

Effects of Two Planting Patterns and Plant Densities on Cotton Growth, Yield, Fiber Quality, and Net Return

Dan D. Fromme¹, Lawrence L. Falconer², Roy D. Parker³, Robert G. Lemon⁴, Carlos J. Fernandez⁵, W. James Grichar^{6*}

¹ Texas A&M AgriLife Extension Service, Corpus Christi, TX 78406

² Mississippi State Extension Service, Stoneville, MS 38776

³ Texas A&M AgriLife Extension Service, Corpus Christi, TX 78406

⁴ DowAgroSciences, Caldwell, TX 77836

⁵ Texas A&M AgriLife Research, Corpus Christi, TX 78406

⁶ Texas A&M AgriLife Research, Corpus Christi, TX 78406

ABSTRACT

Aims: To evaluate the effect of two planting patterns across two plant densities on cotton growth, yield, fiber quality, and net returns.

Study Design: Randomized complete block design with a 2 x 2 factorial treatment arrangement with 3 replicates was used for a total of 12 plots.

Place and Duration of Study: Studies were conducted during the 2003 and 2004 growing seasons on a producer's farm located south of Eagle Lake, Texas in Colorado County (29.49360 N, 96.34060 W).

Methodology: Rows were spaced 91.4-cm apart on raised beds. Plot size was eight rows by 972 m long. The two different factors included two row planting patterns, the solid pattern with every single row planted and the skip-row pattern with a 2x1 planting pattern where 2 rows are planted and 1 row is left fallow. For the skip-row pattern, rows three and six were not planted in the 8 row plot. The second factor was seeding rate with two plant populations of 84000 and 126000 plants/ha.

Results: In neither year were any differences seen with seeding rate. In 2003, days to cut-out with the skip-row pattern were 92.4 while with the solid pattern days to cut-out were 87.9 and plant height with the skip-row pattern was 100 cm while with the solid pattern, plant height was 87 cm. Lint yield was 1504 kg/ha for the solid pattern while with the skip-row pattern lint yield was 1347 kg/ha. In 2004, lint yield with the solid pattern was 27% greater than the skip-row pattern. Slight differences between the two planting patterns were observed during 2004 in days to cut-out or plant height. In both years, the solid planting pattern produced a net dollar value/ha increase over the skip-row pattern and therefore should be the row pattern used along the upper Texas Gulf Coast.

Keywords: cotton, skip-row, solid planting, plant growth, net returns.

1. INTRODUCTION

The practice of alternating two planted rows of cotton with two blank rows has been used for over 50 years in many areas of the U. S. where cotton is grown under low annual rainfall conditions to decrease production costs or when low prices favor skip-row planting patterns [1,2,3,4]. The use of skip-row planting increased in earlier years because allotment acreages could be calculated on planted rows only rather than total land area and because skip-row plantings result in higher lint yields with this system of computation [5]. Dick and Owings [2] reported results of a 3 year study of skip-row cotton which showed increases in yield ranging from 24 to 127%. They compared skip-row patterns, 4x4 and 2x2 with solid planting and the greatest yield increase (127%) came in 1956 from the 2x2 pattern. Research from the Mississippi Delta region of the U. S. indicated that yield response from the 4x4 design would be expected to vary according to seasonal conditions, and that the greatest advantage from this pattern resulted from the more favorable growing seasons [3]. Yield increases in the 4 year study from this design ranged from 25 to 73% [3]. Grissom and Spurgeon [6] reported that cotton planted on Dubbs and Bosket soils in a 4x4 pattern produced 45% more yield and the 2x2 pattern produced 67% more than solid plantings. However, they reported no yield increase from skip-row planting on Sharkey clay where plants were approximately 61 cm tall.

