

**GENETIC ADVANCE IN NEW
MULTI-ADVERSITY RESISTANCE (MAR)
COTTON GERmplasm
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Abstract

The main emphasis of the Multi-Adversity Resistant (MAR) program is to develop improved cotton germplasm and varieties for the Southwest USA cotton belt. New MAR-7A and MAR-7B strains were extensively tested in 1994 and 1995 in the Early Field Planting Test (EFP) at four locations and the Uniform MAR test (UMAR) at 10 locations. New strains with higher levels of resistance to insects and pathogens than previously released MAR germplasm have been identified. The advanced MAR-7 strains gave high stands under the exceptional cold and wet conditions following planting in 1995, indicating high resistance to seed-seedling pathogens and cold tolerance. Resistance levels were improved for pathogens causing Phymatotrichum root rot, Verticillium and Fusarium wilts.

Average lint yield for MAR-7A strains over nine UMAR tests was 592 lb/acre, with a range among locations from 279 lb/acre for McGregor to 926 lb/acre for the Brazos Valley test. In the EFP tests averaged over four locations, yield for the MAR-7B strains ranged from 427 lb/acre at College Station to 739 lb/acre at the Corpus Christi test, with a mean of 636 lb/acre.

The MAR-7 germplasm is genetically diverse for many agronomic and morphological traits. The 1995 results continue to document the improvement in fiber quality traits in the MAR germplasm. Fiber quality traits have improved in the MAR-7 strains, with fiber length ranging from 1.10 to 1.25 inches, uniformity 83.3 to 86.5, strength 28.5 to 34.2 g/tex, elongation 5.5 to 6.9, micronaire 3.7 to 4.8, maturity 80.6% to 95.1% and fineness 149 to 178.

Based on extensive testing and data base we have identified and selected superior cotton strains. Several advanced MAR-7A strains will be released in early 1997. Also, possibly a smooth (glabrous) MAR Tamcot variety will be released in 1997. Advanced MAR-7A strains that combine the many desired traits are: CBD3CUBPIH-3-91, CUBQHGRPIS-1-92, CUBQHGRPIH-1-92, CDRCIQCUBH-2-92, CDULBQSHPS-1-93, BLCCG8CP45H-1-93, and PD23CD3HGS-1-93. The

MAR-7B strains will be further tested to determine their stability over Texas Cotton growing regions and will be released in two years. The MAR-7B promising strains are HGPIHQBPIH-2-94, HGPICG14QH-1-94, PD24HQBPIH-1-94, SPNXHQBPIS-1-94, and HGPICDHGBS-1-94. The new MAR-7 releases will maximize sustainable profits to growers and benefit the USA cotton industry.

Introduction

Cotton breeding programs have made substantial progress in the last 15 years in developing current varieties with higher yield and fiber quality, to meet the demands of both the cotton producer and the textile industry. Mills today demand stronger and mature fibers for the faster rotor and air-jet spinning technology. The MAR genetic improvement system utilizes seed, seedling and plant selection procedures and techniques to develop MAR cottons (1, 2). The MAR program has been very successful in developing cotton germplasm that is resistant to insects, pathogens, environmental stresses, while improving their agronomic characteristics, yield, fiber and seed quality (2,3,4,5,6). The objective of this research was to quantify the genetic gains in resistance to insects and pathogens, yield and fiber quality in the MAR-7 germplasm.

Materials and Methods

A total of 109 MAR-7 strains were identified and selected in 1992 to 1994 and extensively tested in 1995. The MAR-7 hybrid pool strains are divided into two groups: MAR-7A and MAR-7B. The MAR-7A germplasm is 1991 to 1993 strains, and the MAR-7B strains are the 1994 selections. The MAR-7A strains were tested over a two year period, 1994 and 1995, in the Uniform MAR test (UMAR). The UMAR tests were planted in eight locations in Texas and have 24 entries, including 3 variety checks. The MAR-7B strains were planted in replicated tests in 1995 in the Early Field Planting test (EFP) at four locations, and included 32 entries, five entries were variety checks. Entries were arranged in a randomized complete block design, with four replications. Plots were harvested at two dates to estimate earliness and determine lint yield. Fiber quality was analyzed at the International Textile Center, Texas Tech University, Lubbock, utilizing the High Volume Instrument (HVI) line. Analysis of variance was performed to determine differences among strains for each test and combined over locations. When measured traits had a significant *F* value ($P < 0.05$), means were separated using Fisher's least significant difference (LSD) procedure.

