WHOLE FARM RETURN FOR NARROW SPINDLE PICKER ROW PATTERNS IN A NON-IRRIGATED ENVIRONMENT; FINAL REPORT

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Abstract

The introduction of John Deere PRO 12 VRS Picker unit allows growers to grow cotton in 15-inch rows. Thus growers have the opportunity to produce cotton in 15, 30, and 38-inch rows, with and without skipped rows. However, the number of acres one picker is capable of harvesting is dependent on the row width and skip row pattern planted. Hypothetical cotton farms were constructed for the Northeast "Hill area" (Verona and Falkner, MS) and the Northwest Mississippi Delta (Clarksdale, MS) to provide estimates of costs and returns for eight different row patterns: 1) 15-inch solid; 2) 15-inch in a 2x1 skip; 3) 15-inch rows in a 2x2 skip; 4) 30-inch solid; 5) 30-inch in a 2x1 skip; 6) 60-inch solid; 7) 38-inch solid; and 8) 38-inch in a 2x1 skip. Seeding rates were 4 seed/ft of row for all 38-inch rows and 3 seed/ft of row for all 30 and 15-inch row patterns. Revenues for each system were estimated using mini-gin (equivalent to a state-of-art commercial gin) turnout, lint yield and HVI fiber data from a two year (2004-2005) field study at Clarksdale, MS and four year (2003-2006) field studies for Verona and Falkner, MS, with Roundup Ready/BT cotton.

Machinery ownership costs were estimated for each row pattern system based on the annual capital recovery cost method. The farm size for each row pattern was determined by picker harvest swath width, picker rate of travel of 3.6 mph, picker field efficiency of 70% and 200 hrs of operation per picker. The new PRO 12 VRS spindle picker was assumed for the 15-inch systems while a conventional spindle picker was assumed for the other systems. Operating costs estimates did not include management and overhead. The eight-row pattern operating costs and whole farm net return estimates were made for each location.

The results indicated the 15-inch 2x2 skip row at both Hill locations and the 38-inch solid at a Northwest Delta location provided the highest whole farm net revenue of all row patterns. At both Hill locations, the 15-inch 2x2 skip-row pattern had 100% larger acreage, 44% lower machinery ownership cost per acre and $72 to $76/acre more net return than 15-inch solid. The Northwest Delta location indicated the 38-inch row pattern had 26% larger acreage, 24% lower machinery ownership cost per acre and $76/acre higher net return than 15-inch row solid. The lower machinery ownership cost per acre for the 15-inch 2x2 skip row hill locations and the 38-inch rows for the Northwest Delta location was related to the wider harvest swaths of 20 and 19 ft, respectively. The wider harvest swath allowed more acreage to be farmed for the 15-inch 2x2 skip row and 38-inch solid than 15-inch or 30-inch solid, which had harvest swath widths of 10 and 15 ft for the hills and delta, respectively. The 30-inch and 15-inch row solid for all locations ranked 7th and 8th in total whole net farm revenue. Therefore, when considering changing row configurations, one should not only consider the impact the selected row pattern will have on yield but also on picker harvesting capacity, the whole farm equipment operation efficiency and the total whole farm net revenue.

Introduction

Efficient cotton production for improved net returns is essential for cotton growers to maintain a competitive advantage in a global economy. UNR stripper cotton and skip row cotton production systems have been used as means for improving profitability. UNR cotton yields (Atwell 1996; Buehring et al., 2001; Nichols and Snipes 2002; Shurley et al., 2002) and net returns (Parvin et al., 2002; Shurley et al., 2002) were equal or higher than conventional

wide rows. However, the $.03 to $.05/lb discount for the fiber's (neps and trash) negative spinning quality; the inability to operate the finger strippers under high humidity or dampness in the mid-south; and the increased trash content have offset these advantages. The increased trash content in the material taken to the gin reduces gin-processing capacity (Brashears 1968; Mayfield 1999; Anthony et al., 1999; 2000). HVI fiber quality analysis showed no differences between spindle picker, brush stripper, and finger stripper harvested cotton in 10-inch rows (Anthony et al., 1999; 2000; Willcutt et al., 2001). However, their reports indicated the finger stripper samples had increased neps/gm (spinning flaws in making fabric). Therefore, stripper harvested UNR cotton is most often discounted 3 to 5 cents/lb of lint; plus any reductions for bark, trash, or preparation (Willcutt et al., 2001).

Reports indicated a skip row improves profitability especially when cotton prices are low (Hargett, 2000; Parvin et al., 2000, 2002; Jost et al., 2003; Fromme et al., 2004). The improved profitability is associated with savings of seed and "down-the-row" production input costs, such as seed, technology fees, chemicals costs, and fixed costs due to increased harvesting capacity (harvest more acres with same machine). However, seldom have economic return analysis in these reports been based on actual field side-by-side comparisons for lint yield, gin turnout, and lint value ($)/acre based on HVI fiber analysis. For growers to make an informed decision regarding solid row cotton versus skip row cotton, economic comparisons of actual field study data including yield, gin turnout, fiber quality, net lint price (based on HVI fiber data) and net returns above total specified cost are necessary.

Deere and Company's introduction of the new 15-inch row John Deere PRO 12 VRS spindle picker makes possible spindle picker production systems that not only approximate UNR stripper cotton systems, but also have the potential to maximize fiber spinning quality (lower neps and trash than for stripper harvested lint) while retaining the operational benefits of a spindle picker. This system also allows for possible 15-inch skip row combinations to reduce boll rot potential that can occur with UNR cotton in the rain belt. These PRO 12VRS units are capable of picking 15-inch rows (as well as other row widths from 30 to 40 inches) by the addition of an inline cutting unit to each standard picking unit. Each unit picks two rows by cutting one of the rows off and diverting it into the standing row. It is hypothesized that skip row combinations with this header can increase the "swath" width per header similar to conventional 30 or 38-inch skip row planting, while maintaining a more uniform plant spacing and thus lower harvesting cost with little or no negative effect on yield.

