EFFECT OF PLANTING DATE, MOISTURE, AND HEAT UNITS ON COTTON YIELD AND FIBER QUALITY UNDER DRYLAND PRODUCTION

K. M. El-Zik, P. M. Thaxton,
T. F. Dusek and T. D. Brooks
Texas A&M University
College Station, TX
K. Schaefer
TAMU Agricultural Research
& Extension Center
Corpus Christi, TX

Abstract

Planting early in the season at an optimum time is important for cotton productivity and profit, especially in rainfed-dryland production systems. Twenty cotton genotypes: 17 multi-adversity resistance (MAR-8) strains and three variety checks, were included in a three-planting-dates test, in Corpus Christi, Texas. Planting dates were on March 2, April 6 and April 9, 1999. Heat units and moisture were adequate for all three planting dates. The analysis of variance for lint yield and fiber quality traits showed that planting date and genotypes were highly significant for all traits measured. Planting date x genotype interaction was significant only for fiber uniformity and micronaire. The third planting date, April 9, produced the highest lint yield and fiber quality. Averaged over genotypes, the third planting date produced 1290 lb/acre, fiber length of 1.11 inches and strength of 28.8 g/tex compared to the 999 lb/acre yield of the first planting, with 1.06 inches fiber length and strength of 27.6 g/tex. Yield and fiber quality traits of the second planting were between both the third and first planting dates. Micronaire values were significantly higher for the second (4.61 units) and for the third (4.56 units) planting dates than the first date (4.38 units). Rainfall amounts and distribution for the area in 1999 were the exception rather than the normal. More rainfall is received normally in April and May and much less in June and July in the Corpus Christi area. Therefore, planting as early as possible under favorable conditions in the Coastal Bend Region of Texas is important to allow for cotton growth, development, and early fruit set prior to the minimum rainfall and higher temperatures that prevail during June and July.

Introduction

Manipulation of planting dates is one of the oldest methods used by growers to achieve profitable cotton production. Several considerations contribute to timing of planting. These include climate, length of the growing season, water availability, and biotic and abiotic factors that influence plant development and fruiting (El-Zik and Frisbie, 1985). Cotton planting is usually delayed until the soil temperature reaches at least 60ºF. This occurs in late February and early March along the Texas Gulf Coast and in Arizona, in April in the San Joaquin Valley of California, after mid-April in most of the Cotton Belt, and in May in the Texas Rolling and High Plains and in Oklahoma.

About 65% of the cotton acreage in Texas is rain-fed (dryland production). Texas experienced severe drought in 1998, and in 1999 the season had a slow start in South Texas followed by adequate moisture (rainfall) and growing conditions. In the 1999 multi-adversity resistance (MAR) tests at Corpus Christi, Texas, two of three tests dried out due to marginal planting moisture and high winds. These two tests were replanted about a month later after receiving two inches of rainfall. This study reports on observed differences in yield and fiber quality characteristics between the three planting date tests.

Material and Methods

The first planting date (Strains test) was on March 2, 1999, which is the normal planting time for the region, and was harvested July 29. The second planting (Uniform MAR test) was on April 6 and was also harvested July 29. The third test (Nueces County test) was replanted April 9 and harvested August 9. Twenty genotypes were common to all three tests, 17 advanced MAR-8 strains and three variety checks: Tamcot Sphinx, Tamcot Luxor (El-Zik and Thaxton 1996; Thaxton and El-Zik 1994, 1996, 1999), and Deltapine 50. The experimental design for each planting date was a randomized complete block with four replications. The MAR system is utilized to develop elite MAR strains and Tamcot varieties with simultaneous genetic improvement for lint yield, earliness, resistance to insects and pathogens, drought tolerance, and fiber and seed quality (El-Zik and Thaxton 1989).

Data collected were daily rainfall and temperature, and heat units were calculated. Plots were harvested, a grab seed cotton sample taken, processed and ginned, and lint percentage and yield determined. Fiber quality traits were measured by the International Textile Center, Texas Tech University, utilizing the HVI double line. Data were statistically analyzed for each planting date and over dates for each trait.