The common locations for both the UMAR and EFP tests were Weslaco, Corpus Christi, College Station, and Temple. The UMAR test was also grown at Temple, McGregor, Halfway and Chillicothe. These locations represent a wide range of diverse environments including

moderate to severe water stress, and insect and disease pressures. All locations are used to test for stand ability and resistance to seed-seedling diseases. Natural infestation of bacterial blight (*Xanthomonas campestris* pv. *malvacearum*) has been observed in most Texas locations in recent years. All MAR strains are artificially inoculated with a mixture of the four races of the bacterial blight pathogen in the field and greenhouse to screen for resistance. The Temple and McGregor sites are naturally infested with *Phymatotrichum omnivorum*. Plants killed by *Phymatotrichum omnivorum* were counted three times during the season, and the percentage of dead plants calculated for each plot. The Chillicothe and Halfway nurseries are infested with *Verticillium dahliae*. Plants with foliar *Verticillium* wilt symptoms are counted approximately five weeks prior to maturity. Resistance to insects is based on grades and observations that are made at each of the locations several times during the season, knowing the insect pressures and damage, and on lint yield and earliness.

Results and Discussion

Resistance to Pathogens

Evaluation of resistance of the MAR-7A germplasm to seed-seedling pathogens is based on stand data from the 1995 UMAR tests. Since non-treated, ungraded seed is used for planting, and exceptional early season adverse and cold conditions occurred, it was a difficult season for stand establishment. Four locations had to be replanted this year. Each plot was planted with 100 seeds, and counts were made for emergence and final stand. Averaged over eight UMAR test locations, final stand ranged from 36.9% for HGC23HGPIH-1-93 to 71.7% for Tamcot Sphinx, with an overall mean of 55.3% (Table 1). At College Station, stand ranged from a low of 12.3% to a high of 82.3%. Those strains not able to give an acceptable stand under the cold-wet conditions will be discarded from the program. In the presence of exceptional early season adverse conditions for stand establishment, six MAR-7A strains gave stands higher than 60%. In the EFP tests, averaged over four locations, final stand for the MAR-7B strains ranged from 40.3% for Tamcot CAMD-E to 81.5% for LBHGHQSHPS-1-94, with a mean of 71.0% (Table 2).

The established MAR laboratory, greenhouse, and field screening and selection procedures continue to be effective for developing germplasm resistant to seed-seedling pathogens and cold tolerance in cotton.

Table 3 summarizes the improvement in resistance to pathogens causing diseases for advanced MAR-7A strains in comparison with Tamcot HQ95. Increased level of resistance is indicated with a + sign, a decrease with a - sign, and no change with an = sign. Based on data from the UMAR tests, the MAR-7A germplasm is equal to or better than Tamcot HQ95 for resistance to pathogens. Three MAR-7A strains had higher resistance levels to pathogens causing seed-seedling disease. Since all MAR

germplasm is tested annually for resistance to races of the bacterial blight pathogen, all new MAR germplasm has high resistance or immunity to bacterial blight. In addition, several new MAR-7A have equal or higher levels of resistance to *Verticillium dahliae* and *Phymatotrichum omnivorum*, especially the glabrous strains CUBQHGRPIS and PD23CD3HGS than Tamcot HQ95.

Resistance to Insects

Table 4 summarizes the improvement of MAR-7A strains for resistance to insects in comparison to Tamcot HQ95. Two new strains, CUBQHGRPIS (glabrous) and its isoline CUBQHGRPIH (hairy) had higher levels of resistance to all insects than Tamcot HQ95, and even better than Tamcot Sphinx. Overall, 4 new strains had improved resistance to aphids, 2 to fleahoppers, 6 to the boll weevil and 5 to the bollworm/budworm. The new MAR-7B strains have the highest improvement in insect resistance. Based on grades and observations, insects pressure and damage in 1995 tests, HGPIHQBPIH and HGPICG14QH had higher resistance levels than Tamcot HQ95 and Tamcot Sphinx to all four insects (Table 5). Overall, 4 new strains had improved resistance to aphids, 3 to fleahoppers, 5 to the boll weevil and 5 to the bollworm/budworm. Progressive increases in levels of resistance to seven insects: thrips, aphids, fleahopper, boll weevil, budworm, bollworm and whitefly, have been obtained in the MAR-7 germplasm.

Lint Yield

As with the improvements in resistance to pathogens and insects, a parallel increase in lint yield was obtained in the MAR-7A and MAR-7B germplasm. Yields for new MAR-7A strains in the UMAR test, for each location and averaged over eight locations are presented in Table 6. Four UMAR tests were dryland and four were irrigated. Mean lint yield ranged among locations from 279 lb/acre at McGregor, which is a minimum input production system, because it is dryland, not sprayed with insecticides, and had only one cultivation early in the season, to 926 lb/acre on the A&M Farm in the Brazos Valley. Averaged over six UMAR tests, under both irrigated and dryland production (Corpus Christi, Temple (2), McGregor), lint yield ranged from 415 lb/acre for HGC23HGPIH-1-93 to 839 lb/acre for Tamcot Sphinx, with an overall mean of 654 lb/acre (Table 6). Five MAR-7A strains produced lint yields similar to Tamcot Sphinx and significantly higher than the previously released Tamcot varieties. Three of the top MAR-7A strains are glabrous and three are hairy.