Research reports indicated the 15-inch solid row pattern resulted in greater lint yields than 30-inch or 38-inch rows (Buehring et al., 2004, 2005, 2006; Willcutt et al., 2004, 2005, 2006; Wilson et al., 2005; Stephenson et al., 2007; Reddy et al., 2007). However, a study (Buehring et al., 2005, 2006; Willcutt 2005, 2006) conducted in the Northwest Delta area of Mississippi in 2004-2005 indicated the 15-inch solid pattern lint yield was equal to 38-inch rows. Others have reported 15-inch skip row and 15-inch solid produced lint yield equivalent to 30 or 38-inch rows (Harrison et al., 2006; Balkcom et al., 2007; Gwathamey et al., 2007.)

Hypothetical whole farm cost and return analysis reported by Spurlock et al. (2006), using 2005 input prices, indicated the 15-inch 2x2 skip row pattern for the Mississippi Hill area allowed greater acreages to be farmed and showed higher net revenue than 15-inch solid cotton. For the Delta area, the 30-inch (2x1 skip) showed higher farm net returns than 15-inch solid and only slightly higher than the 38-inch row. The objective of this study was to estimate the revenue and production costs in a whole farm cotton enterprise system for 15-inch, 30 and 38-inch row solid and skip-row patterns in a non-irrigated environment for three Mississippi locations; and determine the returns above production costs based on actual research field plot gin turnout, lint yield and HVI fiber quality using 2006 Mississippi input prices.

Materials and Methods

The studies were conducted in 2003-2006 on a Marietta silt loam and Falaya sandy loam soil at Verona and Falkner, Mississippi (Hill area), respectively. A study also was conducted in 2004 and 2005 on a Northwest Delta Dubbs very fine sandy loam soil at Clarksdale, MS. Studies at all locations were conducted as a split plot with row pattern as main plot and years as subplot with four replications. Plot size was 20 ft by 120 ft with row patterns as shown in Figure 1. Deltapine DP 449BG/RR cultivar was planted no-till into spring prepared stale seedbeds in early to late May 2003-2006 at Falkner and Verona; and late April to early May 2004-2005 at Clarksdale.

Current agronomic production practices were used at all locations. Seeding rates at all locations and years were 3 seed/ft of row for all 15 and 30-inch rows and 4 seed/ft of row for 38-inch rows. All cotton plots were harvested in

2003 and 2004 with a John Deere PRO 12 VRS picker unit mounted on a single row picker using a John Deere 4020 tractor as the power unit. In 2005 and 2006, the plots were harvested with a John Deere 9960 picker equipped with two John Deere PRO 12 VRS picker units that were adjustable for each row pattern. Four or 8 rows of the 15-inch solid; four rows of the 15-inch 2 x 1 skip row and 15-inch 2 x 2 skip row; and 2 rows of the 60, 30 and 38-inch solid, and the 30 and 38-inch 2x1 skip rows of each plot were harvested for yield. The border rows of each plot were not harvested for yield.

The seed cotton from the harvested plots was ginned with a mini-gin (state of the art cotton gin, equivalent to a commercial gin) to determine lint yield. Lint moisture determinations were made on all samples after ginning. The lint yield was calculated on a land area basis and adjusted to 6% moisture for all plots before data analysis.