Sturkie and Boseck [7] found that 3 year average yield increases for the 2x2 and 4x4 patterns over solid plantings were 57 and 31%, respectively where 272 kg/ha fertilizer was used and 46 and 28%, respectively where 408 kg/ha fertilizer was used. Langsford [8] tested 11 different systems of skip-row plantings, six of which involved interplanting with other crops. [8]. He showed that all skip-row systems increased cotton yield from 10 to 60%, indicating that cotton benefitted from the skip-row design, whether those rows were planted to other crops or left fallow. Other studies, depending on location, have shown skip-row lint yields for row spacings > 76-cm to be 54 to 100% of solid-planted yields on a land area basis [4,9,10,11,12].

With skip-row cotton, plants adjacent to the skipped rows partially compensate for lost yield by growing into the unplanted areas, such that the reduction in yield is less than proportional to the reduction in planted area [13]. This yield compensation may be due to less competition for nutrients and soil moisture, greater light penetration to lower leaves, or some combination of these factors [11].

Another strategy producers have utilized to decrease production costs is reducing the cotton seeding rate or plant densities [14]. Establishing an acceptable stand of cotton is paramount to obtaining high yields [14,15]. However, recent studies have shown no differences in cotton yield due to plant density [16,17,18,19,20]. The lack of yield differences can be explained by an increased number of main stem nodes, and location of sympodial and monopodial bolls on plants grown at lower densities [14,15,16].

Current technology allows cotton to be effectively seeded and harvested in alternative planting patterns. Also, reducing cotton plant densities can be a practical option for producers to decrease production costs. However, little information is available concerning the effect of alternative planting patterns utilizing different plant populations along the upper Texas Gulf Coast where moisture is usually not a limiting factor [21,22]. Therefore, the purpose of this study was to compare cotton response to conventionally planted pattern versus the skip-row 2x1 pattern along the upper Texas Gulf Coast. Additionally, partial budget analysis was performed to evaluate the returns of conventional planting patterns as compared to skip-row patterns.

2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY

2.1 Field studies

Studies were conducted during the 2003 and 2004 growing season on a producer's farm located south of Eagle Lake, Texas in Colorado County (29.49360 N, 96.34060 W) to compare cotton response of skip-row pattern (2x1) with solid plantings and two different plant populations (84000 and 126000 plants/ha). Rows were spaced 91.4 cm apart on slightly raised (no more the 10 to 12 cm tall) beds. Plot size was 8 rows wide by 972 m long. For the skip-row treatments, the 2x1 configuration was obtained by not planting rows three and six in the eight row plot. Soil type at this site near Eagle Lake was a Weswood silt loam (fine-silty, mixed, superactive, thermic Udifluventic Haplustepts) with 1.0 % organic matter and pH 7.2. These studies were in different fields each year but in the same general area. Fertilizer (112, 34, and 60 kg/ha of N, P, and K, respectively) was applied by the grower as needed according to Texas A&M AgriLife Extension Service recommendations for cotton. Plots were maintained weed-free throughout the growing season using a preemergence application of flumeturon (Cotoran®, Griffin, LLC, Valdosta, GA 31603) at 0.42 kg/ha plus S-metolachlor (Dual II Magnum®, Syngenta Crop Protection, Greensboro, NC 27419-0135) at the 0.43 kg/ha applied in a 30-cm band over the top after cotton was planted. In 2003, the plot area was cultivated three times while in 2004, glyphosate at 0.6 L/ha was applied once and plots were cultivated three times.

FiberMax 832B was planted on April 1, 2003 while DPL 444 BG/RR was planted on March 30, 2004 with an 8-row John Deere MaxEmerge II vacuum planter. FiberMax 832B was not available the second year of the study; therefore, DPL 444 BG/RR was used since it is also medium-early and both have the same maturity. Beginning at first bloom, weekly counts of nodes above white flower values were obtained by sampling ten plants from each plot. Twenty plants per plot were measured at the end of the season to determine final plant height. Number of bolls to produce a kilogram of lint was obtained by hand-harvesting 0.002 of a hectare at three different places in each plot. Both sites were maintained under rain-fed conditions. Rainfall data was collected within 400 m of test sites and maintained by the producer.

