EFFECT OF VARIOUS INTRA-ROW SKIPS, PLANT POPULATIONS, AND IRRIGATION LEVELS ON DEVELOPMENT AND YIELD IN COTTON

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Abstract

Cotton (Gossypium hirsutum) production and lint quality were evaluated using two varieties (PM2200RR and PM2326RR) in three skip patterns (Fig. 1) at a constant population of 52,272 plants/acre (average of 4 plants/foot) at Halfway, TX and Lubbock, TX, in 1998. The same study was expanded in 1999 to include three plant populations (52,272, 39,204, and 26,126 plants/acre) and two irrigation regimes (50% and 100% ET replacement). No differences where noted in yield due to plant population, skip pattern, or irrigation level in either year. Differences were observed for the lint strength and micronaire in 1998, but no cause and effect relationship could be identified.

Introduction

On the High Plains of Texas there are many environmental conditions that affect the seedling emergence and stand establishment of cotton. Cool temperatures, hail, and sandstorms reduce stands and often leave skips in the field. Other factors causing intra-row skips in cotton include the use of poor quality seed, non-uniform seed placement, and seedling disease. The cotton plant has the ability to compensate to a degree for poor stands; however, many researchers maintain that uniform seedling establishment is critical in reaching the full yield potential of a cotton crop. This study investigated cotton planted on 40-inch rows to determine if intra-row spacing directly effects the yield and the lint quality of two stripper cotton varieties grown on the High Plains.

Objective

The overall objective of this study was to determine the effects of various intra-row plant spacing patterns on growth, yield, and fiber properties of cotton.

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Materials and Methods

Field studies were conducted in 1998 and 1999 at the Texas Agriculture Experiment Station at Halfway, TX and the Texas Tech University Research Farm east of New Deal. During both years, the research plot area was prepared using standard tillage techniques. After listing (40” row), 60 pounds/acre of nitrogen and 40 pounds/acre of phosphorus were applied to the soil. In addition, Treflan (label rate) was broadcast applied to the soil surface and subsequently incorporated for weed control. This tillage operation also served to incorporate the fertilizer. Prior to planting, the area was irrigated to field capacity utilizing a sub-surface drip irrigation system with the drip lines spaced on 40-inch centers (i.e., located under each row).

Planting was accomplished using a John Deere MaxEmerge II vacuum planter calibrated to drop approximately 150,000 seeds/acre (maximum open setting). At planting, approximately 3 pounds/acre of Temik were applied for early season insect control. Immediately after planting, the plot area was again watered using the drip system such that the “water front” was allowed to wet within 0.5 inch of the surface. This allowed for each seed to be in ample moisture to ensure germination of every viable seed. This was needed such that adequate amounts of seedlings were present and uniformly spaced for the thinning of the treatments.

Standard agronomic practices were followed during the growing season for tillage, irrigation, in-season weed control, and insect control. At the end of the growing season, the crop was terminated using Ginstar and Finish (label rates of both) applied with a ground rig. The plots were subsequently hand-harvested and the material ginned on a research gin.

Treatments (Figure 1)

During 1998, treatment variables included two cultivars (varieties) and four intra-row skip patterns. Paymaster 2200RR and 2326RR were the varieties planted as described above. At the one to two true leaf stage, the intra-row skip treatments were imposed by hand-thinning the plots. Four intra-row skip patterns were utilized. These included: 1) thinning to an even distribution of plants spaced every 3 inches (even), 2) thinning to four plants in 6 inches followed by a 6 inch skip (6/6), 3) thinning to eight plants in 12 inches followed by a 12 inch skip (12/12), and 4) thinning to 12 plants in 18 inches followed by an 18 inch skip (18/18). In this treatment pattern, a constant population of 52,272 plants/acre was maintained. During 1998 the plots were fully irrigated (i.e., approximately 100% ET).

