a re-evaluation of ultra-narrow-row (UNR) cotton in West Tennessee. Three field studies were conducted at the Milan (TN) Experiment Station in 1995 to evaluate UNR systems of no-till cotton production. Lint yields of 'Deltapine 20' were higher in stripped 10" and 20" wide rows than in spindle-picked 20" or 40" rows, despite lower gin turnouts from the stripped plots. Pix increased lint yields most in UNR (10" rows). Trash percentage was higher in lint from stripped than picked plots. Other HVI fiber properties were not affected by row spacing or harvest method. Two picker varieties (Deltapine 20 and Stoneville 132) had higher lint yields, gin turnouts, and micronaire than two stripper varieties (Hyperformer HY007 and Paymaster HS200) in stripped 10" rows. Row spacing did not affect weed biomass or lint yields of 'Chembred 830' grown in 7.5" and 40" rows. Over-the-top weed control was most effective in UNR and wide-row cotton. More research is needed on harvesting technology and economics of UNR to complement these ongoing studies.

Introduction

Cotton performance in ultra-narrow rows (UNR) was evaluated by the University of Tennessee in the early 1970's (Rugh et al., 1973; Hoskinson et al., 1974). Those researchers concluded that UNR cotton offered few advantages to West Tennessee farmers with the technology available at that time. Progress in production technology since then warrants reevaluation of UNR cotton. New technologies include no-till cotton production methods, earlier-maturing cultivars, improved over-the-top herbicide systems, growth regulators such as mepiquat chloride (Pix), and HVI classing procedures.

Meanwhile, rising costs of producing and harvesting picker cotton have revived interest in alternative production systems. More economical cotton production is especially needed in erodible upland fields where no-tillage is being adopted, but where yields are below average. One alternative to traditional row cropping involves drill planting of cotton, as has been widely adopted for soybeans in Tennessee. Cotton grown in UNR (10" or less) may enhance erosion control in no-tillage and may also compete better with certain weed species than cotton in traditional 40" rows. UNR cotton is harvested with a finger stripper that has a single wide-swath header instead of a 4- or 5-row spindle picker.

Current studies in Tennessee are intended to evaluate performance of ultra-narrow-row systems of no-till cotton production as influenced by row spacing, weed competition, Pix, and harvest method.

Materials and Methods

Field experiments were conducted at the Milan (TN) Experiment Station in 1994 and 1995, using notillage. The 1994 pilot study was intended to evaluate effects of row spacing, Pix, weed competition, and harvest method. It was planted on 10 May, but replanted on 2 June due to poor stands. Little weed competition occurred in this study, and results are not reported here.

Three UNR field experiments were conducted at Milan Experiment Station in 1995: a row spacing study, a test of varietal adaptation to UNR, and a study of weed competition in drilled and row-planted cotton. All of these studies used University of Tennessee recommendations for no-till cotton production (Shelby and Bradley, 1995). The 1995 study of row spacing, Pix (mepiquat chloride), and harvest method was planted on 10 May on a Loring silt loam soil. In this study, 'Deltapine 20' was planted in 10", 20", and 40" rows as main plots, using a Kinze tandem planter. Multiple Pix applications (totalling 0 and 0.08 lb ai./acre) were subplot treatments in a RCB split-plot arrangement. Row-spacing-by-harvest-method treatments included 10" and 20" rows harvested with an Allis Chalmers 760 finger stripper equipped with a bur extractor, and 20" and 40" rows harvested with a John Deere 9930 spindle picker. This experiment was harvested once on 7 October, after applications of harvest aids (thidiazuron and ethephon followed by paraquat and sodium chlorate) to all plots. Before picking 20"-row plots, plants between the two harvest rows were removed.

A study of varietal adaptation to UNR was planted with a Kinze tandem planter in 10" rows on 11 May 1995 on a Memphis silt loam soil. Two stripper varieties (Hyperformer HY007 and Paymaster HS200) were compared to two picker

C. Owen Gwathmey and Robert M. Hayes. Dept. of Plant and Soil Sci., Univ. of Tennessee. West Tenn. Exp. Station. 605 Airways Blvd., Jackson TN 38301. Phone: 901-424-1643. Fax: 901-425-4760.

varieties (Deltapine 20 and Stoneville 132), using a RCB design. Three blanket applications of Pix, totalling 0.04 lb a.i./acre, limited plant height to less than 30 inches. Harvest aids consisted of a defoliant (thidiazuron) and boll opener (ethephon) applied on 7 September, and desiccants (paraquat and sodium chlorate) applied on 15 September. This experiment was harvested with an Allis Chalmers 760 finger stripper on 27 September.