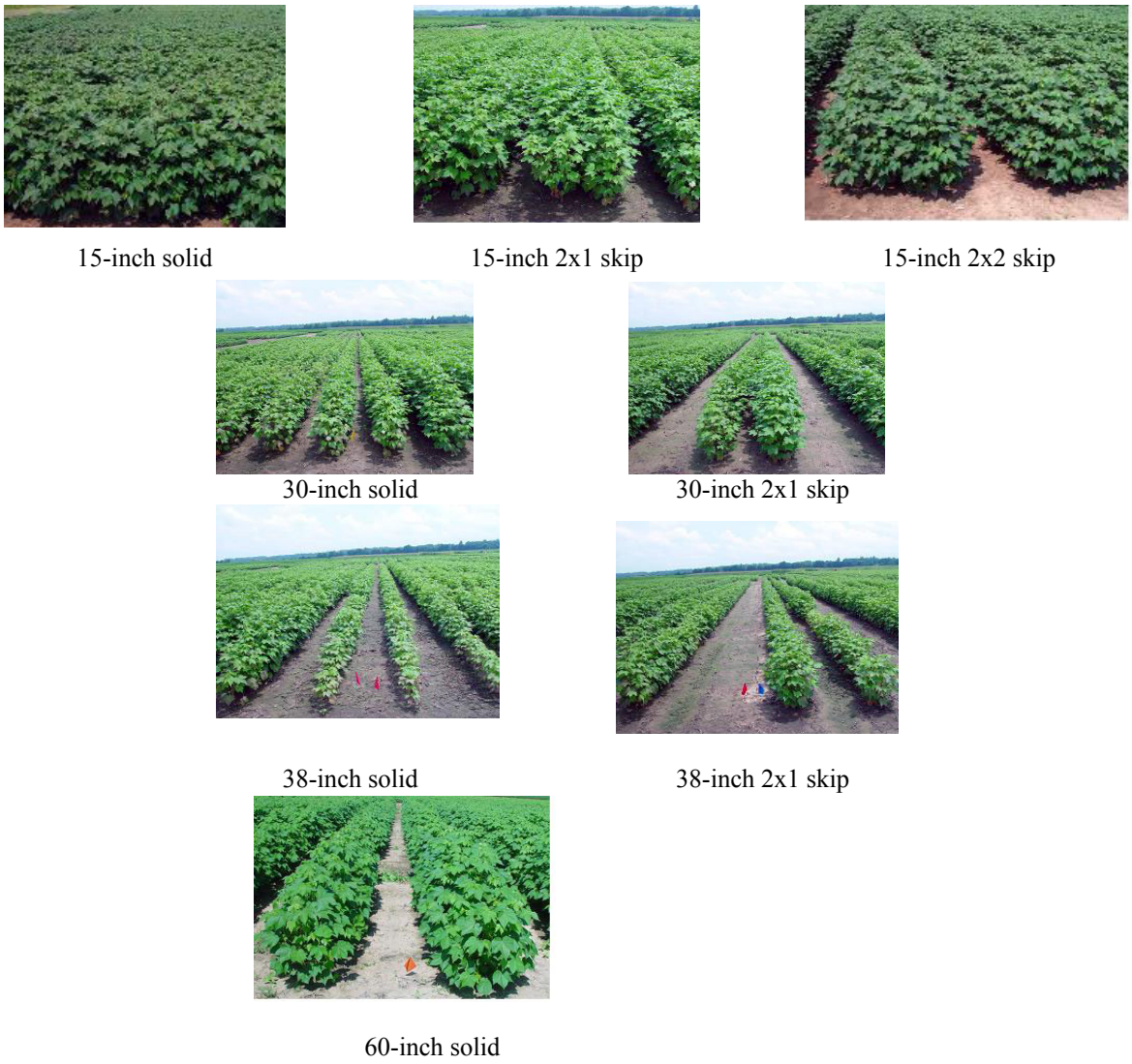

Figure 1. Photographs of experimental plots of eight planting patterns.

In the hypothetical cotton farm enterprise, crop budgets for each treatment and location were developed based on Mississippi 2006 prices and inputs used at each location with some modifications for skip-row and wide row systems. Post-direct layby equipment, herbicide and application costs were used in budgeting for all row patterns, except the 15-inch solid rows. All post-emergence over-top broadleaf and grass herbicides were used on 15-inch solid rows. Table 1 provides details of methods used in determining net revenue for the hypothetical farms.

Table 1. Description of methods used in the hypothetical farm analysis.

I. Cost Definition

A. Operating cost:

1. Inputs, services, repair and labor associated with machinery operation, and maintenance, and interest on these inputs.
2. Total specified operating costs did not include management or farm overhead cost.
3. Operating costs were based on actual production practices used on the study sites with modifications for skip row and wide row systems. A post-direct herbicide application was used for the wide and skip row budgets. Post emergence over-top herbicides were used for 15-inch solid row cotton.
4. Nitrogen as ammonium nitrate was used for Verona and Falkner budgets. Urea-ammonium nitrate solution (UAN) preplant plus urea was used for Clarksdale location budget. The skip row pattern N rates were 90% of solid row cotton.

B. Ownership cost: Manufacturer's Suggested Retail Price (less 10%) was amortized to compute the annualized capital replacement value for equipment at the end of its useful life (8 years useful life for pickers and tractors).

C. Gross Revenue: net loan price x lint yield based on gin turnout (MSU-mini gin; equivalent to a commercial gin) plus cottonseed sale: 1.55 x lint yield x 4.7¢/lb ($94/T).

D. Land rent charge: Hills = $55/acre; Delta = $85/acre (2005 Ag Econ survey).

II. 2006 Prices For MSU Budget Generator (based on state-wide 2006 average prices).

A. Diesel fuel: $2.41/gal

C. Tech fee (Seed cost): Round-up Ready/BT program for the Deltapine DP 449BG/RR variety was used in the study. Seed cost was $0.40 per thousand plus technology fee of $0.93 per thousand seed with a cap at $49/acre.

D. Cotton Lint price: 2006 USDA's Commodity Credit Corporation Base Loan Rate of $0.52/lb with adjustments for HVI fiber quality for the Clarksdale, Verona and Falkner locations.

III. Picker Performances and Cotton Row Pattern Farm Acreages

A. Acres/hr of use = swath width x rate of travel (3.6 mph) x efficiency (0.7) ÷ 8.25

B. Acres/picker = acres/hr x 200 hrs/season.

C. Acres/farm row pattern system = # pickers x acres/picker.

1) Hill Farm: two 4-row pickers at 611 acres/picker in 15 and 30-inch solid.
2) Delta Farm: three 6-row pickers, at 914 acres/picker for 15 and 30 solid and three 4-row pickers at about 1200 acres/picker for 15-inch 2 x 2 skip row, 38-inch 2 x 1 skip row, and 60 inch rows.

D. One Boll Buggy and 2 tractors/picker for all locations. One module builder per picker was used for Verona and Falkner; and two module builders for all 3 pickers was used for Clarksdale.

E. All row patterns per location had the same number of tractors, pickers and boll buggies. The Hill farms had 4 tractors and the Delta farm had 6 tractors.

A John Deere Model 9996 cotton picker was assumed to be configured to accommodate each row pattern. Three patterns had 15-inch rows and thus required the use of the John Deere PRO 12 VRS Picking Units. However, the 15-inch rows with skips required some modifications because the marketed picker is not designed to accommodate skipped rows. Therefore, it was assumed that the picker could be converted to accommodate one or two skipped rows at an extra cost. The other five row patterns had more conventional row spacings and skips; and the John Deere PRO-16 Picking Units were assumed for these patterns.

