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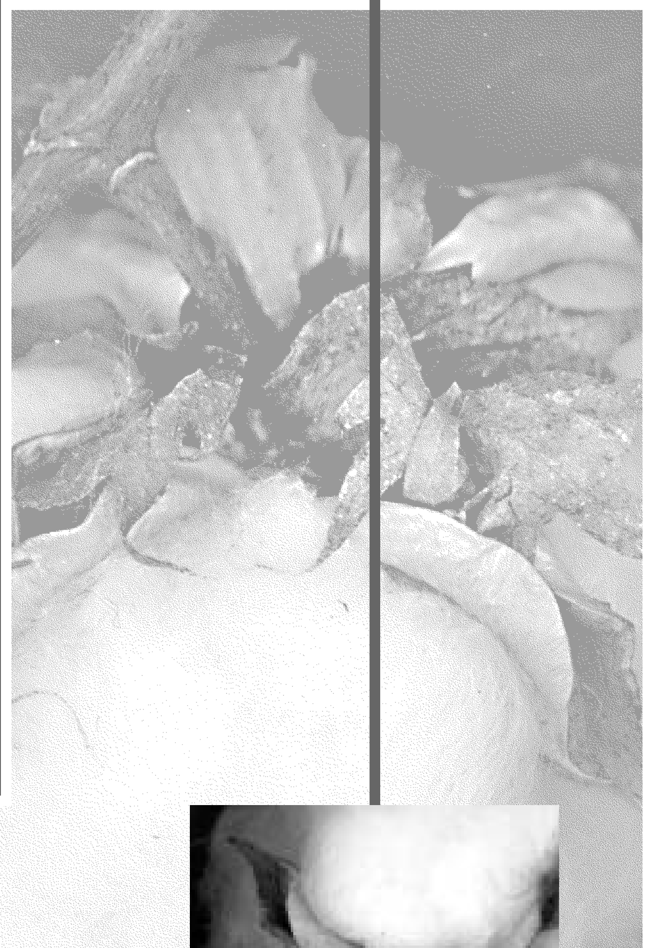
USE OF PRIMITIVE ACCESSIONS OF COTTON AS SOURCES OF GENES

for

Improving Yield Components and Fiber Properties



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Use of Primitive Accessions of Cotton as Sources of Genes for Improving Yield Components and Fiber Properties

Abstract

The breeding of cotton (*Gossypium hirsutum* L.) to improve lint yield and fiber quality is an ongoing process. To meet textile mill requirements and producer demands, both fiber quality and lint yield must be increased. This study was conducted to compare yield and fiber properties when exotic lines are crossed to commercial cultivars. Fourteen lines derived from selected primitive accessions with high fiber strength were crossed as male parents to each of five cultivars. The F2 hybrids and parents were grown in two different field locations in 1998 and 1999, and the F3 hybrids were grown in two locations in 2000. Hybrids and parents were evaluated for yield, yield components, and fiber quality traits. Combination of locations and years were considered as environments for data analyses. All traits measured were significantly affected by environment. The cultivars had higher yields and lint percentages than the exotic male parent lines. Fiber strength for exotic parents exceeded that of cultivars. The mean lint yield for F2 hybrids exceeded the mid-parent value. Lint percentage, boll size, micronaire, elongation, and fiber length were similar between F2 and F3 hybrids and near mid-parent values. Most traits were highly correlated between F2 and F3 generations; however, seed cotton yield and lint yield were not correlated between F2 and F3. This study provides useful data for cotton breeding programs.

Introduction

Cotton (*Gossypium hirsutum* L.) is an important cultivated crop in the United States and many parts of the world. It is grown mostly as a source of lint fiber for the textile industry; however, there are markets for its oil, meal, seed hulls, and linters.

The primitive accessions of *Gossypium* are diverse and contain many desirable traits. The collection, distribution, and evaluation of *Gossypium* germplasm were reviewed by Percival and Kohel (1990). Many of the accessions in the collection have been reported to have useful genetic variability (Percival, 1987; Meredith, 1991; McCarty and Jenkins, 1992; McCarty et al., 1995). One undesirable trait in many accessions is their flowering response to photoperiod. Their use in Upland cotton breeding programs has been limited by their short-day flowering habit. A backcross-breeding program has been used to introduce genes for day-neutrality into the primitive accessions (McCarty et al., 1979).

Textile industries are demanding better fiber quality — especially fiber strength — because of the increased speed of new fiber spinning equipment. This demand for improved fiber quality increases the need for new sources of genetic variability and additional research efforts. The relationship of yield and fiber quality has been studied in the form of F2 hybrids. In crosses between pest-resistant germplasm and commercial cultivars, Tang et al. (1992, 1993 a, b) found that most of their high-yielding F2 hybrids had commercially acceptable fiber properties. Robinson et al. (1997) reported that when germplasm lines resistant to the root-knot nematode (*Meloidogyne incognita* [Kofoid and White] Chitwood) were crossed to cultivars, resulting F2 populations combined root-knot resistance with acceptable yield and fiber quality. Meredith (1990) reported that F2 hybrids had significantly longer and finer lint than the parents; however, the improvements were too small to be of practical value. He suggested that F2 hybrids have the genetic potential for increasing cotton yields and fiber quality.

The objectives of this study were to evaluate the utility of high fiber strength selections from primitive accessions of cotton as sources of genes for agronomic traits and fiber properties. For this evaluation, the yield and fiber properties of F2 and F3 hybrids derived from selected primitive accessions crossed with commercial cultivars were used.

Materials and Methods

The mating design used for this study was a North Carolina Design II. Five cultivars used as female parents were crossed to each of 14 exotic derived lines as male parents in 1997. Cultivars used were (1) ‘Deltapine 50’ (DPL50), (2) ‘DES119’, (3) ‘Stoneville 474’ (ST474), (4) ‘Deltapine Acala 90’ (DPL90), and (5) ‘Sure-Grow 125’ (SG125).

The male parents were derived from day-neutral selections from crosses of cultivars with exotic primitive race accessions. The exotic lines were designated as male parents 6 through 19 and were developed as follows (Table 1). Parent 6 was developed from a cross between ‘Deltapine 16’ (DPL16) and the primitive accession T75 (PI 549138), where day-neutral flowering habit was selected in the F2. This day-neutral selection was then backcrossed to T75. A single high-strength, day-neutral plant was selected in the BC1F2. A single high-strength plant was selected in the two succeeding generations. The BC1F4 plant was then advanced via bulk increase to the BC1F6 (Table 1).

Parents 7 through 9 were developed from a cross between ‘DES56’ and the primitive accession T1388 (PI 415112). A single high-strength, day-neutral plant was selected in the F2 and F3. Three high-strength plants were selected in the F4. The three F4 plants were then advanced via bulk increase to the F6 (Table 1).

Parents 10 through 16 were developed from a cross between DPL16 and the primitive accession T239 (PI 163693), where day-neutral flowering habit was selected in the F2. This day-neutral selection was then backcrossed three times to T239, each time selecting for the day-neutral flowering habit in the F2 following each backcross. A single high-strength, day-neutral plant was selected in the BC3F2. In the BC3F3, three high-strength plants were selected. From these plants, seven selections were made. The seven BC3F4 plant were then advanced via bulk increase to the BC3F6 (Table 1).

Parents 17 through 19 were developed from a cross between DPL16 and the primitive accession T237 (PI 163657), where day-neutral flowering habit was selected in the F2. This day-neutral selection was then backcrossed to T237. Three BC1F2 day-neutral plants were selected for length and strength. A single plant was selected from each of these three plants in the succeeding two generations. The three BC1F4 plants were then advanced via bulk increase to the BC3F6 (Table 1). The specific plant that was selected in the development of the exotic male parent line is given in Table 1.

Crosses and subsequent evaluations were conducted at the Plant Science Research Center at Mississippi State University (33.4 N, 88.8 W). F1 and male parent seed were sent to a winter nursery in Tecoman, Mexico, to produce the F2 and provide for seed increase. Seed from the 70 F2 hybrids and the 19 parents (five female cultivars and 14 exotic males) were grown at two locations each year in 1998 and 1999. Seed were harvested from the 1999 test, and the resulting F3 populations and parents were grown at two locations in 2000.

The experimental design was a randomized complete block with four replications at each location each year. The combination of year and location (Loc) was considered as environments (Env) for the purpose of statistical analyses. The environments were as follows: Env 1 = 1998, Loc 1; Env 2 = 1998, Loc 2; Env 3 = 1999, Loc 1; Env 4 = 1999, Loc 2; Env 5 = 2000, Loc 1; Env 6 = 2000, Loc 2. Planting dates, defoliation dates, harvest dates, rainfall, and degree-day 60 (DD60) accumulation data are in Tables 2-4. Plot size for environments 1, 2, 4, and 6 was a single row 12 meters in length with row spacing of 0.97 meter. Plot size for environments 3 and 5 was a single row 9 meters

Table 1. Parental lines used for crossing.

Male parental lines		Individual plant selection number in generation			Parental designation
Texas no.	Generation	F2	F3	F4	
T75	BC1F6	18	8	3	M75-1
T1388	F6	8	2	2	M1388-1
T1388	F6	8	2	3	M1388-2
T1388	F6	8	2	4	M1388-3
T239	BC3F6	15	3	1	M239-1
T239	BC3F6	15	3	3	M239-2
T239	BC3F6	15	3	4	M239-3
T239	BC3F6	15	3	5	M239-4
T239	BC3F6	15	5	2	M239-5
T239	BC3F6	15	7	4	M239-6
T239	BC3F6	15	7	5	M239-7
T237	BC1F6	7	5	2	M237-1
T237	BC1F6	7	9	9	M237-2
T237	BC1F6	11	9	3	M237-3
Female parent (commercial cultivar)					
Deltapine 50					DPL50
Des 119					DES119
Stoneville 474					ST474
Deltapine 90					DPL90
Sure-Grow 125					SG125

in length with row spacing of 0.97 meter. The planting for environment 1 was a two-planted/one-skip row pattern, but other environments were planted in a solid-row pattern. The stand density for all environments consisted of single plants spaced approximately 10 centimeters apart. Environment 1 soil type was a Leeper silty clay loam (Fine, smectitic, nonacid, thermic Vertic Epiaquepts). Environments 2, 4, and 6 soil type was a Marietta silty clay loam (Fine-loamy, siliceous, active, Fluvaquentic Eutrudepts). Environments 3 and 5 were a Marietta loam (Fine-loamy, siliceous, active, fluvaquentic Eutrudepts). Standard production practices were followed at all environments.

