PLANT POPULATION EFFECT ON YIELD AND FIBER QUALITY OF THREE UPLAND COTTON VARIETIES AT MARICOPA AGRICULTURAL CENTER, 2002

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Abstract

A field experiment was conducted at the University of Arizona Maricopa Agricultural Center (MAC – 1100 ft. elevation) in 2002 to evaluate plant population relationships with conventional row spacing under a range of high population conditions with new Upland cotton (Gossypium hirsutum L.) varieties. The varieties, which included AG3601, DP458BR, and STV4892BR, were each planted to six densities of 15,000, 30,000, 45,000, 60,000, 75,000, and 90,000. Inseason plant measurement data revealed crop vigor and fruit retention levels were well within the optimum threshold for all varieties and populations. There was no interaction between variety and population in terms of lint yield and fiber quality parameters. However, results show significant differences in lint yield and fiber strength among varieties but not the fiber micronaire. In addition, higher population had no significant effect on lint yield or fiber quality. Higher populations had no effect in lowering fiber micronaire to premium levels as well.

Introduction

Plant population studies are common features of many agronomic research programs. References to cotton (*Gossypium spp.*) population studies are numerous. There are many citations in the literature that provide information relative to optimum plant population evaluations for cotton that been conducted over the past 100 years (Kittock et al., 1986; Norton et al., 1995; Silvertooth et al., 1994). A very common range in optimum plant population recommendations for cotton is for stand densities of 20,000 to 70,000 plants per acre (ppa). Most of these experiments have been conducted with conventional row spacings from 30 to 40 inches (Feaster et al., 1963; Hawkins and Peacock, 1970; Young, 1971).

Recent work with ultra narrow row (UNR) systems and twin line plant configuration systems has provided some renewed interest in plant population studies with cotton. Recent studies in the desert Southwest have shown evidence of maintaining lint yield potentials with the possible improvement and reduction in fiber micronaire values. This is particularly important in light of the significant price discount growers have been suffering due to high micronaire (greater than 5.0) values that have become more and more common in recent years in Arizona. Therefore, there is a renewed interest in plant population dynamics in irrigated cotton production systems in Arizona and in the desert Southwest.

With this information in mind, a field experiment was initiated at the University of Arizona Maricopa Agricultural Center (MAC) in 2002. The objective of this experiment was to evaluate plant population relationships with conventional row spacing under a range of high population conditions with new varieties.

This is a part of the 2003 Arizona Cotton Report, The University of Arizona College of Agriculture and Life Sciences, index at http://cals.arizona.edu/pubs/crops/az1312

Materials and Methods

A field study was conducted in 2002 at the University of Arizona Maricopa Agricultural Center (MAC; 1,175 ft. elevation) on a Casa Grande sandy loam soil. The experimental design was a split-plot within a randomized complete block design with four replications. The mainplot treatments consisted of three Upland cotton (*Gossypium hirsutum* L.) varieties, namely AG3601, DP458BR, and STV4892BR and each subunit consisted of six populations (densities). The six populations were 15K, 30K, 45K, 60K, 75K, and 90K. Subplots were four, 40 inch rows wide and 40 ft. in length. The study was dry planted and watered up on 8 April. Agronomic information for the study is presented in Table 1. All inputs such as fertilizer, water, and pest controls were managed on an as-needed basis.

A complete set of plant measurements were collected from all plots at each site on 14-day intervals. Measurements taken included plant height, number of mainstem nodes, first fruiting branch, total number of aborted sites (positions 1 & 2), number of nodes above the top (1st position) white flower, canopy closure, and number of blooms per unit area. Climatic conditions were also monitored using an Arizona Meteorological network (AZMET) located on the station.

The center two rows of each subplot each harvested on 1 November and subsamples were collected for ginning and turnout estimates. Results for yield and fiber quality were analyzed statistically in accordance to procedures outlined by Steel and Torrie (1980) and the SAS Institute (SAS, 1988).

Results and Discussion

The crop growth and development data revealed relatively strong FR levels for all three varieties (AG3601, DP458BR, and STV4892BR) for each plant population. The crop vigor index, using a HNR, indicated a well-balanced crop in terms of vegetative growth for all independent variables (variety and plant population) as well.

Lint yield and fiber quality results for the population by variety experiment at MAC are presented in Tables 2-7. Because there was no significant difference in interaction between variety and planting density (population) (Table 2), analysis of the result is focused on the differences within the main effect variables, which included variety and population. As shown in Tables 3, there were significant differences in yield and fiber strength but not in fiber micronaire among varieties used in the study. In addition, higher planting population did not result into higher yield and market optimum fiber quality (OSLs>0.05 – Table 3). However, in general it appears that for all varieties which included AG3601, DP458BR, and STV4892BR, a population range of 45,000 – 75,000 is adequate for producing optimum yield and exceeding this level may be uneconomical (Tables 4 and 5). Higher planting densities did not affect fiber quality parameters as well, especially fiber micronaire which was expected to be lowered by higher populations (Tables 4, 6, and 7).