Even under the very severe conditions that occurred in the Rio Grande Valley (Weslaco) in 1995, the two UMAR tests provided valuable information. Eight strains produced lint yield higher than 600 lb/acre (Table 6) The glabrous MAR-7A strain PD23CD3HGS-1-93 produced substantially high yield in both tests.

In the EFP tests averaged over four locations, the new advanced MAR-7B strains performed better than the MAR variety checks, including Tamcot Sphinx, with yield ranging from 441 lb/acre for Tamcot CAMD-E to 825 lb/acre for the MAR-7B strain HGPIHQBPIH, a 15% increase over Tamcot Sphinx and 87% over Tamcot CAMD-E (Table 7). Test means were 598 lb/acre for Weslaco, 739 lb/acre for the Corpus Christi dryland test, 427 lb/acre for the College Station Upland Farm test (had thin non-uniform stands) and 741 lb/acre for the Temple test. Six new MAR-7B strains produced yield in excess of 700 lb/acre and were equal in yield to the MAR-6 Tamcot Sphinx. The highest three yielding strains have a common parent, MAR-CAHUGARPIH, which has the highest levels of resistance to several insects and was released as part of the MAR-6 strains.

Lint Percentage and Gin Turnout

Generally, most of the new MAR-7 strains have similar lint percentage and gin turnout as the latest released Tamcot varieties. In the UMAR test, averaged over five locations, lint percentage of the MAR-7A strains ranged from 33.0% to 37.8%, with a mean of 35%, and gin turnout ranged from 23.4% to 28.6%, with a mean of 26.1% (Table 8). Averaged over the four EFP tests, mean lint percentage of the MAR-7B strains was 32.1% with a range from 30.3% to 33.8%, and gin turnout ranged from 24.0% to 28.2% with a mean of 25.8% (Table 9).

Fiber Quality

Results from the 1995 tests continue to document the genetic improvement and higher fiber quality obtained in the MAR-7 germplasm. In the 1995 UMAR tests, averaged over five locations, fiber length of the MAR-7A strains ranged from 1.06 to 1.18 inches, uniformity 81.5 to 83.9, strength 27.3 to 33.7 g/tex, elongation 5.5 to 6.9, micronaire 3.7 to 4.7, maturity 79.2% to 88.2% and fineness ranged from 172 to 203 (Table 8). Ten MAR-7A strains produced fiber stronger than 30 g/tex. Fiber strength of Tamcot Sphinx and five strains was higher than 31 g/tex. Fiber quality for CUBQHGRPIS-1-92, a glabrous strain and the highest yielder of the MAR-7A strains, is excellent with a length of 1.13 inches, strength 30.7 g/tex and a 4.4 micronaire.

Averaged over three 1995 EFP test locations, the MAR-7B strains are longer than Tamcot Sphinx, and have excellent fiber strength over 30 g/tex (Table 9). Fiber length ranged from 1.06 to 1.16 inches, uniformity 81.7 to 84.0, strength 27.3 to 33.0 g/tex, elongation 5.4 to 6.5, micronaire 3.7 to 4.9, maturity 79.0% to 88.9% and fineness ranged from 158.0 to 200.1 (Table 9). The top five strains have a PI designation in their background which stands for an Argentina strain, Pora Inta, that has excellent fiber quality.

The MAR-7 germplasm is genetically diverse for many agronomic and morphological traits. Fiber quality traits

have improved in the MAR-7 germplasm, with fiber length ranging from 1.10 to 1.25 inches, uniformity 83.3 to 86.5, strength 28.5 to 34.2 g/tex, elongation 5.5 to 6.9, micronaire 3.7 to 4.8, maturity 80.6% to 95.1% and fineness 149 to 178 (Table 10).

Summary

The MAR breeding system continues to make substantial progress in creating and identifying recombinations of genes for resistance to plant pathogens and insects. Further progressive improvements in lint yield potential, fiber quality especially fiber strength and maturity, and resistance to pathogens and insects have been made in the new advanced MAR-7 germplasm. Based on extensive testing and data base we have identified and selected superior cotton strains. Several advanced MAR-7A strains will be released in early 1997. Also, possibly a smooth (glabrous) MAR Tamcot variety will be released in 1997. Elite MAR-7A strains that combine the many desired traits are: CBD3CUBPIH-3-91, CUBQHGRPIS-1-92, CUBQHGRPIH-1-92, CDRCIQCUBH-2-92, CDULBQSHPS-1-93, PD23CD3HGS-1-93, and BLCG8CP45H-1-93. The MAR-7B strains will be further tested to determine their stability over Texas Cotton growing regions and will be released in two years. The MAR-7B promising strains are HGPIHQBPIH-2-94, HGPICG14QH-1-94, PD24HQBPIH-1-94, SPNXHQBPIS-1-94, and HGPICDHGBS-1-94. The new MAR-7 releases will maximize sustainable profits to growers and benefit the USA cotton industry.