A 25-boll, hand-harvested sample was collected from each plot prior to machine harvest. These samples were weighed and ginned on a laboratory 10-saw gin to determine boll weight and lint percentage and to provide lint samples for fiber analysis. Lint samples were sent to STARLAB, Inc., in Knoxville, Tennessee, for determination of micronaire, elongation (E1), fiber strength (T1), 2.5% span length (2.5% SL), and 50% span length (50% SL). The plots were harvested with a mechanical picker, and the seed cotton was weighed. These data were used to calculate yields. Environment 1 in 1998 was not machine-harvested due to extreme late-season insect pressure and weather conditions, which severely impacted yield.

Data were subjected to ANOVA using proc GLM, SAS version 8.0 (SAS Institute, 1999). The linear model was

$$y_{hijk} = \mu + E_h + T_i + G_{j(i)} + TE_{hi} + GE_{hj(i)} + B_{k(h)} + e_{hijk}$$

where y_{hijk} is the observed value for genotype j within type i in block k of environment h, μ is grand mean, E_h is h^{th} environmental effect, T_i is i^{th} type (female, male, F2, and F3) effect, $G_{j(i)}$ is genotype effect within each type, TE_{hi} is type by environment interaction effect, $GE_{hj(i)}$ is genotype within type by environment interaction effect, $B_{k(h)}$ is block effect within environment, e_{hijk} is random error. All effects except blocks and random error were considered fixed. The female cultivar parents, exotic male parents, and hybrids (F2 and F3 generation) were partitioned into a source of variation labeled “type.”

Additional data analyses were conducted by environment using ANOVA, and LSD0.05 values were calculated to compare means of each genotype.

Table 2. Planting , defoliation, and harvest dates.

Environment	Planting date	Harvest date	Defoliation date	Days to defoliation
1	13 May 1998	—	2 Oct.	143
2	12 May 1998	19 Oct.	2 Oct.	144
3	12 May 1999	8 Oct.	16 Sept.	127
4	11 May 1999	12 Oct.	16 Sept.	128
5	12 May 2000	18 Sept.	5 Sept.	116
6	16 May 2000	12 Oct.	19 Sept.	126

Table 3. Rainfall by month in inches from planting to defoliation.

Environment	May	June	July	Aug.	Sept.	Total
1	1.50	0.88	4.48	5.09	0.27	13.40
2	1.47	0.87	5.02	4.08	0.17	12.89
3	1.54	3.79	3.68	0.73	0.33	10.00
4	1.23	3.52	4.18	0.74	0.33	10.07
5	1.82	3.87	0.92	0.12	1.47	8.20
6	1.98	4.33	0.59	0.09	0.86	7.85

Table 4. Cumulative degree day 60’s (DD60) by month from planting to defoliation.

Environment	May	June	July	Aug.	Sept.	Total
1	318	638	686	621	552	2815
2	329	638	686	621	552	2826
3	240	512	674	682	304	2412
4	255	512	674	682	304	2427
5	286	522	692	746	120	2366
6	245	522	692	746	317	2522

Results and Discussion

All traits were significantly affected by environmental conditions (Table 5). The means for all traits were significantly different among type (female cultivar, exotic male parent, hybrids F2 and F3). Lint percentage, boll size, fiber elongation, and fiber strength were mainly affected by type. Genotype within each type affected the mean expression of all traits. The interactions between type and environment significantly affected the expression of seed cotton yield, lint cotton yield, lint percentage, micronaire, and 2.5% span length, but not elongation, fiber strength, and 50% span length. Environment and genotype within type interacted to affect the mean of seed cotton yield, lint cotton yield, lint percentage, boll size, elongation, fiber strength, and 2.5% span length. Therefore, the genetic expression of all traits was not only significantly different among different types, but the genotypes within each type also showed significant variations for all these traits. These differences were as expected considering the range of germplasm used.

Generally, the mean lint percentage for cultivar parents was significantly higher than that for F2 and F3 hybrids, while mean lint percentage for F2 and F3 was significantly higher than that for exotic parents in all environments (Table 6). Mean lint percentage for F2 and F3 were close to the mid-parent. It indicated that this trait might be mainly controlled by additive effects (Table 6). Mean lint yield for cultivars was greater than that for exotics in all environments, except environment 6. The mean lint yield for the F2 hybrids was between cultivar and exotic, but it was greater than that for the mid-parent. Numerically, the mean lint yield for the F3 generation was higher than that for cultivars (Table 6). Mean seed cotton yield for cultivars was higher than that for exotic in environments 2, 3, and 4; however, mean seed cotton yield for exotics was higher than that for cultivars in environments 5 and 6 (year 2000) (Table 6). Mean lint yield for F2 hybrids was higher than that for mid-parent or high parent (cultivar) in environments 2, 3, and 4 (Table 6), while mean lint yield for F3 was above that of the high parents (Table 6).

Generally, the five cultivar parents showed less variation (more stable) than the 14 exotic parents across the different environments. One possible reason is that cultivars yielded slightly less seed cotton in 2000 (environments 5 and 6) than in 1999 (environments 3 and 4), while exotic parents produced more cotton in the dry year (Table 3). More importantly, both the seed cotton yield and lint yield for the F3 generation was higher than that for cultivar parents. It indicated that yield might be controlled by some other genetic effects in addition to additive and dominance effects. It also indicated that some of the crosses could be used for heterosis in early generations followed by selection for pure lines.

Mean values for micronaire, elongation, and fiber strength for F2 and F3 hybrids were between the means for parents in most environments (Table 7). The fiber length for F2 and F3 hybrids was longer than that of high parents for most environments (Table 7).

Results showed that means for lint percentage, boll size, micronaire, elongation, and fiber length were similar between F2 and F3 (Table 8). Variations among F2 hybrids were numerically greater than that among F3 hybrids for seed cotton yield, lint yield, lint percentage, boll size, micronaire, and 2.5% span length. Minimum and maximum values for seed cotton yield and lint yield among F3 hybrids were greater than those among

Table 5. ANOVA mean squares for yield, yield components, and fiber traits.

Source[1]	df	Mean squares[2]								
		Seed cotton yield	Lint yield	Lint percentage	Boll size	Mic.	E1	T1	SL50	SL2.5
Env	4	57109386**	6769412**	30.74**	1.03**	3.05**	2.61**	6925.18**	9.28**	37.02**
Type	3	29867230**	6267439**	2134.37**	5.79**	0.74**	21.38**	45212.04**	2.94**	34.25**
Genotype (Type)	155	514732**	57835**	16.76**	0.96**	0.59**	2.13**	696.25**	0.39**	3.89**
Blocks (Env)	15	1700846**	201300**	5.19**	0.28**	0.41**	3.19**	1074.44**	2.13**	3.51**
Env x Type	7	3250973**	527937**	23.75**	0.92**	1.12**	0.56	128.73	0.26	1.22**
Env x Genotype (Type)	275	320663**	39263**	2.53**	0.17**	0.13	0.47**	161.99*	0.17	0.53**
Error	1320	220884	27081	1.35	0.10	0.12	0.36	136.74	0.18	0.42

[1]Env = Environment; type = male, female, F2, F3.
[2]Traits: Mic – micronaire; E1 – fiber elongation; T1 – fiber strength; and SL50 and SL2.5 – fiber span length 50 and 2.5 percent.*, ** — Significant at 0.05 and 0.01 probability levels, respectively.

Type	Seed cotton yield		Lint yield		Lint percentage		Boll size	
	Mean	Var	Mean	Var	Mean	Var	Mean	Var
	kg/ha	*kg/ha*	*kg/ha*	*kg/ha*	*%*	*%*	*g*	*g*
Env2								
Female	1422	371695	564	50799	40.07	5.07	4.70	0.13
Male	497	86922	152	9361	30.12	5.62	4.24	0.28
F2	1194	225191	415	27830	34.80	5.50	4.67	0.21
LSD(0.05)	165		59		0.84		0.17	
Env3								
Female	2767	371084	1095	60897	39.59	4.61	4.49	0.23
Male	1921	212715	580	23238	30.12	3.58	4.19	0.31
F2	2999	329330	1047	39018	34.96	1.77	4.63	0.23
LSD(0.05)	202		72		0.36		0.13	
Env4								
Female	2612	528443	1051	75298	40.39	5.13	4.58	0.07
Male	1818	294676	549	29225	30.14	4.52	4.15	0.24
F2	2723	381092	956	45656	35.16	2.28	4.49	0.24
LSD(0.05)	238		83		0.38		0.14	
Env5								
Female	2376	345314	915	392319	38.85	5.91	4.43	0.18
Male	2470	217482	789	23219	31.93	2.14	4.66	0.14
F3	2718	199980	936	22879	34.45	1.46	4.73	0.17
LSD(0.05)	186		64		0.36		0.14	
Env6								
Female	1850	338842	733	50830	39.75	4.90	4.36	0.24
Male	2018	335033	664	37779	32.87	1.65	4.46	0.11
F3	2118	243681	749	31316	35.36	2.27	4.50	0.09
LSD(0.05)	211		74		0.36		0.11	

Table 6. Mean and variation of yield traits for different generations within each environment.

F2 hybrids. Minimum and maximum values for lint percentage and fiber length were very close between F2 and F3. The range, for most traits measured, was larger among F2 than among F3. The performances for F2 and F3 hybrids were quite different across different environments for most traits**.**

Tables 9-17 present the means for the different traits measured by environment. In environments 2 and 4, only a few F2 hybrids yielded more seed cotton than the best cultivar parent DPL50. Whereas, in environment 3 (location 2, 1999), 47 out of 70 F2 hybrids yielded more seed cotton than the best cultivar DPL90, 52 out of 70 hybrids yielded more seed cotton than the mean of the five cultivars, 50 hybrids yielded more seed cotton than the overall mean, and 69 hybrids yielded more seed cotton than the mean of 14 exotic lines. In environment 5, only four out of 70 F3 hybrids yielded more seed cotton than the best parent DPL50. However, in environment 6, 20 F3 hybrids yielded more seed cotton than the best parent DPL90. Sixty-seven F2 hybrids yielded more seed cotton than the mean of the 14 exotic lines. It indicated that the exotic parents yielded less seed cotton in 1998 and 1999 (in which there was more rainfall) than in 2000 (less rainfall) (see Table 3). Similar results were found for lint yield.