Acknowledgements

The support provided by the staff at the University of Arizona Maricopa Agricultural Center is greatly appreciated. We also wish to thank the research assistants of the University of Arizona cotton agronomy research program for collecting inseason growth and development data.

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Table 1. Agronomic information for the Population by Variety study, MAC, AZ, 2002.

Variety	Density (X 1,000)	
AG3601	15, 30, 45, 60, 75, 90	
DP458BR	15, 30, 45, 60, 75, 90	
STV4892BR	15, 30, 45, 60, 75, 90	
	Date	Heat Units (HU)
Planting	8 April	633 (since Jan. 1)
Irrigation Termination	27 August	3330 HUAP (HU after planting)
Harvest	1 November	4621 HUAP

Table 2. Experimental effects and statistical significance from the analysis of variance on yield and fiber quality, population by variety study, MAC, 2002.

Source of Variation (Effect)	**OSL (Pr >F)**		
	Lint Yield	Fiber Micronaire	Fiber Strength
Variety	0.0010	0.1721	<0.0001
Population	0.1181	0.4048	0.5632
Variety*Density	0.1318	0.8529	0.4519

Table 3. Main effect results of variety by population study, MAC, 2002.

Variety	Lint Yield (lbs. lint/acre)	Fiber Micronaire	Fiber Strength
AG3601	1493 a*	5.60	35.0 a
DP458BR	1380 b	5.58	28.5 b
STV4892BR	1318 b	5.69	29.0 b
LSD	79	NS	0.72
OSL**	0.0010	0.1721	<0.0001
CV(%)§	9.6	2.0	4.0
Population (X1,000)			
75	1479	5.61	30.6
60	1451	5.59	30.5
45	1430	5.67	30.8
90	1354	5.59	31.3
30	1336	5.64	30.9
15	1331	5.64	30.9
LSD	NS	NS	NS
OSL	0.1181	0.4048	0.5632
CV(%)	10.5	2.2	11.0

*Least Significant Difference – means followed by the same letter are not significantly different according by a Fishers mean separation test at 0.05 level.

**Observed Significance Level.

§Coefficient of Variation

Table 4. Yield and fiber quality as affected by plant population for each variety, MAC, 2002

Density (X1,000)	Lint Yield (lbs. lint/acre)	Fiber Micronaire	Fiber Strength
AG3601			
60	1637	5.58	34.9
45	1563	5.65	35.3
15	1474	5.58	34.9
75	1449	5.58	34.4
30	1446	5.68	35.5
90	1348	5.23	35.0
DP458BR			
75	1542	5.58	28.6
90	1385	5.60	29.5
60	1372	5.23	28.9
45	1355	5.60	28.6
30	1347	5.55	28.2
15	1278	5.65	27.5
STV4892BR			
75	1446	5.68	28.8
45	1374	5.75	28.6
60	1350	5.68	28.0
90	1279	5.65	29.5
15	1242	5.70	30.2
30	1214	5.70	29.1

Variety*Density = Not significant for all variables (yield, Micronaire, and strength)

Table 5. Lint yield (lbs. lint/acre) for all varieties as affected by plant population, MAC, 2002.

	Density (X1,000)					
Variety	15	30	45	60	75	90
AG3601	1474	1446	1563	1637	1449	1348
DP458BR	1278	1347	1355	1372	1542	1385
STV4892BR	1242	1214	1347	1350	1446	1279

Variety*Density = Not significant for all variables (yield, Micronaire, and strength)

Table 6. Fiber micronaire for all varieties as affected by plant population, MAC, 2002.

	Density (X1,000)					
Variety	15	30	45	60	75	90
AG3601	5.58	5.68	5.65	5.58	5.58	5.23
DP458BR	5.65	5.55	5.60	5.23	5.58	5.60
STV4892BR	5.70	5.70	5.68	5.68	5.68	5.65

Variety*Density = Not significant for all variables (yield, Micronaire, and strength)

Table 7. Fiber strength for all varieties as affected by plant population, MAC, 2002.

	Density (X1,000)					
Variety	15	30	45	60	75	90
AG3601	34.9	35.5	35.3	34.9	34.4	35.0
DP458BR	27.5	28.2	28.6	28.9	28.6	29.5
STV4892BR	30.2	29.1	28.6	28.0	28.8	29.5

Variety*Density = Not significant for all variables (yield, Micronaire, and strength)