A study of weed control in drilled and row-planted cotton was planted on 12 May 1995 on a Memphis silt loam soil. A stripper cotton variety, Chembred 830, was planted with a John Deere 750 drill in 7.5" rows and with a no-till planter in 40" rows. Three levels of weed control treatments were applied: low (Prowl [pendimethalin] at 1 lb a.i./acre); medium ("low" plus Cotoran [fluometuron] at 1.5 lb a.i./acre); and high ("medium" plus Staple [pyrithiobac] at 0.06 lb a.i./acre, Poast [sethoxydim] at 0.28 lb a.i./acre, and 32 oz crop oil concentrate/acre). Treatments were arranged in a RCB split-plot, with row spacing and corresponding harvest method as main-plot treatments, and weed control as subplot treatments. Aboveground fresh weed biomass from a 33 ft^2 area of each plot was weighed on 10 August. Harvest aids were applied to all plots prior to harvest as in the other studies described above. Drilled plots were harvested with an Allis Chalmers 760 finger stripper on 9 October, and row-planted plots were harvested on 9 and 30 October with a John Deere 9930 spindle picker.

For all experiments. seed cotton harvested from each plot was weighed and a subsample of seed cotton was collected, weighed, and air dried. In the row spacing study, subsamples were bulked across Pix treatments. Gin turnout was determined using a 20-saw gin equipped with two lint cleaners at the West Tennessee Experiment Station. Lint yield of each plot was calculated using seedcotton weight, gin turnout, and harvested area. Fiber properties of lint samples were determined by HVI procedures at the USDA-AMS Cotton Classing Office in Memphis TN.

Results and Discussion

Row Spacing Study

Plant populations per acre averaged 79,000 in 10" rows, 60,000 in 20" rows, and 36,000 in 40" rows. Effects of row width were thus due in part to plant population. Plant height did not vary significantly with row width, but Pix reduced average maximum height from 39" to 26".

Main effects of row spacing, harvest method, and Pix on lint yields were significant (Table 1). Cotton in 10" or 20" stripped plots yielded more than 20" or 40" picked plots, but yields did not differ between 10" and 20" rows. Yield differences between stripped and picked 20" rows (999 and 846 lbs lint/acre respectively) may be attributed to differences in machine harvesting efficiency, as gin turnouts averaged 31% in stripped plots and 36% in picked plots (Table 2). Picked 20" rows outyielded 40" rows by 30%, possibly due to lower leaf area and fewer bolls/acre in 40" rows, especially at first position sites (data not shown). Lint yields were significantly higher in Pix-treated, stripped 10" and 20" rows (at 1021 and 1034 lb/ac respectively) than in picked 20" or 40" rows with or without Pix (Table 1). The greatest yield response to Pix (12%) occurred in 10" rows.

Gin turnout and fiber quality were strongly influenced by harvest method, but not by row spacing (Table 2). Although gin turnouts from stripped plots were lower than from picked plots, they were relatively high by stripper cotton standards due to efficacy of the harvest aids applied, dry weather at harvest, and bur extraction by the harvester. These same factors ameliorated fiber quality of finger stripped cotton. HVI trash percentage was significantly higher in lint from stripped (1.0%) than picked (0.5%) plots. Yellowness of fiber (+b) was also slightly higher in lint from stripped plots, but this did not change HVI color grade (41-3) appreciably. Other fiber quality traits measured were not significantly affected by row spacing or harvest method

Varietal Adaptation Study

Plant populations per acre averaged 78,000 in the 1O"rows of this study, and varieties did not differ significantly in plant stand.

The two picker varieties, ST 132 and DPL 20, had higher lint yields and gin turnouts in stripped 10" rows than the stripper varieties, HS 200 and HY 007 (Table 3). Some of the differences in lint yields among varieties may be attributed to gin turnout. Virtually all harvestable bolls were open at harvest, and favorable weather conditions at harvest maintained fiber quality in these varieties. Harvest aids were generally effective, but leaf dehiscence from Paymaster HS200 was incomplete. Consequently, trash percentage in HS200 lint was significantly higher than in the other varieties. The two stripper varieties had slightly more fiber length and strength, but lower micronaire than ST 132 and DPL 20.

Results are generally consistent with comparisons of picker and stripper varieties conducted by Hoskinson et al. (1974), who found that stripper varieties were no better adapted to UNR in Tennessee than high-yielding picker varieties.

Weed Control Study

Plant populations per acre of Chembred 830 averaged 98,000 in 7.5" rows, and 59,000 in 40" rows in this study.

Weed biomass and cotton lint yields were strongly influenced by the level of weed control, but not by row spacing (Table 4). Row spacing by weed interactions were not significant. An inverse relationship was observed between fresh weed biomass and lint yield. A low level of weed control resulted in 90% yield reduction due to weed competition in 40"rows, and a 66% yield reduction in 7.5" rows. A medium level of weed control also incurred a significant yield loss in either row spacing, relative to the maximum. These results suggest that despite crop competition, over-the-top weed control may be necessary for UNR cotton to achieve its yield potential.

Table 1. Lint yields of 'Deltapine 20' cotton as affected by row spacing, harvest method, and Pix in 1995.