Lint percentage for all types tended to be consistent (stable) at different environments. None of the F2 or F3 hybrids had higher lint percentages than the best parents or the mean of cultivar parents in any environment. The exotic parents had lint percentages considerably lower than the cultivar parents.

Similar numbers of F2 or F3 hybrids had larger boll size than the best cultivar in environments 2, 4, 5, and 6. More F2 hybrids (20) had larger boll size than the best parent in environment 3. More than half of the hybrids produced larger bolls than the mean of exotic parents.

Most F2 or F3 hybrids had higher fiber strength than the mean of cultivars. More than 50 hybrids had higher fiber strength than the best parents in all environments (except environment 4). Fewer hybrids had higher fiber strength than the mean of exotic parents. It indicated that the fiber strength was improved in most hybrids. The exotic parents had previously been selected for their fiber strength trait.

Less than half the hybrids had higher 2.5% span length than the best cultivar parents in all environments. More than half of the hybrids had higher 2.5% span length than the mean of exotic parents.

Table 7. Mean and variation of fiber traits for different generations within each environment.[1]

Type	Mic		El		T1		SL50		SL2.5	
	Mean	Var	Mean	Var	Mean	Var	Mean	Var	Mean	Var
Env1										
Female	5.02	0.11	7.99	0.48	201.50	130.71	14.85	0.40	29.39	0.41
Male	4.54	1.78	6.90	0.65	240.59	461.57	14.61	0.48	28.53	2.08
F2	4.97	0.20	7.44	0.52	219.18	157.13	14.98	0.35	29.55	1.00
LSD(0.05)	0.28		0.26		5.05		0.23		0.31	
Env2										
Female	5.21	0.03	7.86	1.21	192.00	121.84	14.35	0.14	28.62	0.20
Male	5.02	0.11	6.91	0.92	234.79	223.29	14.20	0.18	27.92	1.23
F2	5.14	0.08	7.24	0.69	214.52	140.58	14.41	0.16	28.68	0.73
LSD(0.05)	0.08		0.27		4.23		0.17		0.29	
Env3										
Female	4.74	0.07	7.32	0.96	213.45	135.84	14.26	0.13	28.28	0.41
Male	4.83	0.17	6.83	0.63	253.02	291.28	14.09	0.13	27.56	1.09
F2	4.83	0.12	7.10	0.53	232.96	205.07	14.25	0.16	28.29	0.59
LSD(0.05)	0.11		0.27		5.73		0.16		0.27	
Env4										
Female	4.88	0.08	7.75	0.57	203.53	198.17	14.17	0.30	28.05	0.32
Male	4.97	0.19	6.79	0.51	243.82	373.47	14.13	0.28	27.71	1.46
F2	4.90	0.11	7.21	0.55	224.28	195.52	14.27	0.20	28.21	0.65
LSD(0.05)	0.11		0.27		4.88		0.18		0.26	
Env5										
Female	4.63	0.03	7.59	0.73	209.10	163.04	14.39	0.11	29.08	0.22
Male	4.62	0.06	6.69	0.40	242.42	205.84	14.33	0.16	28.84	0.49
F3	4.59	0.06	7.07	0.36	228.38	195.19	14.38	0.16	29.08	0.54
LSD(0.05)	0.08		0.22		5.11		0.16		0.26	

[1]Traits: Mic – micronaire; El – fiber elongation (%); T1 – fiber strength (kNm/kg); SL50 and SL2.5 – fiber span length 50 and 2.5 percent (mm).

Table 8. Comparison of agronomic and fiber traits between F2 and F3 hybrids.

Trait[1]	Type	Mean	SD	Min	Max
Yield (kg/ha)	F2	2305	219	1573	2789
	F3	2418	198	2050	2918
Lint yield (kg/ha)	F2	806	73	586	985
	F3	842	69	709	1018
Lint percent	F2	34.97	1.16	32.22	37.63
	F3	34.90	1.05	32.18	37.40
Boll size (g)	F2	4.59	0.33	3.78	5.32
	F3	4.62	0.23	4.05	5.14
Micronaire	F2	4.96	0.23	4.26	5.41
	F3	4.59	0.18	4.13	5.00
Fiber elongation (%)	F2	7.25	0.42	6.39	8.28
	F3	7.07	0.42	6.19	8.00
Fiber strength (kNm/kg)	F2	222.7	7.1	208.3	240.7
	F3	228.4	8.8	205.9	250.8
SL50[1] (mm)	F2	14.48	0.17	14.07	14.85
	F3	14.38	0.23	13.84	14.83
SL2.5[1] (mm)	F2	28.68	0.57	27.29	29.79
	F3	29.08	0.50	27.59	30.35

[1]SL50 and SL2.5 = fiber span length 50 and 2.5 percent.

Table 9. Genotype mean and LSD (0.05) for seed cotton yield (kg/ha) at different environments.					
Genotype	Environment				
	2	3	4	5	6
DPL50 x M75-1	1362	3487	2960	2865	2148
DES119 x M75-1	1204	3218	2684	2854	2385
ST474 x M75-1	1368	3074	2837	3035	2118
DPL90 x M75-1	927	2923	3146	2936	2305
SG125 x M75-1	1590	3408	3088	2461	2392
DPL50 x M1388-1	1315	3271	2307	2872	2376
DES119 x M1388-1	1430	3100	2875	2541	2195
ST474 x M1388-1	1424	3214	2827	2729	1894
DPL90 x M1388-1	1450	2592	2453	3027	2057
SG125 x M1388-1	1236	2827	2923	2959	2479
DPL50 x M1388-2	1472	3289	3179	2491	1882
DES119 x M1388-2	892	3464	2683	2641	1979
ST474 x M1388-2	1198	2906	2737	2801	2135
DPL90 x M1388-2	982	2624	2634	2473	2137
SG125 x M1388-2	1011	2644	2525	2369	2091
DPL50 x M1388-3	1363	3021	2466	2373	1813
DES119 x M1388-3	1127	3138	2699	2280	1991
ST474 x M1388-3	995	2717	2651	2150	1950
DPL90 x M1388-3	1016	2937	3074	2809	2034
SG125 x M1388-3	885	2333	3013	2835	2296
DPL50 x M239-1	1012	3081	2506	3148	2161
DES119 x M239-1	1087	3329	3069	2834	2082
ST474 x M239-1	1185	2332	2726	2473	1890
DPL90 x M239-1	809	2925	3312	2938	2022
SG125 x M239-1	1377	2948	2796	2840	2531
DPL50 x M239-2	1148	3263	3188	2625	1707
DES119 x M239-2	1018	3140	2571	2914	1911
ST474 x M239-2	1218	2935	3086	2543	2090
DPL90 x M239-2	797	3220	1860	3026	2184
SG125 x M239-2	815	3248	2789	2638	2510
DPL50 x M239-3	828	3035	2553	2653	2637
DES119 x M239-3	950	2782	2864	3167	2257
ST474 x M239-3	1110	3576	2226	2775	1995
DPL90 x M239-3	819	2484	2122	2673	2023
SG125 x M239-3	1411	3159	2904	2620	1849
DPL50 x M239-4	1271	2986	2741	2822	1954
DES119 x M239-4	953	3030	3234	2542	2008
ST474 x M239-4	1600	3279	2570	2541	1740
DPL90 x M239-4	1149	2470	2945	3096	1764
SG125 x M239-4	1542	3073	2554	2835	1950
DPL50 x M239-5	1546	3604	2747	2890	2291
DES119 x M239-5	1471	3296	2556	2854	2087
ST474 x M239-5	1799	3021	2638	2651	2082
DPL90 x M239-5	1075	2386	3023	2812	1379
SG125 x M239-5	1807	3494	2957	2699	2013
DPL50 x M239-6	1828	3149	3391	3013	2304
DES119 x M239-6	1088	2976	2332	2860	1779
ST474 x M239-6	815	3304	2415	2427	2023
DPL90 x M239-6	1018	3588	2719	2670	2173
SG125 x M239-6	1617	2971	2548	3017	2820
DPL50 x M239-7	833	3591	2293	3125	2340
DES119 x M239-7	869	3340	3063	2729	2783
ST474 x M239-7	892	3109	2417	2744	2403
DPL90 x M239-7	741	2958	3809	2880	2513
SG125 x M239-7	748	3274	3392	2898	2723
DPL50 x M237-1	1501	3271	2896	3029	1853
DES119 x M237-1	1623	2788	2426	2871	1825
ST474 x M237-1	1140	2641	3434	2535	1902
DPL90 x M237-1	1437	2909	2268	2451	1922
SG125 x M237-1	1464	3109	2434	2559	1852
DPL50 x M237-2	1866	3182	2705	2817	1993
DES119 x M237-2	1253	3014	2300	2505	2350
ST474 x M237-2	1000	2463	2331	2577	2185
DPL90 x M237-2	1083	2703	2643	2146	2066
SG125 x M237-2	1287	2729	2146	2253	1945
DPL50 x M237-3	1302	2736	3174	2563	2399
DES119 x M237-3	822	2221	1677	2668	1799
ST474 x M237-3	903	2755	2745	2478	2090
DPL90 x M237-3	1149	2473	2538	2432	2508
SG125 x M237-3	1225	2372	2238	2905	1933
M75-1	458	1746	1671	2441	2486
M1388-1	942	2667	2371	2670	2064
M1388-2	476	1842	2105	2505	1597
M1388-3	211	1580	1319	2177	1756
M239-1	541	1642	1625	2483	1532
M239-2	223	1433	1800	2109	1840
M239-3	301	1806	1506	2658	2343
M239-4	673	1875	1729	2136	2304
M239-5	522	2241	1627	2412	2029
M239-6	685	2408	2459	2506	2291
M239-7	264	1734	2155	2867	1792
M237-1	449	2378	1846	2432	1881
M237-2	950	1812	1697	2912	2546
M237-3	269	1734	1544	2270	1790
DPL50	1848	2857	3468	3076	2031
DES119	1168	2559	1992	2441	1305
ST474	1052	2794	2529	2128	1827
DPL90	1635	2920	2347	2240	2289
SG125	1409	2706	2722	1993	1797
LSD(0.05)	**534**	**656**	**772**	**604**	**682**

Table 10. Genotype mean and LSD (0.05) for lint yield (kg/ha) at different environments.