2.2 Plot harvest, partial budget, and statistical analyses

Seed cotton yields were obtained by machine harvesting with a two row cotton picker (John Deere 9910). The middle two rows of each plot were picked and weight was determined with a portable cotton weigh wagon (West Texas Lee Co., model WT920-15). In both years, a grab sample of approximately 600 grams of seed cotton from each of the plots was ginned on a 10-saw Eagle Laboratory Gin to determine lint yield and turnout. A 30 gram lint sample from each of the plots was then sent to the International Textile Center (Lubbock, TX) for fiber quality analysis testing for micronaire, staple length, uniformity, strength, and elongation using a Uster HVI 1000 analyzer.

Cotton yield was determined by calculating yield based on total land area not planted area. The economic analysis included in this study is based on partial budgeting of net returns above seed and seed technology costs, in-furrow insecticide costs, banded herbicide costs, picking costs and ginning costs. This partial budgeting technique is appropriate since all other factors of production were the same for both systems. Prices from 2012 were used in the partial budgets with the following assumptions for each year [23]. In 2003, FiberMax 832B had only Bollgard® technology [24,25,26] but no glyphosate tolerance and the technology fee was \$92.50/bag. In 2004, DPL 444 BG/RR had Bollgard® and Roundup-

Ready® [27,28,29] technology with a technology fee of \$262.70/bag. In both years all other assumptions were the same. The loan value for solid and skip-row planting was \$1.194/ kg lint while seed cotton was \$292.11/ metric ton. Seed cost was \$150/bag based on 250,000 seed/bag while the cost of thiamethoxam seed treatment was \$41.90/bag. S-metolachlor costs were \$2.56/ha while flumeturon costs were \$1.61/ha. Picking charges was \$0.267/kg for lint and ginning charge was calculated at \$0.0606/kg of seed cotton.

The treatment design was a factorial arrangement using a randomized complete block design with planting pattern and plant population as factors. An analysis of variance was performed using the ANOVA procedure for SAS (SAS Institute. 1998. SAS user's guide. SAS Inst.,Cary, NC.) to evaluate the significance of planting pattern and plant population on cotton growth, yield, and fiber quality. Treatments means were separated by Fisher's protected least significant difference test at $P = 0.05$. Data for the two years were analyzed separately due to differences in rainfall patterns in each year to determine if this could be a factor in production.

135

136 3. RESULTS AND DISCUSSION

137

138 Since environmental conditions were different in each year of the study, it was thought to
139 analyze each year separately to determine if environmental conditions, specifically rainfall,
140 were a factor in the results.

141 3.1 Rainfall

142 Rainfall amounts along the upper Texas Gulf Coast were variable for the two years (Table
143 1). Rainfall during the 2003 growing season was 41% below normal for most of the growing
144 season with July being the only month that had above average rainfall. In 2004, below
145 average rainfall was received for March and July; however, rainfall amounts for April, May,
146 and June were 1.4, 1.7, and 2.5 times the total average rainfall for those three months
147 respectively (Table 1). Below average rainfall was received for March and July. Overall,
148 rainfall during the 2004 growing season was 40% above normal (Table 1) [30].

149 **Table 1. Monthly rainfall during the growing season at the study locations during 2003**
150 **and 2004.**

	Month	2003	2004	20-yr average
151	Monthly rainfall (mm)			
152	March	33.3	65.0	80.8
153	April	8.6	117.4	83.8
154	May	4.1	205.7	119.4
155	June	96.5	321.6	126.5
156	July	175.3	7.9	83.1
157	August	23.9	98.8	88.9

158 Total 341.7 816.4 582.5

159

160 **3.2 Seeding rate**

161 Plant density had no effect on any variable evaluated (Table 2). Therefore, only differences
162 in planting pattern are discussed. Lack of an effect of seeding rate may be the result of plant
163 compensation, producing increased yield per plant with fewer plants, while in the higher
164 planting density, individual plant productivity decreased (authors' personal opinion).