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Table 1. Percent final stand for cotton varieties and MAR strains in the 1995 Uniform MAR (UMAR) Test at eight locations in Texas.

Variety/Strain	Corpus Christi	College Station	Brazos Valley	Temple -PRR	Temple	McGregor	Chillicothe	Halfway	Mean Over Locations
	%	%	%	%	%	%	%	%	%
Tamcot Sphinx	67.8**	82.3**	59.5**	66.5**	63.8**	69.8**	85.0**	75.3**	71.7**
LB2HGC3PIS-1-92	54.3	59.0	58.0	55.3	48.0	65.3	73.3	53.0	62.0
PD23CD3HGS-1-93	78.3	62.5	61.0	50.3	60.0	62.3	80.0	62.3	64.4
PD24BLPD9H-1-93	84.5	65.0	53.5	55.0	48.5	69.5	80.3	59.8	63.9
Deltapine 50	81.8	62.3	53.0	66.8	62.5	68.0	64.3	57.3	63.6
BLCG8CP45H-1-93	81.5	57.3	58.0	53.5	51.3	71.0	78.3	55.0	61.2
CUBQHGRPIS-1-92	79.3	57.8	58.5	47.3	61.5	54.3	72.0	54.3	60.4
CDRCIQCUBH-2-92	79.3	55.5	46.8	49.3	54.3	62.3	76.8	50.5	58.9
CUBQHGRPIH-1-92	77.8	43.5	63.3	53.0	55.8	76.5	75.5	44.5	58.7
CDULBQSHPS-1-93	54.8	61.8	55.8	49.3	53.8	60.8	78.3	58.5	57.3
PD24BLPD9S-1-93	75.0	55.0	60.3	50.3	45.3	58.0	67.5	49.0	56.8
LBCBHGDPIH-1-91	70.5	43.3	52.0	51.3	42.0	58.3	71.5	48.0	55.7
CBD3CUBPIH-3-91	72.5	42.0	57.0	53.3	43.8	53.5	68.3	48.8	54.3
NLBG8PD23S-1-93	72.0	48.3	47.8	42.8	50.0	59.3	69.3	50.5	54.2
CD3HGC8U8S-1-91	70.5	33.5	53.3	50.5	48.8	57.0	71.3	45.0	53.2
LBCHGHQWIS-4-92	67.5	54.8	47.5	35.5	52.3	59.8	64.5	50.3	53.0
PD24LB2HGS-1-93	69.8	42.5	44.0	37.3	49.8	45.8	67.5	46.8	51.5
NLBG8C5SHS-2-93	76.5	45.3	52.3	37.5	38.0	54.3	70.0	38.0	50.8
PD24CHGWIS-1-93	66.5	38.0	50.0	35.8	48.3	48.3	60.0	45.5	50.6
Tamcot HQ95	63.3	50.3	49.5	37.3	44.5	54.3	56.8	46.8	48.8
Tamcot CAB-CS	64.3	51.8	40.8	33.5	40.0	56.0	56.8	45.5	47.5
CGL2HGRPIH-1-93	71.5	34.5	54.8	40.3	39.8	55.5	36.0	44.0	47.2
CABU2HGC8H-2-91	53.5	12.3	44.8	36.5	36.5	55.5	43.0	20.0	36.9
HGC23HGPIH-1-93	50.3	16.3	39.8	35.0	39.8	45.8	47.3	18.5	36.9
Mean	70.1	48.9	52.5	46.8	49.1	59.5	67.2	48.6	55.3
LSD (P=0.05)†	8.7	10.4	11.5	10.7	11.5	12.5	7.4	8.6	3.9
C. V. %	8.8	15.0	15.5	16.2	16.6	14.9	7.8	12.5	14.4

** Significant at the 0.01 probability level.

† Least significant difference between two means within a column.

Table 2. Percent final stand for cotton varieties and MAR strains in the 1995 Early Field Planting (EFP) Test at four locations in Texas, and mean over locations.