As the effective harvest swath width of a picker increased to accommodate the wider row width or the skipped rows, its harvest capacity (acres per hour) increased, allowing it to cover more acres in the same amount of time. Each picker was assumed to travel at 3.6 miles per hour, have a field efficiency of 70%, and to operate for 200 hours during the harvest season. Thus, the amount of land per picker was adjusted to maintain the maximum harvest capacity of the picker for each row pattern.

Table 2. Four-row unit cotton picker information for the farms in the Hill area.

Treatment	Estimated Purchase Price ($)	Swath Width (feet)	Acres Per Picker	Acres per Farm
1. 15-inch solid	310,266	10	611	1,222
2. 15-inch 2x1 skip	344,187	15	916	1,833
3. 15-inch 2x2 skip	344,867	20	1,222	2,444
4. 30-inch solid	301,094	10	611	1,222
5. 30-inch 2x1 skip	307,560	15	916	1,833
6. 60-inch solid	308,385	20	1,222	2,444
7. 38-inch solid	301,894	12.67	774	1,548
8. 38-inch 2x1 skip	309,641	19	1,161	2,321

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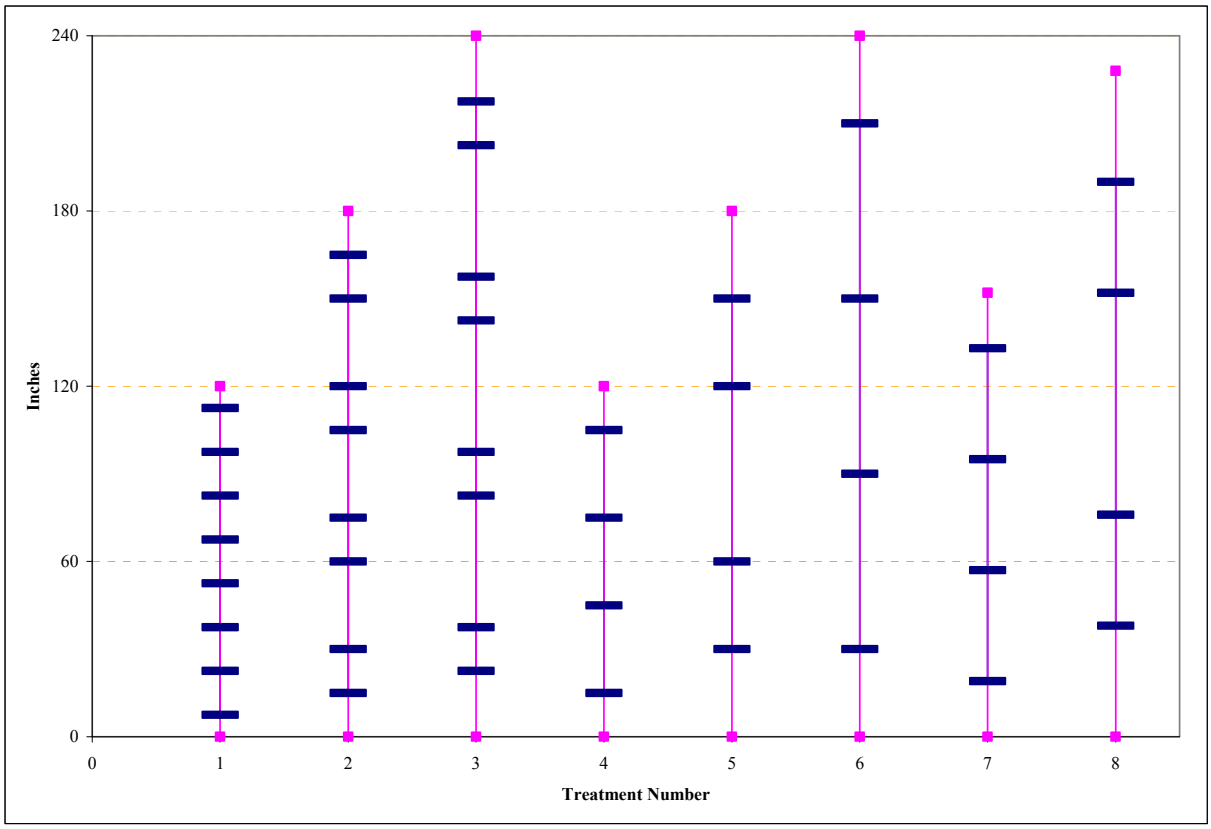

Figure 2. Row spacing and effective harvest swath width for a 4-row unit cotton picker, treatments 1-8.

Picker information for the 8 row pattern treatments at the two hypothetical farms in the Hills area is listed in Table 2. In this area of Mississippi, 4-row unit pickers are more common. It was assumed that these farms would own

two pickers. The estimated purchase price is 90% of the manufacturer suggested retail price (MSRP). Figure 2 shows the configuration of the picking units that would be needed to accommodate the 8 row pattern treatments. As can be seen, the skip row patterns enhance the field harvest capacity of the picker when compared to the solid row patterns. The 60-inch solid (Treatment 6) and the 15-inch 2x2 skip (treatment 3) row patterns had the widest harvest swath (20 ft) and thus the largest acreage per picker and farmed acreage.

The Delta farm was assumed to own three pickers, each with six picking units. However, because existing 6-row unit cotton pickers are not designed to accommodate the larger swath widths required for treatments 3, 6, and 8, these treatments used 4-row unit pickers. Table 3 shows the estimated picker cost, picker harvest swath width, acres per picker, and total acres for the hypothetical Delta farm. The estimated picker purchase price is 90% MSRP. Table 3 indicates the 15-inch 2x1 skip and 30-inch 2x1 skip row patterns had the largest harvest swath of all treatments, and therefore, had the most acreage per picker and total farm acreage.