Results and Discussion

During January and February 1999, 3.5 inches of rainfall was received, not enough to fill the soil profile. The effect of the severe drought of 1998 was still felt. The first planting date received two more inches (a total of 11.2 inches) than the second and third plantings which each received a total of 9.1 inches, that is near the normal (Figure 1). Effective rainfall was received in March (2.1 inches), 1.1 inches in April, 2 inches in May, 2.4 inches in June, and 3.6 inches in July

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:525-528 (2000)
National Cotton Council, Memphis TN

which were beneficial for boll setting, retention and maturity. The first planting date had more total heat units (2,456) than the second (2,143) and third (2,350) planting dates (Figure 2). Heat units and moisture (rainfall) were adequate for all planting dates, but rainfall was more beneficial to the second and third planting dates.

The 1999 season was generally a good one for most of the Texas cotton production regions. Figure 3 shows lint yield for two irrigated (Weslaco and College Station-Brazos Valley) and Figure 4 for three dryland (Corpus Christi, Thrall and McGregor) Uniform MAR tests in 1997, 1998, and 1999. In all tests lint yield was higher in 1999 than in 1997 or 1998. Under irrigation, yield averaged 1017 lb/acre in 1997 compared to 771 lb in 1998 and 1118 lb/acre in 1999. Averaged over the three dryland locations, lint yield averaged 456 lb/acre in 1997, 364 lb in 1998, and 896 lb/acre in 1999, almost double the yield of the previous two seasons.

The analysis of variance for lint yield showed that replication, planting date and genotypes were highly significant (Table 1). The planting date x genotype interaction was not significant. Lint yield was significantly higher for the third planting date on April 9 (1290 lb/acre) than the yield of second (1068 lb) and first (999 lb) planting dates (Table 2). Yield ranged from 817 to 1210 lb/acre for the first planting, 912 to 1247 lb for the second, and 1115 to 1449 lb/acre for the third planting date, which was planted one month later. Mean lint yield over the three dates was 1119 lb/acre with a range of 953 to 1249 lb/acre. Adverse weather stresses; cold, high winds and reduced moisture availability affected plants especially of the first planting date.

Differences in lint yield were significant among strains and varieties within each of the three planting dates and over dates (Table 2). The first six MAR strains produced the highest yields, with the prospective new variety release 'Tamcot Pyramid' leading the way in the second and third planting dates and over dates. The other five are elite strains from the MAR-8 gene pool.

The analysis of variance for fiber quality traits shows that planting date and genotypes were highly significant for fiber length, uniformity, strength and micronaire (Table 3). Replication was significant for fiber length, uniformity and strength. The planting date x genotype interaction was significant for fiber uniformity and micronaire. Fiber length and strength were significantly higher for the third planting date than the first and second dates, which were similar (Table 4). Mean fiber length over genotypes measured 1.06 inches for the first date, l.07 inches for the second and 1.11 inches for the third date. Fiber strength measured 27.3 g/tex for the first date, 27.6 g/tex for the second and 28.8 g/tex for the third planting date, averaged over genotypes. Micronaire values were significantly higher for the second (4.61 units) and third (4.56 units) planting dates than the first date (4.38 units). Significant differences were obtained among genotypes for fiber quality traits in each planting date and over dates.

Conclusion

The third planting date on April 9 produced the highest yield and fiber quality. However, rainfall amounts and distribution for the area during the 1999 season were the exception rather than the normal. More rainfall is received normally in April and May and much less in June and July in the Corpus Christi area. Heat units were normal for all planting dates.

Planting at the optimum time for rapid seed germination and seedling growth is basic to cotton production. It is important to avoid conditions that will tend to delay crop development at any stage. Adverse planting conditions can stunt plants and result in damaged root systems that remain shallow rooted, thus reducing yield and fiber quality. The Coastal Bend Region has a very narrow window for producing the cotton crop before the hurricanes. How much rainfall will be received later in the season can not be predicted. Therefore, planting as early as possible under favorable conditions in the Coastal Bend Region of Texas is important to allow for cotton growth, development, and early fruit set prior to the minimum rainfall and higher temperatures that prevail during June and July.

Acknowledgment

This research was supported in part by grants from the Texas Food and Fibers Commission, and the Texas State Support Committee-Cotton Incorporated. We thank Texas A&M University Agricultural Research and Extension Corpus Christi Center staff Clinton Livingston for providing the weather data and Gilbert Ayala for his efforts in managing the tests.