Variety/Strain	Weslaco-TAES	Corpus Christi	College Station	Temple	Mean Over Locations
	%	%	%	%	%
LBHGHQSHPS-1-94	59.5**	93.3**	82.0**	69.3**	81.5**
LBHGHQSHPS-2-94	66.5	91.5	79.5	72.8	81.3
SPNXHQBPIS-1-94	53.8	90.3	79.3	73.5	81.0
PD24CDHGBS-1-94	59.0	90.0	81.0	63.5	78.2
LBHGBLCG8S-4-94	68.8	89.5	73.8	69.5	77.6
LB2HGCHGBS-1-94	48.3	86.8	76.0	70.0	77.6
HGPIHQBPIH-1-94	57.3	85.3	75.3	70.3	76.9
LBCPIPD24S-1-94	52.5	85.5	78.3	64.0	75.9
CABCBLCG8S-1-94	53.5	91.3	70.3	66.0	75.8
LBHGBLCG8S-2-94	58.3	87.8	68.5	68.5	74.9
HGPICDHGBS-1-94	65.3	89.8	67.5	67.0	74.8
LBHGCG14QH-1-94	65.5	89.5	68.3	65.5	74.4
CDULBCGC8H-1-94	55.8	80.8	73.8	68.0	74.2
LB2HGPD23S-1-94	59.3	90.3	65.8	66.0	74.0
HGPICG14QH-1-94	52.8	89.0	70.8	58.5	72.8
LBHGCGLPIS-2-94	45.3	90.0	67.0	61.3	72.8
Tamcot Sphinx	---	71.8	81.8	64.3	72.6
PD24HQBPIH-1-94	60.8	83.5	67.0	65.0	71.8
LBHGCGLPIS-3-94	56.5	80.0	71.5	63.8	71.8
LBHGBLCG8S-3-94	58.0	86.5	68.5	59.0	71.3
HGPIHQBPIH-2-94	56.5	86.5	67.8	59.5	71.3
CABCSDL50H-2-94	51.0	86.3	64.5	62.5	71.1
CDULBCGBGH-1-94	53.3	86.5	66.3	60.3	71.0
HGPISJ2CIH-2-94	66.3	81.8	77.8	51.5	70.3
HGPISJ2CIH-1-94	56.3	80.5	67.8	60.5	69.6
Deltapine 50	56.0	84.5	64.5	57.3	68.8
HGRPICHGBH-1-94	53.8	74.8	61.5	63.5	66.6
CDULBLBCGH-1-94	39.3	80.5	66.8	52.0	66.4
SPNXCHGLBH-1-94	51.5	77.0	57.8	50.8	61.8
Tamcot CAB-CS	41.5	65.8	52.0	37.3	51.7
Tamcot HQ95	40.8	67.0	48.3	37.8	51.0
Tamcot CAMD-E	19.3	52.8	40.0	28.0	40.3
Mean	55.4	83.3	68.8	60.8	71.0
LSD (P=0.05)†	15.1	10.3	10.5	12.1	10.0
C. V. %	19.5	8.8	10.8	14.2	17.8

** Significant at the 0.01 probability level.

† Least significant difference between two means within a column.

Table 3. Improvement of the MAR-7A strains in resistance to diseases in comparison to Tamcot HQ95.

Genotype	Seed-seedling	Bacterial Blight	Verticillium Wilt	Phymotrichum Root Rot
CUBQHGRPIS	+	=	+	+
CDULBQSHPS	+	=	=	=
PD23CD3HGS	+	=	+	+
CUBQHGRPIH	=	=	=	=
CDRCIQCUBH	=	=	+	=
CBD3CUBPIH	=	=	=	=
HGC23HGPIH	-	=	-	+
TAMCOT HQ95	=	=	=	=
TAMCOT SPHINX	+	=	+	+
No. of Strains with Genetic Gains	3	0	3	3

Table 4. Improvement of the MAR-7A strains in resistance to insects in comparison to Tamcot HQ95.

Genotype	Aphids	Flea-hoppers	Boll Weevil	Bollworm/Budworm
CUBQHGRPIS	+	+	+	+
CDULBQSHPS	+	=	+	+
PD23CD3HGS	+	=	+	+
CUBQHGRPIH	+	+	+	+
CDRCIQCUBH	=	=	+	+
CBD3CUBPIH	=	=	+	=
HGC23HGPIH	-	-	-	-
TAMCOT HQ95	=	=	=	=
TAMCOT SPHINX	+	+	=	+
No. of Strains with Genetic Gains	4	2	6	5

Table 5. Improvement of MAR-7B strains in resistance to insects in comparison to Tamcot HQ95.

Genotype	Aphids	Flea-hoppers	Boll Weevil	Bollworm/Budworm
SPNXHQBPIH	+	=	+	+
HGPIHQBPPIH	+	+	+	+
HGPICG14QH	+	+	+	+
HGPIHQBPPIH	=	+	+	+
PD24HQBPPIH	+	=	+	+
CDULBCGC8H	-	+	=	=
TAMCOT HQ95	=	=	=	=
TAMCOT SPHINX	+	+	=	+
No. of Strains with Genetic Gains	4	3	5	5

Table 6. Total lint yield of cotton varieties and MAR strains in the 1995 Uniform MAR (UMAR) Test at eight locations, and mean over locations.