Row Spacing	Harvest Method	Pix	Lint Yield
		lb a.i./acre	lb/acre
10-inch	Stripped	0	912
		0.08	1021
20-inch	Stripped	0	964
		0.08	1034
20-inch	Picked	0	844
		0.08	848
40-inch	Picked	0	625
		0.08	671
---------- Means across Pix Rates ----------			
10-inch	Stripped		967 a[1]
20-inch	stripped		999 a
20-inch	Picked		846 b
40-inch	Picked		648 c
---------- Means across Row Spacing and Harvest Method ----------			
		0	836 b
		0.08	893 a

Row spacing by Pix interaction is not significant (P = 0.31).
[1] Means within treatment groups that are followed by the same letter do not differ significantly at P = 0.05.

Table 2. Gin turnout and fiber properties of 'Deltapine 20' cotton as affected by row spacing and harvest method in 1995.

Row Spacing	Harvest Method	Gin Turnout	Micro-naire	Fiber Strength	Fiber Length	HVI Trash	Color Rd	Color +b
		%		g/tex	in.	%		
10-inch	Stripped	31.8 b	40 a	29.8 a	1.11 a	1.0 b	74 a	8.5 bc
20-inch	Stripped	30.9 b	41 a	27.9 a	1.09 a	1.0 b	74 a	8.7 c
20-inch	Picked	36.8 a	42 a	28.3 a	1.10 a	0.5 a	73 a	8.1 a
40-inch	Picked	35.5 a	41 a	30.2 a	1.12 a	0.6 a	74 a	8.3 ab
Mean		33.8	41	29.0	1.11	0.8	74	8.4
LSD (0.05)		2.8	ns	ns	ns	0.3	ns	0.3

Means within columns followed by the same letter do not differ significantly at P = 0.05.

Table 3. Lint yields, gin turnouts, and fiber properties of four cotton varieties grown in 10-inch rows in 1995.

Variety	Lint Yield	Gin Turnout	Micro-aire	Fiber Strength	Fiber Length	HVI Trash	Color Rd	Color +b
	lb/ac	%		g/tex	in.	%		
Picker varieties:								
ST 132	975 a	33.2 a	40 ab	30.3 b	1.11 b	0.9 a	74 b	8.3 a
DPL 20	930 ab	31.1 ab	42 a	28.7 c	1.11 b	0.9 a	77 a	8.2 a
Stripper varieties:								
HS 200	882 bc	29.8 bc	37 b	32.4 a	1.14 a	1.2 b	76 a	8.4 a
HY 007	807 c	28.8 c	37 b	32.0 a	1.12 ab	0.8 a	77 a	8.3 a
Mean	898	30.7	39	30.8	1.12	1.0	76	8.3
$LSD_{.05}$	84	2.2	3.3	1.5	0.02	0.3	1.8	ns

Means within columns followed by the same letter do not differ significantly at P = 0.05.

Table 4. Weed biomass and lint yields of 'Chembred 830' cotton as affected by row spacing and weed control in 1995.

Row Spacing	Harvest Method	Weed Control[1]	Weed Biomass[2]	Lint Yield
			T/acre	lb/acre
7.5 in.	Stripped	High	0.5	687
		Medium	6.5	426
		LOW	6.7	236
40 in.	Picked	High	0	742
		Medium	4.9	399
		Low	8.7	68
---------- Means across Weed Control ----------				
7.5 in.	Stripped		4.6 a	450 a
40 in.	Picked		4.6 a	403 a
---------- Means across Row Spacing and Harvest Method ----------				
		High	0.3 a	715 a
		Medium	5.7 b	412 b
		Low	7.7 b	152 c

Row spacing by weed control interactions are not significant (P>0.41). Means within treatment groups that are followed by the same letter do not differ significantly at P = 0.05.

[1] Low = 1 lb a.i. Prowl/acre;
Medium = "low" + 1.5 lb a.i. Cotoran/acre;
High = "medium" + 0.06 lb a.i. Staple, 0.28 lb a.i. Poast, and 32 oz crop oil concentrate/acre.

[2] Aboveground fresh weight in U.S. tons/acre.

Conclusions

These preliminary results suggest that UNR may offer an alternate cotton cropping system for some situations in Tennessee in the future. So far, UNR cotton appears compatible with no-tillage systems. It responds favorably to growth regulation with Pix and to over-the-top weed control. More research is especially needed on planting and harvesting technology, weed management, grade optimization, production economics, and marketing.

Acknowledgements

This research was partially supported by BASF Corporation. The authors appreciate the cooperation of the Milan Experiment Station staff in conducting these experiments.

References Cited

Hoskinson, P.E., J.A. Mullins, and T. McCutchen. 1974. Narrow Row Cotton in Tennessee. Univ. Tenn. Agric. Exp. Sta. Bull. 535. 22 pp.

Rugh, J.W., J.I. Sewell, K.E. Ducketf and J.A. Mullins. 1973. Effects of narrow rows on cotton fiber properties. Tenn. Farm&HomeSci. 88:11-13.

Shelby. P.P. and J.F. Bradley. 1995. No-Till Cotton Production. p. 8-10. *In* Cotton Production in Tennessee. Univ. Tenn. Agric. Ext. Service PB15 14. Knoxville, TN.