165 **Table 2. Plant density effects on study parameters (P > F)^a.**

166	Year		
167	Variables	2003	2004
168	Days to cutout (number)	0.2644	0.883
169	Plant height (cm)	0.8028	0.3765
170	Open bolls (number)	0.1321	-
171	Bolls/kg lint (number)	0.2560	-
172	Lint yield (kg/ha)	0.5413	0.9493
173	Micronaire	0.2231	0.6452
174	Staple length (mm)	0.1055	0.0683
175	Uniformity (%)	0.1561	0.9786
176	Strength (gr/tex)	0.4219	0.4569
177	Elongation	0.1116	0.5239

178 ^aP = 0.05

179 Other researchers have also noted the lack of plant density effect on several variables.
180 Seibert and Stewart [20] observed that plant density did not influence plant height; however,
181 Seibert et al. [19] found a positive relationship between plant height and plant density.
182 Pettigrew and Johnson [31] reported no differences between cotton plant densities of 7, 9,
183 11, or 13 plants m² for plant height and total nodes/plant. Stephenson et al. [14] found that
184 the percentage of total bolls associated with the first position increased with increasing plant
185 densities. In other research, O'Berry et al. [32] found no differences in the number of first
186 and second position bolls per plant as plant densities increased. The effect of plant
187 densities on seed cotton yield has also been variable. Stephenson and Brecke [33] found
188 that cotton seeded at 7 plants m² in 19 cm twin rows yielded 220 kg/ha more than 7 plants
189 m² in 76 cm single row cotton, but differences between planting patterns were not observed
190 at plant densities of 13 and 26 plants m². Others have found that lint yield was not
191 influenced by plant density when cotton was seeded in 90 or 97 cm rows [16,17,19,20].

Plant density also had no effect on fiber quality [14,31,32]. Stephenson et al. [14] reported that plant density had no effect on fiber length, micronaire, strength, or uniformity while O'Berry et al. [32] observed no effect of plant density on lint percentage. Other work indicated that plant density did not influence fiber strength or uniformity, but micronaire was slightly affected [31]. In contrast, Darawsheh et al. [34] observed decreased fiber micronaire and length when plant densities were increased, but fiber strength and uniformity were not affected.

3.3 Agronomic response to planting pattern

3.3.1 Days to cut-out In 2003, the solid pattern resulted in a 5% reduction in the number of days to cut-out over the skip-row pattern (Table 3) while in 2004 no differences were noted between the two planting patterns (Table 4). Since early crop maturation and harvest of cotton can enhance production efficiency by alleviating late-season risks associated with adverse weather and insect problems [35], the reduction seen in 2003 is important in getting the crop out of the field.

Table 3. Cotton response to skip-row versus solid plantings in 2003^a.

Planting pattern	Plant population	Days to cutout	Plant ht	Number open bolls	Bolls/kg lint	Lint yield
	Number/ha	Number	cm	1000's/ha	Number	Kg/ha
Skip-row	84000	92.7	100.3	620.4	493.4	1357
	126000	92.0	99.3	627.0	481.8	1336
		92.4a	99.8a	623.7a	487.6a	1347b
Solid	84000	88.7	87.1	699.6	472.3	1476
	126000	87.0	87.1	741.4	505.3	1531
		87.9b	87.1b	720.5a	488.8a	1504a

^a Means followed by the same letter for each parameter are not significantly different at P = 0.05.