Variety/Strain	Weslaco-TAES	Weslaco-USDA	Corpus Christi	College Station	Brazos Valley	Temple-PRR	Temple	McGregor	Mean Over Locations†
Tamcot Sphinx	----	----	805**	777**	1066**	867**	742**	383**	839**
CUBQHGRPIS-1-92	581**	558**	902	671	1249	459	759	130	788
CDULBQSHPS-1-93	414	247	805	614	1109	778	739	298	781
BLCG8CP45H-1-93	542	487	929	548	1028	874	699	326	736
PD23CD3HGS-1-93	689	838	842	566	984	389	648	354	723
CUBQHGRPIH-1-92	655	560	859	607	828	925	605	299	718
CDRCIQCUBH-2-92	461	430	913	628	902	755	588	313	697
CBD3CUBPIH-3-91	638	423	758	544	929	896	623	289	690
LBCBHGDPIIS-1-91	633	659	667	574	995	903	609	294	690
CABU2HGC8H-2-91	593	386	745	389	1061	670	630	315	688
Deltapine 50	710	624	877	631	830	831	588	275	687
PD24BLPD9S-1-93	560	670	840	571	899	208	566	284	670
PD24BLPD9H-1-93	695	611	954	540	858	678	619	277	667
Tamcot HQ95	515	457	908	481	1017	497	545	285	660
CD3HGCBUS-1-91	537	621	709	511	935	807	634	248	656
LB2HGC3PIS-1-92	578	511	633	535	987	630	549	331	622
Tamcot CAB-CS	695	713	783	477	939	338	451	207	594
PD24LB2HGS-1-93	545	555	755	431	842	535	479	244	579
LBCHGHQWIS-4-92	639	471	733	446	807	469	475	291	574
NLBG8PD23S-1-93	487	537	664	455	941	629	409	279	574
NLBG8C5SHS-2-93	570	592	721	491	912	605	380	257	572
PD24CHGWIS-1-93	587	637	690	447	893	303	488	189	557
CGL2HGRPIH-1-93	454	293	706	435	667	307	441	320	541
HGC23HGPIH-1-93	334	135	553	291	558	434	388	215	415
Mean	570	522	781	527	926	616	569	279	654
LSD (P=0.05)‡	180	134	160	113	164	417	140	99	69
C. V. %	22.3	18.2	14.5	15.1	12.6	48.0	17.4	25.0	18.7

** Significant at the 0.01 probability level.

† Excluding Weslaco.

‡ Least significant difference between two means within a column.

Table 7. Total lint yield of cotton varieties and MAR stains in the 1995 Early Field Planting (EFP) Test at four location in Texas, and mean over locations.

Variety/Stain	Weslaco-TAES	Corpus Christi	College Station	Temple	Mean Over Locations†
	lb/a	lb/a	lb/a	lb/a	lb/a
HGPIHQBPIH-2-94	591**	925**	478**	1072**	825**
HGPICG14QH-1-94	502	906	584	968	819
HGPIHQBPIH-1-94	703	860	511	1029	800
PD24HQBPIH-1-94	793	839	516	928	761
SPNXHQBPIS-1-94	573	812	512	910	745
CDULBCGC8H-1-94	642	744	495	980	740
Tamcot Sphinx	---	721	579	845	715
HGPICDHGBS-1-94	513	806	514	794	705
HGPISJ2CIH-1-94	690	768	480	831	693
SPNXCHGLBH-1-94	679	816	485	765	689
LBHGCGLPIS-3-94	643	729	452	871	684
LB2HGPD23S -1-94	662	733	468	754	652
CABCBLCG8S-1-94	662	812	425	694	644
Deltapine 50	796	728	510	695	644
HGRPICHGBH-1-94	477	670	441	804	638
CABCSDL50H-2-94	488	843	406	649	633
LBHGC14QH-1-94	496	704	416	742	621
CDULBCGBGH-1-94	492	705	438	717	620
LBHGBLCG8S-2-94	708	747	336	715	600
LBHGCGLPIS-2-94	564	708	390	677	591
PD24CDHGBS-1-94	683	695	426	636	586
LBHGHQSHPS-2-94	5845	697	342	713	584
Tamcot HQ95	581	776	370	598	581
CDULBLBCGH-1-94	543	719	402	615	579
LBHGHQSHPS-1-94	606	748	286	670	568
LBHGBLCG8S-3-94	458	670	370	627	556
LBHGBLCG8S-4-94	577	597	353	717	556
LB2HGCHGBS-1-94	357	633	344	649	542
HGPISJ2CIH-2-94	593	655	408	536	533
LBCPIP24S-1-94	521	602	401	549	518
Tamcot CAB-CS	752	719	240	515	491
Tamcot CAMD-E	321	559	288	475	441
Mean	598	739	427	741	636
LSD (P=0.05)‡	169	95	107	207	95
C. V. %	20.3	9.2	17.9	19.9	18.6

** Significant at the 0.01 probability level.

† Excluding Weslaco.

