

COTTON PLANT DENSITY: IMPACTS ON FIBER QUALITY

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Introduction

Cotton plant density has been studied quite intensively in the past and continues to receive attention. The vast majority of this work examines yield, and it is well understood that respectable yields can be obtained from a large range of plant densities. Cotton is unique among many crop plants in that it can exhibit compensatory growth. This characteristic allows for similar yields at plant densities ranging from 1 to 6 plants per foot of row. In addition, yields are also similar between cotton planted in conventional row widths and ultra-narrow rows. What has not been examined so intensively is the impact of these varying plant densities on fiber quality.

As plant density is altered, yields are maintained via alterations in the fruiting pattern of the cotton plant. At higher plant densities fewer bolls per plant will be produced. Plants growing in these higher plant densities also tend to begin fruiting later on higher nodes, and will not produce as many fruiting branches as plants grown in lower plant densities. The potential loss in yield due to less production per plant is overcome by the increased number of plants.

In lower plant densities each individual plant will produce more bolls. Cotton plants grown under these conditions also tend to begin fruiting earlier on lower nodes, produce more fruiting branches, and develop bolls at more distal fruiting positions. All of these factors also lead to a longer fruiting period for plants grown in lower plant densities.

Similar to yield, the quality of the fiber produced by a cotton plant is influenced by many factors such as variety, fertility, insect management, water stress, and temperature. Another factor that potentially influences fiber quality more than yield is weathering of the opened boll.

While growing cotton in lower plant densities may not have an observable impact on yield it may influence quality parameters. Plants grown in lower plant densities produce fruit and develop fiber over a longer period of time, potentially introducing greater variability in developmental conditions for earlier and later set bolls. In addition, plants grown in these lower plant densities will have open bolls exposed to weathering for a longer period of time than will plants produced in higher plant densities. The fiber quality of a boll is at its premium the day it opens, and only deteriorates after that.

A multitude of production practices have changed since the introduction of transgenic cotton varieties, including seeding rates. Cotton seed costs and technology fees associated with seed purchase have steadily increased in recent years. To help offset the rise of seed cost and technology fees producers have reduced seeding rates. The question is whether the reduction seeding rates and plant density has impacted fiber quality.

The objective of this research was to examine the impact of seeding rate on fiber quality.

Materials and Methods

Large plot trials were established across Georgia in growers' fields on cotton variety DP 555 BGRR. Locations included Evans Co., Appling Co., Jefferson Co., Laurens Co. and Pierce Co. Varying plant populations were established by modifying seeding rates on the planter. Low, medium, and high seeding rates consisted of approximately 1.7, 3 and 4 seeds per foot of row, respectively.

Yields were determined by machine harvesting the 4 or 6 center rows of each plot and weighing on a boll buggy equipped with scales at the Appling, Evans, Laurens, and Pierce Co. locations.

Quality was documented in two ways. First a 30 lb subsample of machine picked cotton was collected from each plot. This cotton was ginned at the UGA Microgin in Tifton. HVI data was obtained via the International Textile Center in Lubbock, TX. Secondly, all individual plots from each seeding rate were combined into a module in the Jefferson, Laurens, and Evans Co. locations. These modules were ginned on local commercial gins and all bales were classed with HVI equipment at the Macon classing office.

Results and Discussion

Due to differences in plant emergence there was a significant interaction across locations for final plant stand. Therefore, all yield and quality data generated via the UGA Microgin are presented separately by location in tables 1 through 5.

The variation in stands between the low and high seeding was highly affected by location. In Jefferson Co. the range was only 1.14 to 1.94 plants per foot for the low and high seeding rates, respectively (Table 3). While in Pierce Co. the range was 1.32 to 3.48 plants per foot. Regardless of location or range in final plant stand yield and turnout was unaffected. This further substantiates previous research and grower experience. Thus, there continues to be no yield sacrifice by reducing seeding rates in order to save on seed costs.

Fiber quality as measured from samples ginned at the UGA Microgin and classed at the International Textile Center in Lubbock, TX indicated no consistent trends in HVI parameters as affected by seeding rates.

In Evans, Laurens, and Jefferson Co. cotton from the individual plots were moduled so that separate modules could be built from the varying seeding rates. The fiber quality parameters micronaire, length and strength indicated similar trends to the cotton ginned at the UGA Microgin (data not shown). However, some interesting trends were noted for uniformity. In all three of these locations as the number of plants per foot of row increased, uniformity increased also.

While this discrepancy between data generated at the UGA Microgin and a commercial gin is concerning the magnitude of the change in uniformity with increasing plant density is of little consequence in economic terms. Under the current market structure, the potential economic benefit of increasing uniformity will in no way offset the costs of increased seeding rates.