3.3.2 Plant height In 2003 the skip-row pattern produced a taller plant than the solid pattern (Table 3) while in 2004 not much differences in plant height were noted (Table 4). This difference in plant height in 2003 may be due to the below average rainfall during the early part of the growing season and thus the cotton plant better utilized moisture in the skip-row pattern while in 2004, rainfall from April to June was above normal and the plants had sufficient moisture in both planting patterns (authors' personal observation). Buehring et al. [9] reported that row pattern did not have any effect on plant height. Seibert and Stewart [20] observed that plant density did not influence plant height; however, Seibert et al. [19] found a positive relationship between plant height and plant density. Pettigrew and Johnson [31] reported no differences between cotton plant densities of 7, 9, 11 or 13 plants m² for plant height and total nodes per plant.

Table 4. Cotton response to skip-row versus solid plantings in 2004^a.

Planting pattern	Plant population Number/ha	Days to cutout Number	Plant ht cm	Lint yield Kg/ha
Skip-row	84000	107.3	100.8	1057
	126000	105.3	99.1	1036
		106.3a	100.0a	1047b
Solid	84000	104.0	94.7	1299
	126000	105.7	96.5	1328
		104.9a	95.6a	1314a

221 ^a Means followed by the same letter for each parameter are not significantly different at P =
 222 0.05.

223 **3.3.3 Open bolls and bolls/kg lint** In 2003, solid planting produced numerically more bolls
 224 than skip-row but no statistical differences were seen with respect to bolls/kg lint with either
 225 planting pattern (Table 3). Hawkins and Peacock [1] reported that the solid planting
 226 produced smaller bolls than the skip row planting and they concluded that an increase in boll
 227 size, along with more bolls per lateral branch and more lateral branches per plant [34],
 228 contributed to increased yields from skip-row planting.

229 **3.3.4 Lint yield** In 2003, the solid planting outyielded the skip-row planting by 157 kg (Table
 230 3) while in 2004 the solid planting yielded 267 kg more cotton than the skip-row planting
 231 (Table 4). Mixed results have been seen with skip-row vs solid plantings
 232 [1,2,4,5,10,11,12,14,36]. Hawkins and Peacock [1] reported that skip-row plantings
 233 increased cotton yield over solid plantings by 20 to 75%. Kittock [5] reported that the skip-
 234 row plantings (1x1, 2x1, 2x2, 4x2, and 6x2) gave significant increases in lint yield of Pima
 235 cotton when computed on a planted area basis with the most benefit from skip-row obtained
 236 in the outside rows. He also stated when computed on the total land area basis, all skip-row
 237 patterns gave reduced yields. Bruce [37] found 27 and 34% yield increases from 2x1
 238 planting, compared with solid planting, and attributed some of the differences to more
 239 available soil water for plants in skip-row. Parvin et al. [4] stated that a hectare of solid
 240 cotton exhibited higher yields than a hectare of skip-row cotton. They also reported the
 241 narrower the skip, the closer the yield of the skip-row cotton approached the yield of solid
 242 planted cotton.

243 3.4 Fiber quality

244 **3.4.1 Micronaire** No significant difference in micronaire values was seen in either year
 245 (Table 5). This is in contrast to Larson et al. [13] who reported under nonirrigated conditions
 246 that micronaire values were lower for skip-rows than for solid plantings. McAlister [38] and
 247 Vories et al. [39] reported lower micronaire in narrow-row spacings than in wide-row
 248 spacings. However, Doederlein et al. [40] found no differences in micronaire between solid

249 and skip-row for 102-cm row spacings in Texas while Hons and McMichael [11] reported
250 higher micronaire for solid rows than skip-row at 100-cm row spacing.

Table 5. Cotton fiber characteristics from skip-row versus solid plantings^a.