‡ Least significant difference between two means within a column.

Table 8. Mean lint percent, gin turnout, and fiber quality traits for cotton varieties and MAR strains in the 1995 Uniform MAR (UMAR) Test over five locations.

Variety/MAR Strain	Fiber ¹								
	Lint Percent	Gin turnout	Length U.H.M.	Uniformity	Strength	Elongation	Micro-naire	Percent Maturity	Fine-ness
	%	%	inches		g/tex			%	
Tamcot Sphinx	37.8**	28.6**	1.12**	83.2**	32.4**	6.5**	4.6**	88.2**	185.8**
CUBQHGRPIS-1-92	34.9	26.3	1.13	83.0	30.7	6.9	4.4	83.3	193.0
CDULBQSHPS-1-93	36.5	27.2	1.14	83.5	31.1	6.4	4.3	85.0	183.0
BLCG8CP45H-1-93	34.1	26.2	1.18	83.7	31.4	6.6	4.0	82.2	178.1
CUBQHGRPIH-1-92	35.8	27.1	1.13	83.2	29.3	6.3	4.2	82.8	184.2
PD23CD3HGS-1-93	35.7	27.3	1.09	82.3	28.6	5.6	4.5	87.3	184.2
CDRCIQCUBH-2-92	35.4	26.9	1.09	82.1	32.4	6.4	4.2	82.3	189.9
CBD3CUBPIH-3-91	35.1	26.6	1.11	82.6	29.0	6.1	4.1	79.7	181.4
Deltapine 50	34.1	25.4	1.13	82.9	29.0	6.5	4.6	82.7	202.6
LBCBHGDPIS-1-91	34.4	25.7	1.10	82.4	28.9	5.9	4.2	82.1	183.2
CABU2HGC8H-2-91	37.4	27.1	1.06	81.5	29.2	5.8	4.0	79.4	188.1
PD24BLPD9S-1-93	36.3	26.4	1.18	83.8	30.9	6.7	3.7	76.9	175.3
PD24BLPD9H-1-93	34.2	25.7	1.10	82.6	30.3	5.9	4.6	85.5	195.4
CD3HGCBUS-1-91	34.2	25.8	1.11	82.7	28.9	5.9	4.2	81.5	181.2
Tamcot HQ95	36.2	27.5	1.09	82.2	29.9	5.7	4.0	80.9	179.2
LB2HGC3PIS-1-92	34.3	25.9	1.10	82.2	29.2	6.0	4.5	81.9	193.7
Tamcot CAB-CS	35.1	26.1	1.08	82.3	27.3	5.9	4.0	79.8	185.7
PD24LB2HGS-1-93	34.0	25.3	1.11	82.6	31.1	6.1	4.2	82.2	184.9
NLBG8C5SHS-2-93	35.1	26.2	1.07	81.8	28.8	5.5	4.7	87.3	188.6
NLBG8PD23S-1-93	34.5	25.2	1.11	82.6	28.9	5.7	4.2	84.2	178.4
LBCHGHQWIS-4-92	33.2	24.9	1.14	83.3	29.5	6.2	4.0	82.8	179.4
PD24CHGWIS-1-93	34.3	25.4	1.13	83.2	30.1	5.9	4.1	83.9	172.1
CGL2HGRPIH-1-93	35.1	25.5	1.13	83.1	30.9	6.6	4.1	79.2	185.2
HGC23HGPIH-1-93	33.0	23.4	1.15	83.9	33.7	6.8	3.9	81.1	175.7
Mean	35.0	26.1	1.12	82.8	30.0	6.2	4.2	82.5	184.0
LSD (P=0.05)†	0.5	0.7	0.02	0.6	1.0	0.2	0.2	2.8	7.0
C.V.%	2.3	3.3	2.2	1.1	5.0	5.4	5.6	5.2	5.8

¹ Fiber analysis performed by the International Textile Center, Texas Tech University, utilizing the High Volume Instrument (HVI) line.

** Significant at the 0.01 probability level.

† Least significant difference between two means within a column.

Table 9. Mean lint percent, gin turnout, and fiber quality traits for cotton varieties and MAR strains in the 1995 Early Field Planting (EFP) Test over three locations.