Conclusions

Collectively these data do not suggest consistent yield or quality benefit with varying seeding rates at the rates tested. It still remains UGA Extension recommendations to utilize seeding rates of 2.5 to 3 seed per foot to maximize the chances of obtaining an adequate and uniform plant stand. The potential change in uniformity does justify further studies into the effect of final plant stand on this parameter.

Table 1. Final plant stand, lint yield, turnout, and fiber quality from 3 planting densities, Appling Co., 2005.

Seeding Rate	Final Stand Plants/foot	Yield Lbs Lint/A	Turnout %	Micronaire	Length inches	Uniformity%	Strength g/tex
Low	1.53 c	965 a	40.1 a	4.4 a	1.095 b	81.2 a	29.9 a
Medium	2.36 b	907 a	40.3 a	4.4 a	1.103 a	80.8 a	29.8 a
High	3.24 a	966 a	40.1 a	4.4 a	1.091 b	81.1 a	29.4 a
<i>Pr>f</i>	0.0003	0.7025	0.9253	0.7624	0.0193	0.0593	0.7471
CV	5.8	9.9	1.6	1.7	1.4	0.9	2.2

Table 2. Final plant stand, lint yield, turnout, and fiber quality from 3 planting densities, Evans Co., 2005.

Seeding Rate	Final Stand Plants/foot	Yield Lbs Lint/A	Turnout %	Micronaire	Length inches	Uniformity%	Strength g/tex
Low	1.69 c	920 a	42.9 a	4.6 a	1.083 a	80.6 a	28.9 a
Medium	2.15 b	965 a	41.9 a	4.5 a	1.083 a	80.7 a	28.5 a
High	3.32 a	966 a	41.9 a	4.4 a	1.088 a	80.7 a	28.8 a
<i>Pr>f</i>	0.0003	0.5239	0.0747	0.2992	0.3086	0.9826	0.2004
CV	5.5	5.5	1.0	1.4	1.0	0.9	2.4

Table 3. Final plant stand, lint yield, turnout, and fiber quality from 3 planting densities, Jefferson Co., 2005.

Seeding Rate	Final Stand Plants/foot	Yield Lbs Lint/A	Turnout %	Micronaire	Length inches	Uniformity%	Strength g/tex
Low	1.14 c	802	40.0 a	4.2 a	1.101 a	81.9 a	30.5 a
Medium	1.52 b	846	39.4 a	4.0 a	1.096 a	81.4 a	30.2 a
High	1.94 a	850	39.7 a	4.1 a	1.102 a	81.4 a	30.0 a
<i>Pr>f</i>	0.0007	-	0.7246	0.1814	0.2081	0.4681	0.0716
CV	5.1	-	2.3	2.3	1.3	0.8	2.5

*Yields were determined from final module weights, individual plot data was not available thus, statistical analysis of yield was not possible.

Table 4. Final plant stand, lint yield, turnout, and fiber quality from 3 planting densities, Laurens Co., 2005.

Seeding Rate	Final Stand Plants/foot	Yield Lbs Lint/A	Turnout %	Micronaire	Length inches	Uniformity%	Strength g/tex
Low	1.13 c	937 a	40.4 a	4.4 a	1.083 a	80.8 a	28.5 a
Medium	1.81 b	942 a	39.9 a	4.4 a	1.084 a	80.7 a	28.9 a
High	2.73 a	1046 a	40.9 a	4.5 a	1.084 a	81.0 a	28.7 a
<i>Pr>f</i>	0.0001	0.5195	0.5290	0.7656	0.9070	0.7346	0.6428
CV	10.0	12.4	2.5	1.5	1.2	0.6	2.9

Table 5. Final plant stand, lint yield, turnout, and fiber quality from 3 planting densities, Pierce Co., 2005.

Seeding Rate	Final Stand Plants/foot	Yield Lbs Lint/A	Turnout %	Micronaire	Length inches	Uniformity%	Strength g/tex
Low	1.32 c	798 a	41.8 a	4.6 a	1.101 a	82.1 a	29.7 a
Medium	2.48 b	835 a	42.2 a	4.6 a	1.117 a	81.7 a	29.8 a
High	3.48 a	809 a	41.1 a	4.5 a	1.108 a	81.9 a	29.5 a
<i>Pr>f</i>	0.0001	0.3635	0.5939	0.5017	0.0525	0.6024	0.2100
CV	2.6	3.6	3.2	0.9	1.5	0.8	2.3

Table 6. Uniformity as determined by commercial ginning moduled cotton from 3 planting densities, Evans, Laurens, and Jefferson Co., 2005.

Seeding Rate	Evans	Laurens	Jefferson
	Uniformity %		
Low	79.40	79.51	79.32
Medium	79.78	80.27	79.44
High	79.83	80.32	79.60