Planting	Plant	Micronaire		Staple length		Uniformity		Strength		Elongation	
pattern	population	Units		Mm		%		Gr/tex		Units	
		2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
Skip-row	84000	3.77	4.17	31.50	29.21	85.1	84.3	32.2	31.4	3.83	6.40
	126000	3.80	4.17	31.24	29.72	84.0	84.4	34.1	32.7	3.47	6.30
		3.79a	4.17a	31.37a	29.47a	84.6a	84.4a	33.2a	32.0a	3.65a	6.35b
Solid	84000	3.63	4.23	30.99	29.21	84.4	84.7	31.9	31.6	3.77	6.60
	126000	3.87	4.13	30.48	29.46	83.8	84.6	31.6	31.8	3.60	6.50
		3.75a	4.18a	30.74b	29.34a	84.1a	84.7a	31.8a	31.7a	3.69a	6.55a

251

252 ^a Means followed by the same letter for each parameter are not significantly different at P =
253 0.05.

254 **3.4.2 Staple length** In 2003, the skip-row pattern had slightly longer staple length than the
255 solid planting while in 2004 no differences were noted (Table 5). Larson et al. [13] reported
256 under irrigation that the skip-row pattern had longer staple length than did solid rows. They
257 speculated that decreased staple length may be due to differences in harvest method.
258 Bange et al. [41] in Australia, reported increased staple length for skip-rows relative to solid
259 rows at 100-cm spacings. In this study no explanation can be given for differences in staple
260 length in 2003.

261 **3.4.3 Uniformity and fiber strength** No differences in uniformity or fiber strength with any
262 planting pattern were observed in either year (Table 5). Larson et al. [13] and Stephenson et
263 al. [14] also reported no differences in these lint quality factors with any planting pattern.

264 **3.4.4 Elongation** In 2003, no differences in fiber elongation were noted with any planting
265 pattern while in 2004 the solid planting pattern had a slightly greater elongation than the
266 skip-row pattern (Table 5). No previous research could be found that reported on fiber
267 elongation as affected by planting pattern.

268 3.5 Net returns when comparing planting patterns

269 In 2003, the advantage in net returns for solid planting over skip-row planting was
 270 \$144.96/ha (Table 6). While values for lint cotton and cotton seed were greater for solid
 271 planting, production costs were also always greater.

272

Table 6. Partial budget production costs for solid versus skip-row plantings in 2003 using 2012 budget values.^a

Variables	Solid	Skip-row	Difference (Solid-skip row)
Yield (Lint kg/ha)	1504	1347	158
Turnout (%)	36.99	35.89	1.10
Seed cotton yield (Kg/ha)	4066	3750	316
Cotton seed yield (Kg/ha)	2406	2154	252
Lint value per ha at loan	1795.78	1607.12	188.66
Cotton seed value (\$/ha)	702.82	629.20	73.62
Seed costs (\$/ha)	75.34	50.11	(25.23)
Technology fee (\$/ha)	46.45	30.91	(15.54)
In-furrow insecticide costs (\$/ha)	21.05	13.99	(7.06)
Banded herbicide costs (\$/ha)	25.45	16.98	(8.47)
Picking Costs (\$/ha)	398.56	356.69	(41.87)
Ginning costs (\$/ha)	246.40	227.25	(19.15)
Advantage for solid planting (\$/ha)			144.96

^a FiberMax 832B had only Bollgard® technology but no glyphosate tolerance and the technology fee was \$92.50/bag. The loan value for solid and skip-row planting was \$1.194/kg lint while seed cotton was \$292.11/metric ton. Seed cost was \$150/bag based on 250,000 seed/bag while the cost of thiamethoxam seed treatment was \$41.90/bag. S-metolachlor cost was \$2.56/ha while flumeturon cost was \$1.61/ha. Picking charge was \$0.265/kg lint and ginning charge was calculated at \$0.0606/kg seed cotton.

273

274 Similar trends were seen in 2004 with net returns \$245.65/ha greater for the solid planting
 275 (Table 7). In contrast, Larson et al. [13] reported that net returns for 102-cm skip-row
 276 planting were equivalent to 102-cm solid planting for low or high cotton lint prices in
 277 nonirrigated and irrigated studies. They stated that for base lint prices ranging from \$0.85 to
 278 \$1.38/kg, the savings in seed costs, technology fees, and harvest costs from skip rows were
 279 not enough to offset the yield reductions seen in skip-row with 102-cm row spacing.