References

Bird, L. S. 1982. The MAR (multi-adversity resistance) system for genetic improvement of cotton. Plant Dis. 66:172-176.

El-Zik, K. M. and R. E. Frisbie. 1985. Integrated crop management systems for pest control and plant protection. p. 21-122. *In* M. B. Mandava (ed.) CRC Handbook of Natural Pesticides: Methods. Vol. I. Theory, Practice, and Detection. CRC Press, Inc., Boca Raton, FL.

El-Zik, K. M., and P. M. Thaxton. 1989. Genetic improvement for resistance to pests and stresses in cotton. p. 191-224. *In* R. E. Frisbie, K. M. El-Zik, and L. T. Wilson (Eds.) Integrated Pest Management Systems and Cotton Production. John Wiley & Sons, New York.

El-Zik, K. M., and P. M. Thaxton. 1996. Registration of ‘Tamcot Sphinx’ cotton. Crop Sci. 36:1074.

Thaxton, P. M. and K. M. El-Zik. 1994. Genetic enhancement of MAR cottons for resistance to insects and pathogens, yield and fiber quality. Proc. Beltwide Cotton Prod. Res. Conf., Cotton Improv. Conf. 46:658-661.

Thaxton, P. M. and K. M. El-Zik. 1996. Genetic advance in new multi-adversity resistance (MAR) cotton germplasm. Proc. Beltwide Cotton Prod. Res. Conf., Cotton Improv. Conf. 48:601-611.

Thaxton, P. M., and K. M. El-Zik. 1999. Superior new MAR cotton germplasm for drought, productivity and quality. Proc. Beltwide Cotton Conf., Cotton Improv. Conf. 51:470-472.

Table 1. Analysis of variance for lint yield.

Source	d.f.	*P* > F
Replication	3	0.002
Planting Date	2	0.001
Genotype	19	0.001
Planting Date x Genotype	38	0.818
Error	137	-------

Table 2. Mean Lint yield of twenty cotton genotypes in three planting dates and averaged over dates, Corpus Christi, Texas.

	Planting Date			Mean over
MAR Strain/Variety	**I**	**II**	**III**	**Dates**
Tamcot Pyramid	1051*	1247*	1449**	1249**
SPNXCUQPIH-1-97	1210	1143	1235	1196
CIQBCHGC8H-1-96	991	1220	1352	1188
CIQBCDULBH-1-96	990	1192	1344	1175
LBK8SPXLBH-2-97	1039	1177	1308	1175
PD22CUBQWS-1-95	1072	1066	1354	1164
CUQPIHGP6H-1-97	1102	1078	1305	1162
Tamcot Luxor	1015	1091	1350	1152
GARNTHGPIH-1-96	1091	1082	1243	1139
CUQPI2LBGS-3-97	1023	1007	1370	1133
Deltapine 50	1001	1149	1230	1127
HQ95HGPI6H-1-97	1068	1085	1225	1126
SPNXHGPI6H-1-97	968	965	1393	1109
SPNX2HQPIH-1-97	925	1114	1250	1096
CUQPISXLBH-4-97	955	980	1299	1078
PD2QPIHGCH-1-97	940	1024	1246	1070
LBCHGPI2KS-1-96	926	915	1342	1061
LBQWICQPIS-2-96	871	978	1212	1020
Tamcot Sphinx	921	912	1176	1003
LBK8PD2CGS-1-97	817	928	1115	953
Mean	999	1068	1290	1119
LSD (P=0.05)	159	181	146	120
C.V.%	15.4	15.3	8.0	12.4

*, ** Significant at the 0.05 and 0.01 probability levels, respectively.
† Least significant difference between two means within a column.

Table 3. Analysis of variance for fiber quality traits.

		P > F			
Source	**d.f.**	**Length**	**Unifor-mity**	**Strength**	**Micro-naire**
Replication	3	0.001	0.001	0.095	0.384
Planting Date (PD)	2	0.001	0.001	0.001	0.001
Genotype	19	0.001	0.001	0.001	0.001
PD x Genotype	38	0.413	0.006	0.097	0.020
Error	137	-------	-------	-------	-------

Table 4. Mean fiber, length, strength, and micronaire over genotypes in three planting dates in Corpus Christi, Texas.