During 1999, the treatment variables were expanded to include two irrigation levels and three plant population levels in addition to the two varieties (Paymaster 2200RR and 2326RR) and four intra-row skip patterns (Even, 6/6, 12/12, 18/18) utilized during 1998. The two irrigation levels included 100% ET replacement (as was the case in 1998) and 50% ET replacement. In addition, three population levels were utilized including 4 plants/foot (as was the case in 1998), 3, and 2 plants/foot. This allowed for constant populations of 52,272, 39,204, 26,126 plants/acre, respectively.

Data Collected

During both years, the plots were plant mapped immediately prior to harvesting. After mapping the plants, the plots were hand harvested for lint yield and the fiber was subsequently sent to the International Textile Center at Texas Tech University for evaluation.

Result and Discussion

In 1998, no significant differences were seen in yield due to intra-row skip patterns (Table 1). Due to the experimental design used in 1998, comparisons between varieties were not made. Differences in lint strength among the skip patterns were seen in 1998 for the variety PM2200RR (Table 2). Skip pattern 18/18 produced lint with the highest strength (30.7 g/tex). Even and 12/12 patterns produced lint with an intermediate strength (29.7 and 29.9 g/tex, respectively). The 6/6 skip pattern resulted in the lowest strength (29.0 g/tex). For the variety PM2200RR, skip pattern 18/18 had a lower micronaire fiber (3.9) than that from even, 6/6, and 12/12 skip (4.1, 4.3, and 4.2, respectively) (Table 3). The lint quality of the variety PM2326 was unaffected by the skip patterns (Tables 2 and 3). No pattern was apparent in the differences in lint quality of PM2200RR, so no firm conclusions could be formulated. A split-split plot was used as a design in 1999. No differences in yield between the varieties at the 50% ET regime was observed (Table 4). At the 100% ET level, PM2326RR (995 lbs/acre) yielded significantly more than the variety PM2200RR (929 lbs/acre) (Table 5). No differences where seen in the yield of PM2200RR and PM2326RR due to plant populations, skip patterns, or irrigation levels in 1999 (Tables 6,7,8, and 9). Fiber qualities for 1999 are being analyzed at this time.

Summary

These data would seemingly indicate that no advantage would result from precision planting (i.e., even spacing of plants within the row). It could be explained, however, that the reason for no yield differences among the various intra-row plant spacings were due to the plasticity (compensating ability) of the cotton plant. This would suggest that the plants bordering the skips produced additional lint because of the extra resources available to them. Under the conditions of this study, the lint yield was not significantly reduced with skips of 6", 12", or 18" in length when: 1) populations ranged from 26,000 to 52,000 plants/acre, 2) skips were equally distributed in the field, and 3) equal distribution of plants existed between skips. Further studies with additional intra-row skip patterns would be useful to producers in making replanting decisions. However, it could be suggested that the lack of any yield difference due to the various intra-row skip patterns were due to uniform distribution of the plants in the planted area, thus, indicating that precision seed placement is important in maintaining yield potential when intra-row skips occur.

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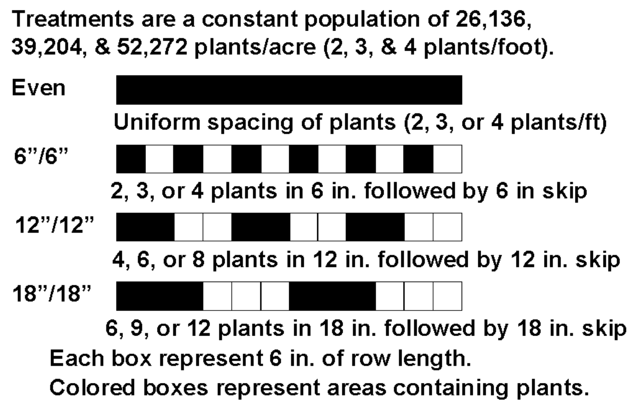

Figure 1. Explanation of treatments.