Table 3. Six-row unit cotton picker information for the Delta farm.

Treatment	Estimated Purchase Price ($)	Swath Width (feet)	Acres per Picker	Acres per Farm
1. 15-inch solid	384,687	15	916	2,749
2. 15-inch 2x1 skip	389,867	22.5	1,375	4,124
3. 15-inch 2x2 skip	344,867	20	1,222	3,665
4. 30-inch solid	370,922	15	916	2,749
5. 30-inch 2x1 skip	373,403	22.5	1,375	4,124
6. 60-inch solid	308,385	20	1,222	3,665
7. 38-inch solid	371,603	19	1,161	3,482
8. 38-inch 2x1 skip	309,641	19	1,161	3,482

Note: Treatments 3, 6, and 8 used a four-row unit picker.

Figure 3 shows the configuration of the picker units that would accommodate the 8 or 12 row pattern treatments for the Delta farm. The skip row patterns show the increased harvest swath width of the picker, which increased the farm acreage per picker. The 15-inch 2x1 skip and 30-inch 2x1 skip row pattern had the largest harvest swath. Planters and other implements were selected to accommodate the row patterns for each treatment. The smaller farms in the Hills area were assumed to own four tractors while the larger farms in the Delta area were assumed to own six tractors.

Revenue from a cotton enterprise arises from the production of lint and cottonseed. Lint yields for the years 2003-2006 field experiments conducted at the North Mississippi Research and Extension Center at Verona and an on-farm study at Falkner; and the 2004-2005 on farm study located at Clarksdale were used to calculate the gross lint revenue. The seed cotton from these studies was ginned with a mini-gin equivalent to a state art commercial gin. In recent years, lint prices received by farmers have been lower than loan rates. Thus, the loan rate for Mississippi of $0.52 per pound was adjusted for HVI fiber quality for each plot and then used to compute the gross lint revenue for each treatment. Cottonseed price was $94 per ton and seed yield was estimated as 1.55 pounds of seed per pound of lint. Because seed was treated as a revenue item, a charge for ginning at $0.08 per pound of lint and hauling at $0.02 per pound of lint were included as operating costs.

Operating costs were estimated with the Mississippi State Budget Generator (Laughlin and Spurlock, 2003) using average prices that occurred in Mississippi during 2006. Operating costs per acre were estimated by multiplying an input's quantity per acre by its price. The seeding rate for treatments 1-6 was 3 per foot of row; for treatments 7 and 8 it was 4 per foot of row. Seed price was $0.40 per thousand with an additional technology fee of $0.93 per thousand. This technology fee was capped at $49.00 per acre and took effect in treatments 1-4 and 7. Other operating cost items were: fertilizer, herbicide, insecticide, growth regulator, harvest aid, haul and gin, labor, diesel fuel, repairs and maintenance for machinery, and interest on operating capital. In addition to seeding rate, some fertilizer and herbicide application rates were directly related to the row length per acre in each treatment. By reducing the row length per acre, some reductions in per-acre input usage and thus cost could be attained.