280

Table 7. Partial budget production costs for solid versus skip-row plantings in 2004 using 2012 budget values.^a

Variables	Solid	Skip-row	Difference (Solid-skip row)
Yield (Lint kg/ha)	1328	1057	271
Turnout (%)	36.00	36.00	-
Seed cotton yield (Kg/ha)	3690	2935	755
Cotton seed yield (Kg/ha)	2125	1691	434
Lint value per ha at loan	1585.63	1262.06	323.57
Cotton seed value (\$/ha)	620.73	493.96	126.77
Seed costs (\$/ha)	77.54	51.59	(25.95)
Technology fee (\$/ha)	135.81	90.36	(45.45)
In-furrow insecticide costs (\$/ha)	21.67	14.41	(7.26)
Banded herbicide costs (\$/ha)	25.45	16.98	(8.47)
Picking Costs (\$/ha)	351.92	280.11	(71.81)
Ginning costs (\$/ha)	223.61	177.86	(45.75)
Advantage for solid plantings (\$/ha)			245.65

^a DPL 444 BG/RR had Bollgard® and Roundup-Ready® technology with a technology fee of \$262.70/bag. The loan value for solid and skip-row planting was \$1.194/ kg lint while seed cotton was \$292.11/metric ton. Seed costs were \$150/bag based on 250,000 seed/bag while the cost of thiamethoxam seed treatment was \$41.90/bag. S-metolachlor cost was \$2.56/ha while flumeturon cost was \$1.61/ha. Picking charge was \$0.265/kg lint and ginning charge was calculated at \$0.0606/kg seed cotton.

281 However, in the same study, Larson et al. [13] reported that skip-row plantings produced
282 larger net returns than solid row plantings at 25- and 76-cm row spacing under low-lint price
283 scenario (\$0.85/kg) in nonirrigated and irrigated studies. Thus, at low lint prices, savings in
284 seed cost, technology fees, and harvest labor and machinery cost associated with skip-row
285 plantings led to greater net returns than the solid plantings. These results support the theory
286 of Parvin et al. [4] who stated that low prices favor skip-row plantings. To make skip-rows
287 more profitable than solid plantings at high lint prices, a combination of increased yields from
288 skip rows and additional cost savings (e.g., in-row chemical costs) would be needed [13].

289 4. CONCLUSION

290
291 **Conclusions or recommendations on skip-row versus solid planting cotton favor the solid**
292 **planting.** In our studies, no advantage was seen with the skip-row cotton planting with plant
293 populations from 84000 to 126000 plant/ha when compared to single row planting using 91.4
294 cm row spacing. Higher yields and greater net returns were seen with solid plantings and
295 **Rainfall patterns failed to have an effect on the results.** Differences in fiber quality between
296 the solid and skip-row plantings were not consistently significant and therefore, along the
297 upper Texas Gulf Coast, there seems to be no advantage to skip-row cotton plantings.

298 299 ACKNOWLEDGEMENTS

300
301 Cotton Incorporated provided funding for this research but did not participate in any study
302 design, data collection, or interpretation of the results. The Mahalita Family provided land,
303 labor, and equipment for conducting this research. Jim Bosch, Technical Service
304 Agronomist, Delta Pine Land Company, helped with cotton harvest.

305 306 307 COMPETING INTERESTS

308
309 Authors have declared that no competing interests exist.

310 311 AUTHORS' CONTRIBUTIONS

312
313 D. Fromme designed the study, wrote the protocol, and performed the statistical analysis. L.
314 Falconer provided economic input. R. Parker, R. Lemon, and C. Fernandez provided
315 technical support and data analysis. W. Grichar wrote the manuscript. All authors read and
316 approved the final manuscript.

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