Genotype	Environment					Genotype	Environment				
	2	3	4	5	6		2	3	4	5	6
DPL50 x M75-1	467	1207	1044	986	794	DPL50 x M239-6	619	1072	1149	1010	796
DES119 x M75-1	403	1137	947	986	866	DES119 x M239-6	377	1034	832	1006	635
ST474 x M75-1	496	1127	1001	1097	755	ST474 x M239-6	290	1221	914	865	744
DPL90 x M75-1	299	977	1068	1003	781	DPL90 x M239-6	367	1261	946	918	739
SG125 x M75-1	556	1245	1070	864	845	SG125 x M239-6	587	1053	918	1051	985
DPL50 x M1388-1	446	1113	786	976	816	DPL50 x M239-7	279	1185	748	1010	785
DES119 x M1388-1	513	1101	1038	869	809	DES119 x M239-7	299	1140	1032	926	979
ST474 x M1388-1	512	1129	1014	932	675	ST474 x M239-7	316	1073	856	951	836
DPL90 x M1388-1	502	932	851	1062	720	DPL90 x M239-7	245	1011	1289	981	876
SG125 x M1388-1	442	1008	1059	1034	922	SG125 x M239-7	249	1148	1162	992	968
DPL50 x M1388-2	479	1125	1088	812	645	DPL50 x M237-1	502	1102	956	1023	591
DES119 x M1388-2	314	1187	933	915	728	DES119 x M237-1	575	969	821	993	628
ST474 x M1388-2	427	1015	957	971	786	ST474 x M237-1	403	959	1231	895	671
DPL90 x M1388-2	341	899	925	836	763	DPL90 x M237-1	490	1002	786	823	681
SG125 x M1388-2	356	948	885	818	745	SG125 x M237-1	506	1081	874	886	652
DPL50 x M1388-3	472	1038	830	828	640	DPL50 x M237-2	653	1099	989	971	718
DES119 x M1388-3	410	1079	933	799	712	DES119 x M237-2	456	1125	848	897	860
ST474 x M1388-3	347	981	958	780	720	ST474 x M237-2	359	920	876	944	834
DPL90 x M1388-3	358	1030	1078	966	740	DPL90 x M237-2	392	966	977	761	732
SG125 x M1388-3	308	837	1102	997	862	SG125 x M237-2	458	998	797	779	702
DPL50 x M239-1	342	1046	865	1034	738	DPL50 x M237-3	461	949	1135	906	860
DES119 x M239-1	382	1148	1075	965	722	DES119 x M237-3	305	826	627	962	688
ST474 x M239-1	438	840	1013	874	660	ST474 x M237-3	339	1040	1041	900	778
DPL90 x M239-1	281	1004	1168	983	702	DPL90 x M237-3	431	895	950	870	929
SG125 x M239-1	498	1045	1005	1021	896	SG125 x M237-3	447	846	834	1026	726
DPL50 x M239-2	385	1051	1068	864	561	M75-1	119	463	447	791	793
DES119 x M239-2	360	1112	926	995	702	M1388-1	300	832	748	894	702
ST474 x M239-2	425	1011	1073	842	748	M1388-2	147	526	631	822	508
DPL90 x M239-2	277	1102	619	1011	741	M1388-3	63	496	392	738	579
SG125 x M239-2	269	1119	944	866	889	M239-1	160	529	509	786	499
DPL50 x M239-3	282	1035	852	909	883	M239-2	62	421	501	634	590
DES119 x M239-3	328	943	993	1074	799	M239-3	84	518	431	849	758
ST474 x M239-3	404	1250	778	950	712	M239-4	208	552	508	670	758
DPL90 x M239-3	274	841	717	904	698	M239-5	165	690	534	751	664
SG125 x M239-3	482	1096	1006	921	637	M239-6	216	783	787	821	759
DPL50 x M239-4	407	981	921	913	625	M239-7	75	491	607	856	573
DES119 x M239-4	336	1048	1153	857	717	M237-1	139	716	541	743	606
ST474 x M239-4	562	1159	883	898	601	M237-2	308	553	533	943	876
DPL90 x M239-4	382	832	991	1037	599	M237-3	86	557	513	745	629
SG125 x M239-4	332	1060	890	960	685	DPL50	672	1043	1304	1076	748
DPL50 x M239-5	523	1205	922	949	759	DES119	479	1018	801	946	520
DES119 x M239-5	541	1182	922	1004	768	ST474	450	1184	1093	890	783
ST474 x M239-5	639	1032	921	897	712	DPL90	650	1131	913	865	889
DPL90 x M239-5	365	816	1023	947	471	SG125	570	1098	1143	798	726
SG125 x M239-5	656	1241	1059	934	706	**LSD(0.05)**	**190**	**232**	**268**	**208**	**240**

Genotype	Environment 2	3	4	5	6	Genotype	Environment 2	3	4	5	6
DPL50 x M75-1	34.17	34.62	35.26	34.40	36.94	DPL50 x M239-6	33.80	34.03	33.88	33.53	34.54
DES119 x M75-1	33.55	35.32	35.29	34.54	36.33	DES119 x M239-6	34.49	34.73	35.69	35.17	35.68
ST474 x M75-1	36.10	36.65	35.29	36.13	35.65	ST474 x M239-6	35.54	36.95	37.86	35.64	36.77
DPL90 x M75-1	31.94	33.41	33.93	34.15	33.89	DPL90 x M239-6	35.79	35.16	34.80	34.37	34.00
SG125 x M75-1	34.84	36.52	34.67	35.10	35.32	SG125 x M239-6	36.31	35.45	36.02	34.83	34.94
DPL50 x M1388-1	33.87	34.02	34.08	33.99	34.36	DPL50 x M239-7	33.65	33.00	32.62	32.32	33.57
DES119 x M1388-1	35.66	35.52	36.09	34.17	36.85	DES119 x M239-7	34.13	34.14	33.70	33.91	35.18
ST474 x M1388-1	35.96	35.12	35.87	34.16	35.64	ST474 x M239-7	35.29	34.50	35.40	34.64	34.78
DPL90 x M1388-1	34.63	35.97	34.68	35.08	34.99	DPL90 x M239-7	32.98	34.17	33.85	34.07	34.84
SG125 x M1388-1	35.81	35.67	36.25	34.94	37.18	SG125 x M239-7	33.14	35.07	34.27	34.24	35.56
DPL50 x M1388-2	32.58	34.21	34.22	32.59	34.29	DPL50 x M237-1	33.13	33.68	33.01	33.76	31.88
DES119 x M1388-2	35.22	34.26	34.78	34.64	36.81	DES119 x M237-1	35.47	34.77	33.84	34.59	34.41
ST474 x M1388-2	35.63	34.92	34.97	34.66	36.83	ST474 x M237-1	35.31	36.31	35.85	35.32	35.25
DPL90 x M1388-2	34.67	34.27	35.14	33.80	35.70	DPL90 x M237-1	34.26	34.43	34.64	33.58	35.43
SG125 x M1388-2	35.21	35.85	35.05	34.52	35.63	SG125 x M237-1	34.59	34.78	35.92	34.62	35.21
DPL50 x M1388-3	34.63	34.37	33.63	34.86	35.30	DPL50 x M237-2	35.03	34.54	36.57	34.47	36.01
DES119 x M1388-3	36.19	34.38	34.57	35.07	35.75	DES119 x M237-2	36.55	37.33	36.88	35.81	36.59
ST474 x M1388-3	35.18	36.11	36.13	36.27	36.90	ST474 x M237-2	35.94	37.36	37.59	36.64	38.16
DPL90 x M1388-3	34.99	35.05	35.06	34.38	36.41	DPL90 x M237-2	36.19	35.73	36.94	35.45	35.44
SG125 x M1388-3	34.69	35.88	36.57	35.17	37.54	SG125 x M237-2	35.62	36.56	37.14	34.57	36.07
DPL50 x M239-1	33.81	33.95	34.50	32.85	34.17	DPL50 x M237-3	35.43	34.67	35.75	35.37	35.86
DES119 x M239-1	35.03	34.47	35.04	34.04	34.67	DES119 x M237-3	37.14	37.19	37.41	36.05	38.25
ST474 x M239-1	36.96	36.04	37.16	35.35	34.91	ST474 x M237-3	37.19	37.76	37.93	36.34	37.24
DPL90 x M239-1	34.66	34.34	35.25	33.47	34.72	DPL90 x M237-3	37.42	36.20	37.43	35.79	37.05
SG125 x M239-1	36.02	35.44	35.95	35.96	35.37	SG125 x M237-3	36.58	35.66	37.29	35.33	37.55
DPL50 x M239-2	33.60	32.21	33.50	32.92	32.86	M75-1	26.06	26.49	26.73	32.41	31.90
DES119 x M239-2	35.37	35.41	36.00	34.13	36.75	M1388-1	31.74	31.20	31.55	33.49	34.00
ST474 x M239-2	34.75	34.45	34.77	33.10	35.78	M1388-2	30.54	28.54	29.95	32.80	31.83
DPL90 x M239-2	34.41	34.23	33.29	33.39	33.93	M1388-3	30.07	31.40	29.75	33.89	32.99
SG125 x M239-2	33.21	34.45	33.86	32.82	35.42	M239-1	29.46	32.21	31.32	31.67	32.57
DPL50 x M239-3	34.15	34.10	33.36	34.26	33.48	M239-2	27.71	29.38	27.82	30.04	32.06
DES119 x M239-3	34.64	33.90	34.66	33.90	35.38	M239-3	28.13	28.67	28.60	31.96	32.34
ST474 x M239-3	36.25	34.95	34.93	34.24	35.68	M239-4	30.67	29.42	29.36	31.37	32.91
DPL90 x M239-3	33.10	33.85	33.80	33.81	34.47	M239-5	31.67	30.77	32.79	31.12	32.71
SG125 x M239-3	34.09	34.71	34.65	35.17	34.47	M239-6	31.67	32.51	31.99	32.76	33.14
DPL50 x M239-4	32.08	32.86	33.61	32.37	31.99	M239-7	28.34	28.30	28.16	29.87	31.99
DES119 x M239-4	35.02	34.59	35.65	33.70	35.68	M237-1	30.45	30.10	29.32	30.55	32.25
ST474 x M239-4	35.11	35.34	34.37	35.36	34.55	M237-2	32.39	30.49	31.41	32.37	34.38
DPL90 x M239-4	33.35	33.70	33.65	33.49	33.92	M237-3	32.80	32.13	33.22	32.79	35.15
SG125 x M239-4	27.34	34.49	34.84	33.85	35.13	DPL50	36.56	36.49	37.59	34.99	36.82
DPL50 x M239-5	33.92	33.43	33.57	32.85	33.12	DES119	40.71	39.77	40.24	38.75	39.86
DES119 x M239-5	36.85	35.87	36.08	35.16	36.78	ST474	42.69	42.38	43.22	41.84	42.83
ST474 x M239-5	35.57	34.16	34.91	33.85	34.21	DPL90	39.72	38.74	38.90	38.60	38.83
DPL90 x M239-5	33.91	34.19	33.85	33.67	34.13	SG125	40.66	40.58	41.98	40.04	40.42
SG125 x M239-5	36.02	35.51	35.80	34.61	35.08	**LSD(0.05)**	**2.73**	**1.18**	**1.23**	**1.18**	**1.17**

Table 11. Genotype mean and LSD (0.05) for lint percentage (%) at different environments.