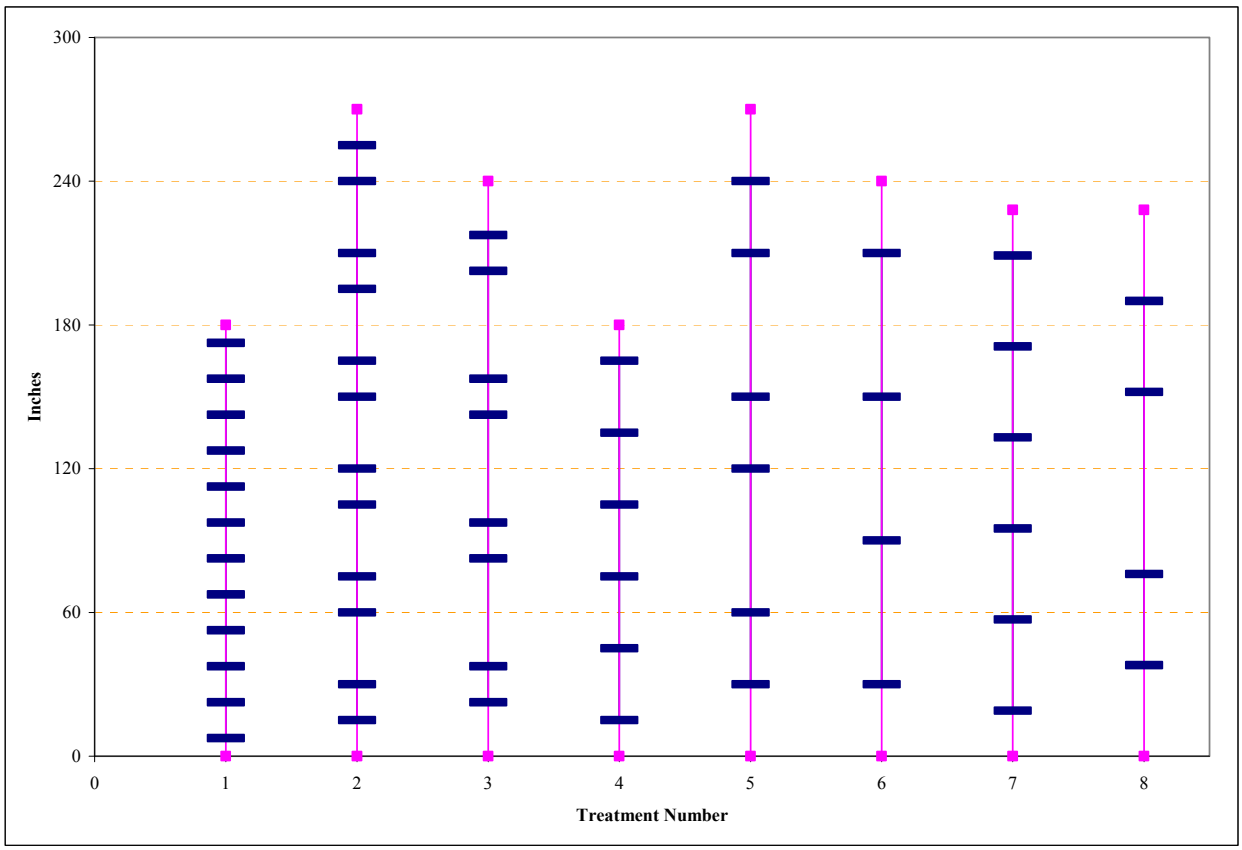

Figure 3. Row spacing and effective swath width for a 6 row unit cotton picker, treatments 1, 2, 4, 5, and 7 (a 4 row unit picker was used for treatments 3, 6, and 8).

Ownership cost for the machinery items that were assumed to be required for each farm was estimated on an annual basis by using the capital recovery method (Boehlje and Eidman, 1984) at an interest rate of 5%. Per-acre ownership cost was calculated by dividing the total machinery ownership cost by the number of acres for each row pattern treatment. A land charge of $55 per acre was assigned to the Hill farms and $85 per acre for the Delta farm. Overhead and management fees were not included in the cost analysis.

Results and Discussion

Wet soil conditions in May delayed planting at Verona and Falkner until the last days of May in 2003. Planting was accomplished at all locations from April 27 to May 10 in 2004 and 2005 and mid-May in 2006. Above normal rainfall during the growing season at all locations in 2003 and 2004 resulted in above average yield. However, the 2005 growing season from planting through August 26 at Clarksdale had only 4.25 inches of rainfall. Hurricane Rita in late September also caused 20 to 30% yield losses (visual estimate). At Verona in 2005, the growing season had highly erratic rainfall with only 27% of normal for May, 17% above normal for June with all rainfall the first 13 days of June, followed by no rainfall from June 14 through July 4. This was followed by a wet July with 185% of normal rainfall; and a 4 week period from August 1 through August 28 with no rainfall. This erratic rainfall appeared to have had a negative effect on growth and yield, especially on 15-inch solid cotton. Falkner had excellent growing conditions all 4 seasons except for dry conditions in mid August 2005 and 2006.

Plant populations at harvest at all locations were good with an 83% emergence rate over all row patterns and years (data not shown). Seeding rates of 4 seed/planted row ft in the 38-inch and 38-inch 2x1 skip-row pattern at all locations resulted in the 38-inch 2x1 inch skip-row population being 67% of the 38-inch row. Seeding rates of 3 seed/planted rows for all 15-inch and 30-inch row patterns at all locations resulted in different plant densities on a

per acre basis for these row patterns. However, on a planted acre basis, the plant populations at harvest for all row patterns, years and locations were higher than 30,000 plants/acre. Seibert et al. (2005) reported that populations greater than 13,755 plants/acre in 38-inch row solid had no negative effect on yield. The 15-inch solid across years at all locations had the highest population of 70,000 to 84,000/acre. Wilson et al. (2005; 2006) reported that populations for 15-inch solid from 25,000 to 125,000 had no negative effect on yield. Therefore, we would assume the high populations in this study had no negative effect on yield. However, higher seeding rate resulted in $23/acre more input cost for 15-inch solid than the 30-inch or 38-inch solid. All row patterns across years and locations showed only minor HVI and AFIS fiber quality differences (data not shown). HVI fiber quality had no effect on lint gross returns for all row patterns and locations.

Verona: The 15-inch 2x1 skip row had the highest yield average of 1050 lb/acre but showed net returns above operating and machinery ownership cost per acre to be similar to 15-inch 2x2 skip row (Table 4). The 15-inch 2x2 skip row had lower yield, revenue and machinery cost per acre with similar net returns per acre as 15-inch 2x1 skip row. The 30 and 15-inch solid lint yields of 1021 and 1047 lb/acre, respectively, were higher than the 15-inch 2x2 skip row pattern. However, both had a smaller harvest swath width of 10 ft with the lowest cotton acreage, the highest machinery ownership cost of $112 and $115/acre and ranked 7th and 8th in total whole farm net revenue, respectively (Table 5). The 15-inch 2x2 skip row pattern had the largest acreage (widest harvest swath width) and provided the highest whole farm net revenue of $155,917. The 15-inch 2x1 skip row ranked second in net revenue. The 60-inch solid cotton also had the same acreage as the 15-inch 2x2 skip row and provided the third highest total whole farm net revenue of $90,057.

The 15-inch solid seed costs/acre in the crop budget was $23/acre more than 30-inch and 38-inch rows (data not shown). However, when we changed the seed cost in the crop budgets to be equal to the 30-inch solid row pattern, the results indicated the 15-inch solid yield had to be increased by an additional 226 lb/acre in order for the 15-inch solid whole farm net revenue to be equal to the 15-inch 2x2 skip row pattern.

Table 4. Per acre lint yield, revenue, and operating cost for eight row patterns, Verona, Mississippi.