Planting Date	Length	Strength	Micronaire
	inches	g/tex	units
I. March 2	1.06a†	27.3 a	4.38 a
II. April 6	1.07 a	27.6 a	4.61 b
III. April 9	1.11 b	28.8 b	4.56 b
Mean	1.08	28.0	4.54

† Means followed by the same letter within a column are not significantly different (*P*=0.05).

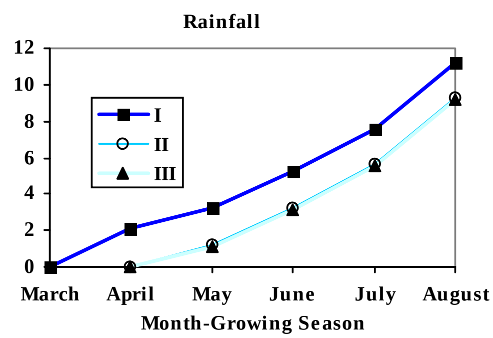

Figure 1. Cumulative rainfall for three planting dates during the 1999 growing season at the Corpus Christi Test location.

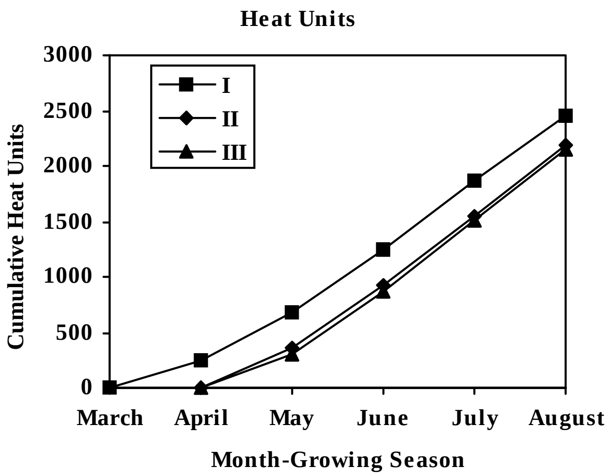

Figure 2. Cumulative heat units for three planting dates during the 1999 growing season at the Corpus Christi Test location.

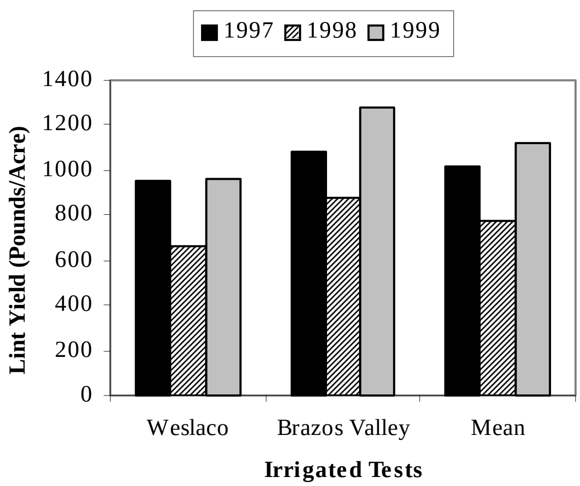

Figure 3. Mean lint yield for MAR cotton strains and varieties in the Uniform MAR (UMAR) Test at two irrigated location and three years, and mean over locations.

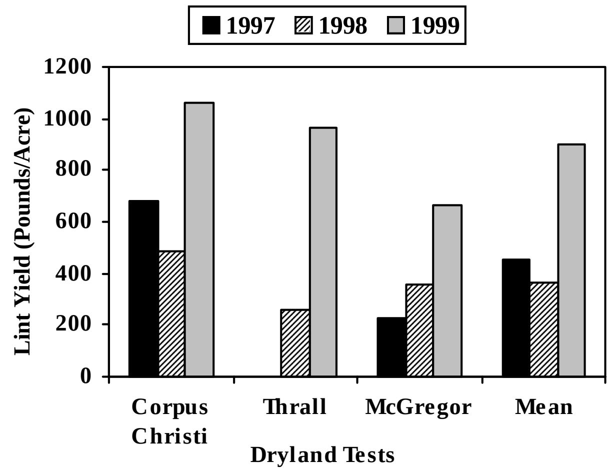

Figure 4. Mean lint yield for MAR cotton strains and varieties in the Uniform MAR (UMAR) Test at three dryland locations and three years, and mean over locations.