Table 12. Genotype mean and LSD (0.05) for boll size (g) at different environments.

Genotype	Environment					Genotype	Environment				
	2	3	4	5	6		2	3	4	5	6
DPL50 x M75-1	4.39	4.05	3.97	4.30	4.50	DPL50 x M239-6	5.05	4.76	5.09	5.03	4.53
DES119 x M75-1	4.52	4.27	4.02	4.56	4.32	DES119 x M239-6	4.63	4.80	4.25	5.04	4.56
ST474 x M75-1	4.49	4.59	4.29	4.55	4.36	ST474 x M239-6	4.55	4.87	4.40	4.11	4.15
DPL90 x M75-1	4.64	4.42	4.26	4.71	4.48	DPL90 x M239-6	4.84	4.95	4.66	4.60	4.80
SG125 x M75-1	4.13	4.23	4.12	4.26	4.55	SG125 x M239-6	4.84	4.83	4.85	4.76	4.59
DPL50 x M1388-1	4.54	4.55	4.36	4.72	4.44	DPL50 x M239-7	5.04	4.84	4.34	4.83	4.48
DES119 x M1388-1	4.63	4.22	4.12	4.44	4.36	DES119 x M239-7	4.53	4.61	4.46	4.47	4.64
ST474 x M1388-1	4.92	4.78	4.29	4.96	4.34	ST474 x M239-7	4.93	4.77	4.71	4.89	4.68
DPL90 x M1388-1	4.70	4.84	4.50	4.76	4.60	DPL90 x M239-7	4.62	5.05	5.00	4.77	4.56
SG125 x M1388-1	4.65	4.49	4.57	5.16	4.67	SG125 x M239-7	4.82	4.62	4.47	4.92	4.45
DPL50 x M1388-2	4.85	4.65	4.85	4.58	4.15	DPL50 x M237-1	4.42	4.32	4.61	4.97	4.46
DES119 x M1388-2	4.57	4.62	4.09	4.74	4.74	DES119 x M237-1	4.64	4.20	4.10	4.50	4.40
ST474 x M1388-2	4.53	4.67	4.44	4.96	4.45	ST474 x M237-1	4.09	4.23	4.24	4.47	4.35
DPL90 x M1388-2	4.37	4.47	4.40	4.67	4.32	DPL90 x M237-1	4.32	4.38	4.33	4.59	4.31
SG125 x M1388-2	4.87	3.86	4.50	4.60	4.43	SG125 x M237-1	4.52	4.57	4.04	4.51	4.38
DPL50 x M1388-3	4.29	3.96	4.09	4.16	4.13	DPL50 x M237-2	4.56	4.26	4.29	4.20	4.56
DES119 x M1388-3	3.96	3.90	3.68	4.10	4.01	DES119 x M237-2	4.73	4.21	4.13	4.77	4.26
ST474 x M1388-3	4.06	3.83	3.44	4.05	4.07	ST474 x M237-2	4.83	4.38	3.94	4.57	4.47
DPL90 x M1388-3	3.88	3.96	3.90	4.24	4.08	DPL90 x M237-2	4.40	4.38	4.75	4.64	4.56
SG125 x M1388-3	4.06	3.95	3.78	4.40	4.27	SG125 x M237-2	4.56	4.55	3.88	4.68	4.24
DPL50 x M239-1	5.18	5.44	5.23	5.37	4.80	DPL50 x M237-3	4.92	4.79	4.92	5.03	4.63
DES119 x M239-1	5.09	4.91	4.57	4.91	4.74	DES119 x M237-3	4.73	4.50	4.47	4.70	4.32
ST474 x M239-1	4.53	4.72	4.37	5.21	4.26	ST474 x M237-3	4.91	4.72	4.85	4.88	4.71
DPL90 x M239-1	5.44	5.32	5.20	5.10	4.51	DPL90 x M237-3	4.56	4.61	4.63	4.74	4.73
SG125 x M239-1	4.79	4.55	4.90	4.71	4.82	SG125 x M237-3	4.89	4.67	4.78	5.31	4.84
DPL50 x M239-2	4.68	5.33	4.77	4.49	4.48	M75-1	3.90	3.73	3.78	4.22	4.29
DES119 x M239-2	4.31	4.34	4.31	4.79	4.44	M1388-1	4.53	4.64	4.17	4.87	4.47
ST474 x M239-2	4.94	4.86	4.88	4.99	4.50	M1388-2	4.14	3.48	4.05	4.42	4.33
DPL90 x M239-2	4.66	5.16	5.00	4.78	4.60	M1388-3	3.32	3.21	3.42	4.59	4.12
SG125 x M239-2	4.79	4.74	4.92	4.54	4.71	M239-1	4.40	4.59	4.77	5.10	4.44
DPL50 x M239-3	4.70	4.96	4.58	4.50	4.84	M239-2	3.88	4.88	4.33	4.67	4.31
DES119 x M239-3	4.61	4.37	4.55	5.03	4.56	M239-3	4.32	4.49	4.37	4.70	4.81
ST474 x M239-3	4.89	5.09	4.66	4.82	4.52	M239-4	4.68	4.39	4.68	4.71	5.18
DPL90 x M239-3	4.73	5.06	4.54	5.12	4.72	M239-5	4.40	4.49	4.23	4.36	4.37
SG125 x M239-3	4.71	4.70	4.76	4.51	4.50	M239-6	4.29	4.26	4.23	4.45	4.23
DPL50 x M239-4	4.76	5.59	4.65	5.03	5.16	M239-7	4.67	4.68	4.31	4.85	4.40
DES119 x M239-4	5.10	5.38	5.34	5.27	4.74	M237-1	4.64	4.25	4.34	4.93	4.44
ST474 x M239-4	5.33	5.03	4.77	4.77	4.47	M237-2	4.09	3.39	3.33	4.50	4.46
DPL90 x M239-4	5.09	5.40	5.30	5.16	4.70	M237-3	4.08	4.22	4.08	4.88	4.55
SG125 x M239-4	5.30	5.23	5.03	5.24	5.05	DPL50	4.77	4.72	4.88	5.03	4.66
DPL50 x M239-5	4.76	4.34	4.57	5.07	4.38	DES119	4.48	4.16	4.42	3.99	3.68
DES119 x M239-5	4.75	4.63	4.24	4.81	4.57	ST474	4.93	4.28	4.47	4.32	4.52
ST474 x M239-5	4.93	4.80	4.40	4.68	4.39	DPL90	4.53	4.82	4.64	4.38	4.23
DPL90 x M239-5	4.59	4.60	4.51	4.76	4.45	SG125	4.78	4.46	4.48	4.43	4.71
SG125 x M239-5	4.60	4.56	4.53	4.72	4.46	**LSD(0.05)**	**0.54**	**0.43**	**0.47**	**0.44**	**0.35**

Table 13. Genotype mean and LSD (0.05) for micronaire at different environments.					
Genotype	Environment				
	2	3	4	5	6
DPL50 x M75-1	4.90	5.16	5.00	4.95	4.65
DES119 x M75-1	5.13	5.24	5.18	5.13	4.85
ST474 x M75-1	5.24	5.39	4.98	5.10	4.78
DPL90 x M75-1	4.99	5.16	5.10	5.05	4.83
SG125 x M75-1	5.03	5.16	5.00	5.25	4.48
DPL50 x M1388-1	5.14	5.23	4.85	4.83	4.78
DES119 x M1388-1	5.09	5.21	4.83	5.20	4.65
ST474 x M1388-1	5.11	5.35	4.70	4.75	4.48
DPL90 x M1388-1	5.08	5.28	4.65	5.00	4.48
SG125 x M1388-1	5.28	5.26	4.93	4.83	4.78
DPL50 x M1388-2	3.84	5.10	4.90	5.03	4.68
DES119 x M1388-2	4.83	4.95	4.78	4.85	4.58
ST474 x M1388-2	5.23	5.08	4.88	4.80	4.63
DPL90 x M1388-2	4.90	5.03	4.68	4.75	4.55
SG125 x M1388-2	5.11	5.15	4.78	4.70	4.55
DPL50 x M1388-3	4.73	4.99	5.08	4.90	4.83
DES119 x M1388-3	4.93	5.00	4.70	5.10	4.65
ST474 x M1388-3	5.13	5.40	5.05	5.10	4.50
DPL90 x M1388-3	4.99	5.16	5.10	5.05	4.70
SG125 x M1388-3	5.10	5.16	5.05	4.93	4.78
DPL50 x M239-1	4.99	5.20	4.80	5.13	4.65
DES119 x M239-1	5.00	5.49	4.93	4.95	4.70
ST474 x M239-1	5.40	5.36	5.00	5.23	4.70
DPL90 x M239-1	5.05	5.26	5.05	5.05	4.53
SG125 x M239-1	4.91	5.21	5.00	5.30	4.75
DPL50 x M239-2	5.48	5.35	5.13	5.10	4.60
DES119 x M239-2	5.39	5.40	5.10	5.28	4.90
ST474 x M239-2	5.23	5.59	5.35	5.15	4.93
DPL90 x M239-2	5.28	5.27	5.18	5.00	4.85
SG125 x M239-2	5.35	5.41	5.15	5.05	4.63
DPL50 x M239-3	5.05	5.19	4.85	4.95	4.55
DES119 x M239-3	4.96	5.01	4.70	5.05	4.75
ST474 x M239-3	4.94	5.49	5.18	4.98	4.80
DPL90 x M239-3	5.18	5.26	4.88	4.98	4.63
SG125 x M239-3	5.14	5.23	4.78	5.00	4.40
DPL50 x M239-4	4.75	4.86	4.73	4.63	4.38
DES119 x M239-4	4.91	5.07	4.63	4.73	4.48
ST474 x M239-4	4.78	5.16	4.83	4.80	4.45
DPL90 x M239-4	4.75	4.95	4.60	4.85	4.50
SG125 x M239-4	4.79	4.99	4.53	4.60	4.50
DPL50 x M239-5	5.01	5.15	4.78	4.85	4.58
DES119 x M239-5	4.94	5.11	4.68	4.75	4.73
ST474 x M239-5	4.99	5.23	4.73	4.85	4.55
DPL90 x M239-5	4.63	5.08	4.75	4.73	4.53
SG125 x M239-5	5.05	5.04	4.58	4.78	4.43