Row Pattern Treatment	Lint Yield	Gross Revenue	Operating Cost	Net Above Op. Cost	Machinery Ownership Cost	Net Above Op. + Own. Costs
	lb/acre			$/ac		
2. 15-inch 2x1 skip	1050	655	451	204	84	120
4. 30-inch solid	1021	649	458	190	112	78
3. 15-inch 2x2 skip	956	600	417	183	64	119
7. 38-inch solid	979	618	440	178	89	89
5. 30-inch 2x1 skip	894	567	400	168	77	91
1. 15-inch solid	1047	647	490	157	115	42
6. 60-inch solid	823	520	369	151	59	92
8. 38-inch 2x1 skip	835	532	387	145	63	82

The wider harvest swath (20 ft) for the 15-inch 2x2 skip row pattern compared to 10 ft swath for 15-inch solid allowed a 100% increase in cotton acreage using the same equipment and harvest machinery complement. This reduced the machinery ownership cost per acre by 44% which contributed to higher whole farm net revenue for the 15-inch 2x2 skip row pattern. The 38-inch solid row yield of 979 lb/acre ranked 6th in total whole farm net revenue. The 30-inch 2x1 and 38-inch 2x1 skip row pattern yields of 894 and 835 lb/acre ranked 4th and 5th in total whole farm net revenue.

Table 5. Whole farm acreage, revenue and operating cost for eight row patterns, Verona, Mississippi.

Row Pattern Treatment	Total Acres	Total Revenue	Operating Cost	Machinery Ownership Cost	Land Charge	Net Revenue
			----------$----------			
3. 15inch 2x2 skip	2,444	1,466,612	1,018,770	157,524	134,400	155,917
2. 15-inch 2x1 skip	1,833	1,200,249	826,670	154,301	100,800	118,478
6. 60-inch solid	2,444	1,271,356	901,757	145,143	134,400	90,057
5. 30-inch 2x1 skip	1,833	1,039,372	732,390	140,858	100,800	65,324
8. 38-inch 2x1 skip	2,321	1,234,677	898,803	145,580	127,680	62,614
7. 38-inch solid	1,548	956,105	680,426	137,289	85,120	53,269
4. 30-inch solid	1,222	792,677	560,075	136,840	67,200	28,562
1. 15-inch solid	1,222	790,716	598,288	140,292	67,200	-15,064

Falkner: The Falkner 15-inch solid results were similar to Verona with the highest 4 year lint yield average of 1278 lb/acre and the highest gross revenue per acre (Table 6). However, as at Verona, it also had the highest machinery ownership and operating cost per acre; and the smallest picker harvest swath and farm acreage. This resulted in the 15-inch solid row having the lowest net returns per acre above operating plus machinery ownership cost which resulted in the lowest whole farm net revenue. The 60-inch solid lint yield average of 1004 lb/acre (79% of 15-inch solid) had the lowest gross revenue, lowest operating and machinery ownership costs/acre of all treatments, but it ranked 2nd in net whole farm net revenue (Table 7). The 15-inch 2x2 skip row pattern with a lint yield of 1179 lb/acre (92% of 15-inch solid) and farm acreage of 2444 acres (twice that of 15-inch solid) showed the highest whole farm net revenue of $354,966.

Table 6. Per-acre lint yield, revenue and operating costs for eight row patterns, Falkner, Mississippi.

Row Pattern Treatment	Lint Yield	Gross Revenue	Operating Cost	Net Above Op. Cost	Machinery Ownership Cost	Net Above Op. + Own. Costs
	lb/acre		----------$/acre----------			
4. 30-inch solid	1,255	771	501	270	112	158
3. 15-inch 2x2 skip	1,179	723	458	265	64	200
5. 30-inch 2x1 skip	1,139	708	444	263	77	187
2. 15-inch 2x1 skip	1,245	749	488	261	84	177
7. 38-inch solid	1,199	741	480	261	89	172
1. 15-inch solid	1,278	779	535	243	115	128
6. 60-inch solid	1,004	623	407	216	59	157
8. 38-inch 2x1 skip	1,023	635	424	211	63	148

One important thing to note is that 15-inch 2x2 skip row and 60-inch solid picker harvest swath widths of 20 ft compared to 10 ft for both 30-inch and 15-inch rows. The wider harvest swath for the 60-inch solid and 15-inch 2x2 skip-row patterns allowed the cotton acreage to increase 100% with the same equipment complement as 30 and 15-inch solid. This reduced machinery ownership cost by 44% and 42% compared to 15-inch and 30-inch solid, respectively. Both 30-and 15-inch solid had similar yield (1255 vs 1278 lb/acre) with the smallest harvest swath width of 10 ft ranked 7th and 8th, respectively, in whole farm net revenue. The 38-inch solid system yield of 1199 lb/acre with a harvest swath of 12.7 ft ranked 6th in whole farm net revenue. The 30-inch 2x1 skip, 15-inch 2x1 skip and 38-inch 2x1 skip-row pattern ranked 3rd, 4th and 5th in total whole farm net revenue, respectively.

The 15-inch solid seed costs and technology fees were $23/acre more than 38 and 30-inch solid. However, even when we changed the seed cost/acre in the crop budgets to be equivalent to the 30-inch solid, the 15-inch solid yield would have to be increased by 382 lb/acre in order for the whole farm net revenue for the 15-inch solid to be equivalent to the 15-inch 2x2 skip row pattern.

Table 7. Whole farm acreage, revenue and operating costs for eight row patterns, Falkner, Mississippi.