Table 1. Lint yields for the two varieties and four intra-row patterns during 1998.

Intra-row Pattern	PM2200RR (lbs./acre)	PM2326RR (lbs./acre)	Mean (lbs./acre)
Even	1150	1107	**1129**
6/6	1135	1099	**1117**
12/12	1130	1091	**1111**
18/18	1142	1095	**1119**
Mean	**1139**	**1098**	

Table 2. Fiber strength for the two varieties and four intra-row skip patterns during 1998. (Means followed by different letters are signigicantly different at the 5% level.)

Intra-row Pattern	PM2200RR (gms./tex)	PM2326RR (gms./tex)	Mean (gms./tex)
Even	29.7 b	29.0	**29.4**
6/6	29.0 c	29.7	**29.4**
12/12	29.9 b	28.9	**29.4**
18/18	30.7 a	29.2	**30.0**
Mean	**29.8**	**29.2**	

Table 3. Fiber micronaire for the two varieties and four intra-row patterns during 1998. (Means followed by different letters are signigicantly different at the 5% level.)

Intra-row Pattern	PM2200RR (units)	PM2326RR (units)	Mean (units)
Even	4.1 a	4.0	**4.1**
6/6	4.3 a	4.2	**4.3**
12/12	4.2 a	3.9	**4.1**
18/18	3.9 b	3.8	**3.9**
Mean	**4.1**	**4.0**	

Table 4. Lint yields for the two varieties under the 50% ET replacement regime in 1999.

Variety	Yield (lbs./acre)
Paymaster 2200RR	616
Paymaster 2326RR	610
Mean	**613**

Table 5. Lint yields for the two varieties under the 100% ET replacement regime in 1999.

Variety	Yield (lbs./acre)
Paymaster 2200RR	929 a
Paymaster 2326RR	995 b
Mean	**962**

Table 6. Lint yields for Paymaster 2200RR at the various plant populations and intra-row plant patterns under the 50% ET replacement regime in 1999.

Intra-row Pattern	2 plants/foot (lbs/acre)	3 plants/foot (lbs/acre)	4 plants/foot (lbs/acre)	Mean (lbs/acre)
Even	619	602	642	**621**
6/6	639	610	611	**620**
12/12	618	547	619	**594**
18/18	625	607	655	**629**
Mean	**625**	**592**	**632**	

Table 7. Lint yields for Paymaster 2200RR at the various plant populations and intra-row plant patterns under the 100% ET replacement regime in 1999.

Intra-row Pattern	2 plants/foot (lbs/acre)	3 plants/foot (lbs/acre)	4 plants/foot (lbs/acre)	Mean (lbs/acre)
Even	957	954	879	**930**
6/6	931	945	925	**934**
12/12	930	912	969	**937**
18/18	933	941	873	**916**
Mean	**938**	**938**	**912**	

Table 8. Lint yields for Paymaster 2326RR at the various plant populations and intra-row plant patterns under the 50% ET replacement regime in 1999.

Intra-row Pattern	2 plants/foot (lbs/acre)	3 plants/foot (lbs/acre)	4 plants/foot (lbs/acre)	Mean (lbs/acre)
Even	641	605	633	**626**
6/6	611	658	600	**623**
12/12	588	617	611	**605**
18/18	587	588	586	**587**
Mean	**607**	**617**	**608**	

Table 9. Lint yields for Paymaster 2326RR at the various plant populations and intra-row plant patterns under the 100% ET replacement regime in 1999.

Intra-row Pattern	2 plants/foot (lbs/acre)	3 plants/foot (lbs/acre)	4 plants/foot (lbs/acre)	Mean (lbs/acre)
Even	1005	1006	994	**1002**
6/6	996	1037	977	**1003**
12/12	1010	1002	976	**996**
18/18	971	1026	942	**979**
Mean	**996**	**1018**	**972**	