Genotype	Environment				
	2	3	4	5	6
DPL50 x M239-6	5.11	5.28	4.85	4.95	4.75
DES119 x M239-6	5.15	5.35	4.83	4.78	4.53
ST474 x M239-6	5.23	5.25	4.90	5.00	4.55
DPL90 x M239-6	5.11	5.40	4.98	4.80	4.53
SG125 x M239-6	4.96	5.08	4.80	4.70	4.38
DPL50 x M239-7	5.33	5.40	5.03	5.13	4.68
DES119 x M239-7	4.96	5.38	5.20	5.23	4.68
ST474 x M239-7	5.49	5.48	5.20	5.48	5.00
DPL90 x M239-7	5.08	5.41	5.28	5.28	4.88
SG125 x M239-7	5.44	5.59	5.30	5.23	4.85
DPL50 x M237-1	4.48	4.64	4.35	4.45	4.43
DES119 x M237-1	4.69	4.66	4.43	4.43	4.43
ST474 x M237-1	4.53	4.88	4.68	4.70	4.45
DPL90 x M237-1	4.01	4.36	4.20	4.48	4.13
SG125 x M237-1	4.61	4.58	4.30	4.55	4.30
DPL50 x M237-2	4.59	4.75	4.38	4.65	4.20
DES119 x M237-2	5.08	5.01	5.00	4.90	4.40
ST474 x M237-2	5.11	5.23	4.43	4.80	4.45
DPL90 x M237-2	4.79	4.98	4.65	4.78	4.45
SG125 x M237-2	4.78	4.91	4.78	4.45	4.38
DPL50 x M237-3	4.66	4.80	4.73	4.73	4.45
DES119 x M237-3	4.81	4.74	4.50	4.53	4.45
ST474 x M237-3	4.88	5.04	4.58	4.58	4.40
DPL90 x M237-3	4.60	5.10	4.40	4.65	4.50
SG125 x M237-3	4.76	4.80	4.20	4.55	4.30
M75-1	4.96	4.91	4.98	5.15	4.83
M1388-1	5.03	5.21	5.03	5.10	4.80
M1388-2	3.65	5.04	4.88	4.93	4.65
M1388-3	3.40	4.71	4.90	4.78	4.58
M239-1	4.94	5.00	4.80	5.15	4.68
M239-2	4.04	5.36	5.33	5.43	4.85
M239-3	5.08	5.29	5.08	5.53	4.73
M239-4	4.45	4.86	4.53	4.63	4.48
M239-5	3.88	5.20	5.10	5.13	4.58
M239-6	5.29	5.36	4.93	5.13	4.63
M239-7	5.58	5.44	5.35	5.28	4.80
M237-1	4.44	4.74	4.40	4.65	4.63
M237-2	4.55	4.59	4.30	4.53	4.25
M237-3	4.24	4.58	4.10	4.25	4.25
DPL50	5.03	5.18	4.90	5.10	4.55
DES119	5.05	5.16	4.70	4.68	4.53
ST474	5.21	5.33	4.65	4.83	4.68
DPL90	4.75	5.09	4.80	4.80	4.68
SG125	5.08	5.28	4.65	5.00	4.70
LSD(0.05)	**0.90**	**0.24**	**0.34**	**0.36**	**0.27**

Table 14. Genotype mean and LSD (0.05) for elongation (%) at different environments.

Genotype	Environment					Genotype	Environment				
	2	3	4	5	6		2	3	4	5	6
DPL50 x M75-1	7.44	8.00	7.56	7.88	7.56	DPL50 x M239-6	7.56	6.56	6.88	6.50	7.13
DES119 x M75-1	8.19	8.44	7.69	7.44	7.56	DES119 x M239-6	7.50	7.00	6.56	7.06	6.88
ST474 x M75-1	7.69	7.94	7.75	7.06	6.75	ST474 x M239-6	7.13	6.44	7.19	6.94	6.81
DPL90 x M75-1	7.13	6.75	7.25	6.38	6.88	DPL90 x M239-6	6.38	5.94	6.56	6.69	6.94
SG125 x M75-1	8.38	8.38	7.94	7.56	7.69	SG125 x M239-6	7.38	7.06	7.06	7.56	7.06
DPL50 x M1388-1	7.81	7.31	6.94	7.19	6.94	DPL50 x M239-7	7.25	6.81	6.75	6.94	6.44
DES119 x M1388-1	8.00	7.44	7.38	7.44	7.44	DES119 x M239-7	6.56	7.31	6.25	7.13	6.63
ST474 x M1388-1	7.19	6.94	6.88	6.81	7.06	ST474 x M239-7	7.25	6.81	6.44	6.38	6.63
DPL90 x M1388-1	7.25	6.75	7.19	7.00	6.81	DPL90 x M239-7	6.50	6.13	6.44	6.56	6.81
SG125 x M1388-1	7.75	7.31	6.56	7.50	7.31	SG125 x M239-7	7.38	7.31	6.56	6.81	6.81
DPL50 x M1388-2	7.38	7.38	6.50	7.06	6.75	DPL50 x M237-1	7.25	7.00	7.44	6.69	6.88
DES119 x M1388-2	7.31	7.25	6.63	7.25	6.44	DES119 x M237-1	7.25	7.00	6.50	7.31	7.38
ST474 x M1388-2	6.88	6.69	7.25	6.81	6.38	ST474 x M237-1	7.25	7.38	7.13	7.00	6.75
DPL90 x M1388-2	7.00	6.56	6.06	6.19	6.81	DPL90 x M237-1	6.56	6.69	6.13	6.50	6.75
SG125 x M1388-2	7.38	7.00	7.31	7.13	7.06	SG125 x M237-1	7.25	7.56	7.56	8.13	7.94
DPL50 x M1388-3	7.50	8.44	7.56	6.88	7.25	DPL50 x M237-2	8.69	8.67	7.63	8.13	7.50
DES119 x M1388-3	8.38	7.56	7.63	7.94	7.44	DES119 x M237-2	7.81	8.44	7.69	7.94	8.00
ST474 x M1388-3	7.50	7.00	6.63	7.06	6.94	ST474 x M237-2	7.06	7.38	6.50	7.56	7.38
DPL90 x M1388-3	7.00	6.94	7.25	7.06	6.56	DPL90 x M237-2	7.88	7.44	7.69	7.31	7.44
SG125 x M1388-3	7.56	8.00	7.75	7.81	7.13	SG125 x M237-2	7.81	6.31	7.94	8.19	7.88
DPL50 x M239-1	7.19	7.75	7.00	7.31	7.75	DPL50 x M237-3	7.44	6.75	7.25	7.25	7.56
DES119 x M239-1	7.88	7.75	7.13	7.25	7.38	DES119 x M237-3	7.88	7.25	7.69	7.50	7.38
ST474 x M239-1	7.63	7.44	7.31	7.13	6.63	ST474 x M237-3	7.69	7.50	7.25	6.94	7.44
DPL90 x M239-1	6.56	6.81	6.56	6.94	6.75	DPL90 x M237-3	7.19	6.75	6.50	6.94	6.94
SG125 x M239-1	7.13	7.88	7.25	7.50	7.56	SG125 x M237-3	7.81	8.00	7.38	7.44	7.19
DPL50 x M239-2	7.63	7.38	7.00	7.25	7.13	M75-1	8.06	8.75	8.06	7.81	7.19
DES119 x M239-2	7.00	7.13	7.44	7.19	6.63	M1388-1	6.63	6.44	6.13	6.44	6.38
ST474 x M239-2	6.94	6.88	6.75	6.94	6.63	M1388-2	6.94	6.75	7.19	6.94	7.19
DPL90 x M239-2	6.67	6.00	7.13	6.31	6.19	M1388-3	7.06	7.69	6.75	7.00	6.63
SG125 x M239-2	8.00	6.81	6.38	6.94	6.75	M239-1	6.94	6.19	6.56	6.13	6.31
DPL50 x M239-3	7.94	7.94	7.50	7.56	7.50	M239-2	7.00	6.88	7.13	7.25	6.69
DES119 x M239-3	7.63	7.88	7.44	7.44	6.94	M239-3	7.13	7.75	6.63	7.31	6.38
ST474 x M239-3	7.13	6.69	7.56	7.00	6.25	M239-4	6.75	6.81	6.94	6.50	7.44
DPL90 x M239-3	6.75	7.13	6.38	6.75	6.69	M239-5	7.63	6.94	6.63	6.94	6.75
SG125 x M239-3	8.25	7.63	7.44	7.75	7.56	M239-6	6.31	6.75	6.94	6.38	6.75
DPL50 x M239-4	8.13	8.25	8.00	8.06	7.31	M239-7	5.67	5.69	6.50	6.19	6.13
DES119 x M239-4	7.31	7.08	7.69	7.44	7.44	M237-1	7.13	6.81	6.69	6.25	6.19
ST474 x M239-4	7.25	6.88	7.13	7.19	6.94	M237-2	6.19	6.69	6.56	7.00	7.00
DPL90 x M239-4	7.13	7.13	6.56	7.25	6.63	M237-3	7.19	6.56	6.88	6.94	6.69
SG125 x M239-4	7.56	7.88	7.00	7.88	7.75	DPL50	8.50	9.00	7.44	8.38	8.13
DPL50 x M239-5	8.00	7.25	7.38	7.00	7.19	DES119	7.75	8.25	7.94	7.88	8.44
DES119 x M239-5	7.44	7.38	7.00	7.63	6.94	ST474	8.31	7.13	6.75	7.44	6.88
ST474 x M239-5	7.63	7.00	6.75	7.13	7.31	DPL90	7.13	6.63	6.13	6.94	6.63
DPL90 x M239-5	7.69	6.25	7.00	7.19	6.81	SG125	8.25	8.31	8.33	8.13	7.88
SG125 x M239-5	7.75	7.19	7.44	7.75	7.19	**LSD(0.05)**	**0.84**	**0.86**	**0.88**	**0.87**	**0.71**

Table 15. Genotype mean and LSD (0.05) for fiber strength (kNm/kg) at different environments.