Row Pattern Treatment	Total Acres	Total Revenue	Operating Cost	Machinery Ownership Cost	Land Charge	Net Revenue
			----------$----------			
3. 15-inch 2x2 skip	2,444	1,766,992	1,120,102	157,524	134,400	354,966
6. 60-inch solid	2,444	1,522,898	994,982	145,143	134,400	248,374
5. 30-inch 2x1 skip	1,833	1,296,768	813,919	140,858	100,800	241,191
2. 15-inch 2x1 skip	1,833	1,373,086	895,072	154,301	100,800	222,913
8. 38-inch 2x1 skip	2,321	1,475,020	985,289	145,580	127,680	216,471
7. 38-inch solid	1,548	1,146,925	743,628	137,289	85,120	180,888
4. 30-inch solid	1,222	941,920	611,880	136,840	67,200	125,999
1. 15-inch solid	1,222	951,252	654,094	140,292	67,200	89,665

Clarksdale: The 38-inch solid 2-year average yield of 1194 lb/acre, and had similar yield and gross revenue per acre as the 15-inch solid row (Table 8). However, the operating cost and machinery ownership cost per acre for 15-inch solid row was $47 and $26/acre higher than 38-inch solid row, respectively. The machinery ownership cost for 38-inch solid row was $8/acre more than the 15-inch 2x1 skip-row pattern which had a harvest swath of 22.5 ft and 1144 lb/acre (96% of 38-inch) of lint yield. The net revenue per acre above operating and machinery ownership costs for 38-inch solid was $75/acre more than 15-inch solid. The lower gross revenue per acre for 15-inch 2x1 skip was related to lower yield (96% of 38-inch yield) and $25/acre lower net returns than 38-inch.

Table 8. Per-acre lint yield, revenue and operating cost for eight row patterns, Clarksdale, Mississippi.

Row Pattern Treatment	Lint Yield	Gross Revenue	Operating Cost	Net Above Op. Cost	Machinery Ownership Cost	Net Above Op. + Own. Costs
	lb/acre		----------$/acre----------			
7. 38-inch solid	1,194	760	500	259	83	176
4. 30-inch solid	1,184	750	509	240	105	136
2. 15-inch 2x1 skip	1,144	722	497	226	75	151
3. 15-inch 2x2 skip	1,128	712	487	225	79	145
8. 38-inch 2x1 skip	1,058	672	462	211	76	134
1. 15-inch solid	1,195	757	547	210	109	101
5. 30-inch 2x1 skip	1,086	684	476	208	71	137
6. 60-inch solid	1,018	645	441	204	73	132

Note: Treatments 3, 6, and 8 had 4-row unit pickers; other treatments had 6-row unit pickers.

The 38-inch solid pattern, with a harvest swath width of 19 ft, had a farm size of 3482 acres of cotton and had the highest whole farm net revenue (Table 9). This was in contrast to the 30 and 15-inch solid patterns which had 15 ft picker harvest swaths, 2749 acreage and ranked 7th and 8th in whole farm net revenue. The 15-inch 2x1 skip and 15-inch 2x2 skip-row patterns ranked 2nd and 3rd in whole farm net returns. When the 15-inch solid seed rate was changed to 2 seeds/ft (equivalent seed rate/acre to the 30-inch row) in the crop budgets, the 15-inch solid yield had to be increased by 144 lb/acre in order for the 15-inch solid whole farm net revenue to be equivalent to the 38-inch

solid. Although the Hill locations (Falkner and Verona) used a 4-row harvester complement of equipment, the 30 and 15-inch row patterns solid across all locations had the lowest farm acreage and the highest machinery ownership cost/acre of all row patterns and ranked 7th and 8th in whole farm net revenue.

Table 9. Whole farm acreage, revenue and operating cost for eight row patterns, Clarksdale, Mississippi.

Row Pattern Treatment	Total Acres	Total Revenue	Operating Cost	Machinery Ownership Cost	Land Charge	Net Revenue
		----------$----------				
7. 38-inch row	3,482	2,644,771	1,741,422	289,935	295,985	317,429
2. 15-inch 2x1 skip	4,124	2,978,659	2,047,406	307,619	350,509	273,125
3. 15-inch 2x2 skip[1]	3,665	2,608,453	1,784,875	290,401	311,564	221,613
5. 30-inch 2x1 skip	4,124	2,820,618	1,963,614	291,922	350,509	214,573
8. 38-inch 2x1 skip[1]	3,482	2,341,658	1,607,549	266,211	295,985	171,913
6. 60-inch solid[1]	3,665	2,364,019	1,614,834	267,068	311,564	170,553
4. 30-inch solid	2,749	2,061,539	1,400,552	287,321	233,673	139,993
1. 15-inch solid	2,749	2,080,359	1,503,368	300,272	233,673	43,046

[1]4-row unit harvesters were used in the analysis.

Conclusions

The 15-inch row lint yields were 2 and 6% slightly higher than 30 and 38-inch, respectively, for the Hill locations with no difference at the Delta location. The whole farm revenue analysis using the maximum acreage per cotton harvester for each row pattern, indicated 30-inch and 15-inch solid row patterns had the smallest harvester swath widths, lowest farm cotton acreages, highest machinery ownership cost per acre and ranked lowest (7th and 8th) in whole farm net revenue at all locations. The 15-inch 2x2 skip row pattern in the Hills and the 38-inch solid rows in the Delta produced the highest whole farm net revenue. The 15-inch 2x1 and 2x2 skip row patterns ranked 2nd and 3rd in total whole farm net revenue at Clarksdale. These results suggest the 15-inch skip row patterns may have greater potential than 15-inch solid rows for improving profitability.

The selected planting row pattern can have a substantial impact on both operating and ownership costs as well as lint yield and net revenue. Therefore, when considering cotton row configuration options, one should not only consider the row configuration's impact on lint yield but also the potential impact on picker harvesting capacity (picker swath width), whole farm equipment operation efficiency and total farm net revenue.

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