Variety/MAR Strain	Lint Percent	Gin turnout	Fiber ¹						
			Length U.H.M.	Uniformity	Strength	Elongation	Micronaire	Percent Maturity	Fineness
	%	%	inches	g/tex				%	
HGPIHQBPIH-2-94	32.3**	26.7**	1.13**	83.9**	30.6**	6.5**	4.6**	83.5**	199.5**
HGPICG14QH-1-94	32.9	27.3	1.14	83.8	33.0	6.5	4.3	85.3	173.3
HGPIHQBPIH-1-94	32.4	27.1	1.14	83.9	30.9	6.4	4.8	88.9	193.1
PD24HQBPIH-1-94	32.5	26.9	1.15	84.0	30.7	6.2	4.2	83.5	180.8
SPNXHQBPIS-1-94	31.8	25.9	1.16	84.0	30.1	6.3	4.6	87.7	184.1
CDULBCGC8H-1-94	33.1	27.3	1.13	83.3	30.6	6.4	4.8	87.6	194.9
Tamcot Sphinx	33.3	27.7	1.11	83.3	32.3	6.0	4.7	88.4	183.4
HGPICDHGBS-1-94	32.3	26.7	1.10	83.2	30.0	6.1	4.7	86.8	189.3
HGPISJ2CIH-1-94	31.9	25.3	1.14	83.8	32.8	6.4	4.1	82.4	175.2
SPNXCHGLBH-1-94	33.8	28.2	1.14	83.5	30.7	6.0	4.1	82.9	173.6
LBHGCGLPIS-3-94	31.6	25.4	1.12	82.9	29.0	5.7	4.1	82.8	170.1
LB2HGPD23S-1-94	33.1	26.9	1.11	82.8	29.9	5.7	4.5	85.4	185.1
CABCBLCG8S-1-94	33.0	26.5	1.08	82.2	27.5	5.6	4.4	85.1	181.3
Deltapine 50	31.6	25.3	1.12	83.6	29.5	6.4	4.9	86.9	200.1
HGRPICHGBH-1-94	32.0	25.8	1.07	82.8	31.1	6.1	4.6	85.4	197.1
CABCSDL50H-2-94	31.9	26.0	1.10	82.7	29.0	5.5	4.0	82.4	164.7
LBHGCGLPIS-1-94	31.6	25.4	1.12	82.8	30.5	5.8	4.1	84.7	172.9
CDULBCGBGH-1-94	31.4	25.2	1.07	82.6	30.5	5.9	4.4	83.4	188.5
LBHGBLCG8S-2-94	32.6	26.1	1.08	82.2	27.5	5.4	4.3	85.6	180.7
LBHGCGLPIS-2-94	31.7	25.1	1.14	83.6	29.7	6.5	4.0	82.3	172.8
PD24CDHGBS-1-94	31.0	24.3	1.12	83.1	29.6	6.3	4.1	83.7	175.1
LBHGHQSHPS-2-94	31.4	25.0	1.11	82.5	28.7	5.5	4.0	81.6	166.4
Tamcot HQ95	33.7	27.0	1.10	82.3	29.3	5.6	4.1	82.6	175.2
CDULBLBCGH-1-94	33.1	26.6	1.06	82.0	28.3	5.8	4.3	84.0	181.8
LBHGHQSHPS-1-94	31.0	24.0	1.13	82.6	29.5	5.4	3.7	80.8	158.0
LBHGBLCG8S-3-94	32.3	25.3	1.11	82.7	29.5	5.8	4.3	85.6	181.0
LBHGBLCG8S-4-94	31.8	25.0	1.08	82.1	29.2	6.0	4.3	83.3	180.3
LB2HGCHGBS-1-94	30.9	24.6	1.08	82.0	28.6	5.6	4.3	84.6	180.2
HGPISJ2CIH-2-94	31.9	25.5	1.11	83.1	32.7	6.2	4.4	88.4	175.8
LBCPIPD24S-1-94	30.3	24.7	1.13	82.8	30.2	6.5	3.7	79.0	165.3
Tamcot CAB-CS	32.4	24.5	1.09	82.4	27.5	5.8	4.0	84.9	168.6
Tamcot CAMD-E	31.9	25.3	1.06	81.7	27.3	5.6	4.0	79.6	175.4
Mean	32.1	25.8	1.11	82.9	30.0	6.0	4.3	84.3	179.4
LSD (P=0.05)†	0.9	1.0	0.02	0.7	0.9	0.2	0.2	3.2	7.8
C.V.%	4.0	4.7	2.3	1.2	4.2	4.8	6.8	5.5	6.3

¹ Fiber analysis performed by the International Textile Center, Texas Tech University, utilizing the High Volume Instrument (HVI) line.

** Significant at the 0.01 probability level.

† Least significant difference between two means within a column.

Table 10. Fiber quality traits for MAR-7 germplasm.

Fiber Trait	Range
Length (inches)	1.10 - 1.25
Uniformity	83.3 - 86.5
Strength (g/tex)	28.5 - 34.2
Elongation	5.5 - 6.9
Micronaire	3.7 - 4.8
Maturity (%)	80.6 - 95.1
Fineness	149 - 178