Genotype	Environment				
	2	3	4	5	6
DPL50 x M75-1	212.13	209.88	224.75	209.38	227.38
DES119 x M75-1	220.13	216.00	227.13	219.50	225.25
ST474 x M75-1	225.00	212.00	229.00	227.00	234.00
DPL90 x M75-1	222.38	216.00	239.00	233.50	234.63
SG125 x M75-1	210.00	210.88	218.00	221.13	227.25
DPL50 x M1388-1	208.88	203.88	214.63	217.25	213.25
DES119 x M1388-1	219.75	209.25	227.75	225.50	237.25
ST474 x M1388-1	222.38	224.00	240.88	234.75	226.63
DPL90 x M1388-1	208.63	213.63	233.38	239.88	231.00
SG125 x M1388-1	212.25	202.63	228.00	212.00	219.38
DPL50 x M1388-2	219.13	208.00	226.88	223.00	228.75
DES119 x M1388-2	227.63	219.13	242.13	226.75	242.50
ST474 x M1388-2	215.13	209.25	232.00	217.63	228.00
DPL90 x M1388-2	223.00	232.38	249.13	242.00	246.13
SG125 x M1388-2	212.63	214.75	231.25	223.88	229.25
DPL50 x M1388-3	218.25	202.50	224.75	228.50	218.25
DES119 x M1388-3	229.88	234.63	229.25	232.88	243.38
ST474 x M1388-3	222.63	214.50	239.50	225.50	224.25
DPL90 x M1388-3	221.38	212.00	246.88	243.88	236.00
SG125 x M1388-3	213.50	220.88	234.00	231.50	220.63
DPL50 x M239-1	213.00	208.50	229.50	209.88	216.88
DES119 x M239-1	221.88	222.88	227.13	229.38	220.25
ST474 x M239-1	212.75	210.88	234.50	220.63	211.88
DPL90 x M239-1	228.38	217.75	237.38	241.13	238.00
SG125 x M239-1	208.75	203.63	211.25	215.75	223.63
DPL50 x M239-2	210.25	206.50	230.00	217.00	225.13
DES119 x M239-2	228.13	219.50	258.25	217.88	230.13
ST474 x M239-2	220.50	211.88	230.13	227.50	229.00
DPL90 x M239-2	232.00	214.00	234.00	235.00	241.50
SG125 x M239-2	222.25	206.63	233.00	217.25	230.38
DPL50 x M239-3	219.38	204.88	234.63	206.50	226.25
DES119 x M239-3	228.88	213.25	243.00	230.63	232.88
ST474 x M239-3	219.00	215.63	234.38	223.50	235.63
DPL90 x M239-3	233.00	219.63	242.75	242.63	236.25
SG125 x M239-3	209.13	214.50	226.63	222.00	232.63
DPL50 x M239-4	205.75	201.75	216.25	209.63	214.88
DES119 x M239-4	217.00	216.33	238.25	226.50	230.25
ST474 x M239-4	213.38	208.88	223.88	221.88	227.88
DPL90 x M239-4	225.13	233.50	233.13	225.75	238.88
SG125 x M239-4	209.63	208.38	228.13	208.63	221.63
DPL50 x M239-5	225.38	213.50	221.63	219.25	217.50
DES119 x M239-5	229.63	213.38	234.75	221.00	224.63
ST474 x M239-5	216.38	221.63	234.25	236.88	230.25
DPL90 x M239-5	218.13	216.50	241.25	228.38	233.25
SG125 x M239-5	209.00	202.13	229.00	221.63	221.50
DPL50 x M239-6	222.00	215.25	229.00	222.00	225.50
DES119 x M239-6	233.63	223.38	237.25	229.13	213.50
ST474 x M239-6	223.75	209.75	240.25	222.50	229.25
DPL90 x M239-6	224.25	221.50	229.38	228.75	244.00
SG125 x M239-6	218.00	205.88	235.75	217.75	227.88
DPL50 x M239-7	208.50	224.38	233.00	228.00	221.75
DES119 x M239-7	222.00	235.25	233.88	224.88	232.75
ST474 x M239-7	219.25	215.50	239.75	227.00	223.75
DPL90 x M239-7	221.63	233.75	253.63	238.00	236.38
SG125 x M239-7	232.38	220.75	235.75	216.25	228.25
DPL50 x M237-1	224.63	212.25	239.25	215.63	225.63
DES119 x M237-1	230.00	221.63	248.63	227.38	220.13
ST474 x M237-1	225.63	227.88	232.13	234.00	230.75
DPL90 x M237-1	237.63	231.13	252.33	241.88	250.75
SG125 x M237-1	219.13	220.88	232.13	223.13	232.38
DPL50 x M237-2	200.25	205.83	224.63	222.50	205.88
DES119 x M237-2	222.13	202.50	219.13	218.00	223.75
ST474 x M237-2	210.13	203.38	226.65	212.88	222.63
DPL90 x M237-2	223.25	222.75	239.88	228.88	238.38
SG125 x M237-2	206.00	206.88	230.63	204.38	226.50
DPL50 x M237-3	203.38	202.00	226.75	206.38	213.38
DES119 x M237-3	217.00	214.00	225.75	226.63	236.00
ST474 x M237-3	223.50	216.63	244.00	224.88	238.63
DPL90 x M237-3	229.00	206.50	226.38	224.50	235.25
SG125 x M237-3	204.25	204.75	225.88	222.75	219.25
M75-1	225.25	224.13	242.50	236.63	231.88
M1388-1	229.38	229.50	255.00	220.50	235.88
M1388-2	257.00	240.25	273.13	261.38	254.63
M1388-3	270.38	252.25	263.38	260.88	250.13
M239-1	228.50	235.63	240.75	248.25	236.25
M239-2	229.63	222.63	251.13	229.00	241.38
M239-3	249.63	228.50	264.63	248.88	238.88
M239-4	250.00	237.13	252.00	225.50	236.50
M239-5	220.63	222.38	246.00	234.75	235.13
M239-6	241.25	241.63	244.63	243.75	244.25
M239-7	257.33	239.38	266.00	276.00	255.25
M237-1	236.38	240.13	244.25	249.13	247.50
M237-2	251.63	235.63	253.00	229.88	237.13
M237-3	221.25	238.00	245.88	249.00	249.13
DPL50	189.38	181.00	201.88	194.13	197.00
DES119	208.63	197.63	214.75	202.00	208.63
ST474	198.38	194.50	215.63	194.50	200.63
DPL90	212.13	202.38	225.00	226.50	223.63
SG125	199.00	184.50	210.00	200.50	215.63
LSD(0.05)	**16.35**	**13.72**	**18.57**	**15.82**	**16.57**

Table 16. Genotype mean and LSD (0.05) for 50% fiber span length (mm) at different environments.

Genotype	Environment 2	3	4	5	6
DPL50 x M75-1	14.38	14.32	14.00	13.75	13.97
DES119 x M75-1	14.76	14.35	13.94	14.26	14.29
ST474 x M75-1	14.64	14.10	14.19	14.32	14.57
DPL90 x M75-1	14.41	13.97	13.72	14.16	14.13
SG125 x M75-1	14.67	14.35	14.16	14.00	14.70
DPL50 x M1388-1	14.92	14.35	14.19	14.07	14.26
DES119 x M1388-1	14.99	14.19	14.26	13.91	14.54
ST474 x M1388-1	14.83	13.91	14.29	13.84	14.10
DPL90 x M1388-1	14.80	14.41	14.13	14.13	14.07
SG125 x M1388-1	14.61	14.22	14.38	14.29	14.51
DPL50 x M1388-2	14.67	14.45	14.35	14.32	14.51
DES119 x M1388-2	15.30	14.48	14.32	14.61	14.57
ST474 x M1388-2	14.80	14.35	14.35	14.61	14.35
DPL90 x M1388-2	15.21	14.54	14.57	14.13	14.54
SG125 x M1388-2	15.05	14.54	14.35	14.70	14.61
DPL50 x M1388-3	14.95	14.03	13.72	14.07	14.48
DES119 x M1388-3	14.83	14.45	14.10	14.10	14.45
ST474 x M1388-3	15.02	14.38	13.78	14.10	13.84
DPL90 x M1388-3	14.48	13.97	13.97	14.45	13.91
SG125 x M1388-3	14.76	14.51	14.32	14.38	14.03
DPL50 x M239-1	14.76	14.80	14.45	14.61	14.32
DES119 x M239-1	14.92	14.32	14.41	14.45	14.38
ST474 x M239-1	14.86	14.19	14.16	13.78	14.16
DPL90 x M239-1	15.05	14.54	14.26	14.35	14.35
SG125 x M239-1	15.24	14.35	14.26	13.94	14.35
DPL50 x M239-2	14.45	14.41	14.26	14.41	14.61
DES119 x M239-2	15.14	14.54	14.38	14.48	14.13
ST474 x M239-2	14.83	14.61	14.26	14.57	14.64
DPL90 x M239-2	14.90	14.14	14.48	14.07	14.19
SG125 x M239-2	15.02	14.61	14.67	14.61	14.64
DPL50 x M239-3	14.64	14.38	13.97	14.45	14.10
DES119 x M239-3	15.14	14.26	14.35	14.26	14.35
ST474 x M239-3	14.83	14.13	14.22	14.22	14.16
DPL90 x M239-3	14.70	14.32	14.67	14.41	13.87
SG125 x M239-3	15.08	14.54	14.54	14.32	14.57
DPL50 x M239-4	15.05	14.41	14.35	14.07	14.16
DES119 x M239-4	14.80	14.73	14.38	14.41	14.57
ST474 x M239-4	15.30	14.29	13.94	14.38	14.61
DPL90 x M239-4	15.40	14.32	14.26	14.22	14.13
SG125 x M239-4	15.21	14.48	14.00	14.26	14.51
DPL50 x M239-5	14.76	14.32	13.97	14.19	14.03
DES119 x M239-5	15.08	14.41	14.10	14.45	14.22
ST474 x M239-5	15.34	14.54	14.35	14.41	14.64
DPL90 x M239-5	15.68	14.54	14.48	14.13	14.19
SG125 x M239-5	15.34	14.51	14.16	14.48	14.45
DPL50 x M239-6	15.11	14.41	14.38	14.32	14.48
DES119 x M239-6	15.05	14.41	14.35	14.57	14.35
ST474 x M239-6	14.99	14.45	13.97	13.49	14.61
DPL90 x M239-6	14.99	14.10	14.48	14.16	14.22
SG125 x M239-6	15.40	14.67	14.22	14.57	14.64
DPL50 x M239-7	14.95	14.32	14.10	14.41	14.45
DES119 x M239-7	15.05	14.38	14.22	14.07	14.45
ST474 x M239-7	15.02	14.38	14.00	14.19	14.41
DPL90 x M239-7	14.86	14.16	14.22	14.19	14.32
SG125 x M239-7	14.54	14.51	14.29	14.35	14.10
DPL50 x M237-1	15.11	14.70	14.41	14.70	14.80
DES119 x M237-1	15.30	14.41	14.10	14.29	14.51
ST474 x M237-1	15.46	14.89	14.54	14.51	14.35
DPL90 x M237-1	15.05	14.45	14.10	14.16	14.61
SG125 x M237-1	14.92	14.73	14.22	14.32	14.67
DPL50 x M237-2	15.14	14.52	14.45	14.26	14.29
DES119 x M237-2	15.34	14.38	13.97	14.26	14.83
ST474 x M237-2	14.61	14.38	14.10	13.53	14.41
DPL90 x M237-2	14.76	14.54	14.41	13.91	14.57
SG125 x M237-2	15.46	14.45	14.54	14.07	14.29
DPL50 x M237-3	15.18	14.35	14.38	14.13	14.29
DES119 x M237-3	15.02	14.73	14.51	14.67	14.76
ST474 x M237-3	15.65	14.57	14.51	14.45	14.41
DPL90 x M237-3	14.76	14.26	14.13	14.54	14.61
SG125 x M237-3	15.53	14.86	14.19	14.57	14.73
M75-1	13.84	13.72	13.84	13.30	14.22
M1388-1	14.70	13.87	13.87	13.91	14.00
M1388-2	14.73	14.35	14.51	14.16	14.38
M1388-3	15.24	14.45	13.84	14.10	14.16
M239-1	14.54	14.07	13.87	13.56	14.32
M239-2	14.86	14.03	14.00	14.26	14.07
M239-3	14.45	14.10	14.07	14.16	14.54
M239-4	14.67	14.35	14.22	14.13	14.57
M239-5	14.16	14.32	14.03	14.48	14.22
M239-6	14.73	14.19	14.03	14.26	14.07
M239-7	14.22	14.26	14.00	14.35	14.51
M237-1	14.45	14.07	14.22	14.10	14.32
M237-2	14.70	14.35	14.48	14.45	14.48
M237-3	15.30	14.64	14.26	14.57	14.70
DPL50	14.80	14.26	14.10	14.00	14.29
DES119	14.92	14.64	14.51	14.57	14.48
ST474	14.76	14.48	14.32	14.38	14.19
DPL90	15.11	13.97	14.10	14.00	14.41
SG125	14.64	14.41	14.29	13.91	14.57
LSD(0.05)	**0.75**	**0.55**	**0.53**	**0.58**	**0.51**

Table 17. Genotype mean and LSD (0.05) for 2.5% fiber span length (mm) at different environments.

Genotype	Environment				
	2	3	4	5	6
DPL50 x M75-1	28.58	27.88	26.96	26.73	27.59
DES119 x M75-1	28.23	27.62	26.96	27.31	27.75
ST474 x M75-1	28.10	27.11	27.08	26.86	28.83
DPL90 x M75-1	28.67	27.59	26.92	27.40	28.13
SG125 x M75-1	28.73	27.72	27.18	26.86	28.83
DPL50 x M1388-1	28.67	28.19	27.91	27.50	28.83
DES119 x M1388-1	29.05	27.97	27.75	26.92	28.83
ST474 x M1388-1	28.83	27.78	28.32	27.24	28.89
DPL90 x M1388-1	28.32	28.23	27.65	27.94	28.26
SG125 x M1388-1	28.45	28.26	28.23	27.88	28.96
DPL50 x M1388-2	29.18	28.77	28.19	27.88	28.96
DES119 x M1388-2	29.91	29.15	28.07	28.51	29.34
ST474 x M1388-2	29.46	28.70	28.29	28.54	29.08
DPL90 x M1388-2	30.26	29.21	28.83	28.58	29.85
SG125 x M1388-2	29.53	29.05	28.38	29.02	29.21
DPL50 x M1388-3	29.46	28.19	27.31	27.69	29.08
DES119 x M1388-3	29.46	28.73	28.07	27.81	29.08
ST474 x M1388-3	29.94	27.97	27.37	27.91	28.45
DPL90 x M1388-3	29.21	28.38	27.81	28.67	28.51
SG125 x M1388-3	29.59	28.70	28.00	27.75	28.45
DPL50 x M239-1	29.97	29.34	28.96	28.19	29.27
DES119 x M239-1	29.46	28.07	28.10	28.19	28.99
ST474 x M239-1	28.83	27.56	27.78	27.69	28.58
DPL90 x M239-1	30.23	28.64	28.10	28.58	29.08
SG125 x M239-1	29.15	28.23	28.07	27.43	28.83
DPL50 x M239-2	28.83	28.70	28.26	28.29	29.40
DES119 x M239-2	28.99	28.23	28.04	27.78	28.77
ST474 x M239-2	29.37	28.26	28.45	28.61	29.08
DPL90 x M239-2	29.04	27.94	28.51	28.29	28.89
SG125 x M239-2	29.34	28.67	28.86	28.80	29.59
DPL50 x M239-3	29.59	28.58	28.19	28.26	28.67
DES119 x M239-3	29.53	28.26	28.13	28.07	28.70
ST474 x M239-3	29.15	28.51	28.26	28.48	29.08
DPL90 x M239-3	28.96	28.89	29.46	28.77	28.96
SG125 x M239-3	28.70	28.32	28.07	28.10	29.08
DPL50 x M239-4	29.85	29.15	28.58	28.10	29.08
DES119 x M239-4	29.59	29.38	28.83	28.54	29.46
ST474 x M239-4	30.45	28.83	28.29	28.04	29.08
DPL90 x M239-4	30.16	28.96	28.32	28.61	29.34
SG125 x M239-4	29.88	28.83	28.19	28.45	29.21
DPL50 x M239-5	29.46	28.83	28.45	28.35	28.58
DES119 x M239-5	29.72	29.21	28.45	28.10	29.05
ST474 x M239-5	30.42	29.34	28.45	28.96	29.97
DPL90 x M239-5	30.42	29.21	28.89	28.61	29.08
SG125 x M239-5	29.88	28.96	28.45	28.54	29.08
DPL50 x M239-6	29.69	28.70	28.58	28.45	29.21
DES119 x M239-6	28.83	28.23	28.32	28.26	28.89
ST474 x M239-6	29.34	28.83	28.00	27.18	29.46
DPL90 x M239-6	29.85	28.32	28.45	28.48	28.96
SG125 x M239-6	30.64	29.21	28.32	28.80	29.59
DPL50 x M239-7	29.11	29.08	28.32	28.19	29.15
DES119 x M239-7	28.96	28.04	27.88	28.00	29.08
ST474 x M239-7	28.48	28.07	27.88	27.59	28.96
DPL90 x M239-7	29.08	28.45	28.19	28.58	28.70
SG125 x M239-7	28.45	28.04	27.88	27.91	28.07
DPL50 x M237-1	30.23	29.85	29.34	29.56	29.72
DES119 x M237-1	29.91	29.18	29.15	28.32	29.21
ST474 x M237-1	31.27	29.85	28.99	28.96	29.21
DPL90 x M237-1	30.86	29.85	28.89	28.64	29.72
SG125 x M237-1	29.85	29.37	28.70	28.70	29.85
DPL50 x M237-2	30.67	29.08	28.99	28.73	29.21
DES119 x M237-2	30.23	28.70	28.29	28.00	29.59
ST474 x M237-2	29.27	28.96	28.32	27.62	29.34
DPL90 x M237-2	29.56	29.34	28.61	27.78	29.46
SG125 x M237-2	30.89	28.96	28.83	28.86	29.34
DPL50 x M237-3	30.73	29.72	28.99	29.08	29.15
DES119 x M237-3	30.48	29.97	29.46	29.24	30.35
ST474 x M237-3	30.23	29.53	29.08	29.31	29.59
DPL90 x M237-3	30.48	28.35	28.42	28.73	29.72
SG125 x M237-3	30.89	29.72	28.96	29.27	30.10
M75-1	26.32	26.86	25.43	25.21	28.19
M1388-1	27.97	26.67	27.21	26.61	28.26
M1388-2	28.32	27.50	27.34	27.50	28.58
M1388-3	30.10	28.48	27.08	27.53	28.83
M239-1	27.94	27.40	26.86	26.89	28.83
M239-2	28.35	27.50	27.91	27.94	28.54
M239-3	27.91	27.11	27.56	28.00	28.96
M239-4	29.34	28.58	28.29	28.00	28.96
M239-5	27.69	28.32	27.69	27.69	29.08
M239-6	28.54	28.04	27.81	28.13	28.70
M239-7	27.52	27.65	27.15	27.59	28.58
M237-1	28.73	28.13	28.19	28.32	28.83
M237-2	29.59	28.89	28.77	29.05	29.34
M237-3	31.15	29.72	28.58	29.46	30.10
DPL50	29.59	28.45	28.26	28.04	28.70
DES119	29.34	28.83	28.26	27.78	29.34
ST474	29.08	28.54	28.51	28.00	28.96
DPL90	29.75	28.19	28.19	28.32	29.08
SG125	29.21	29.08	28.19	28.10	29.34
LSD(0.05)	**1.01**	**0.95**	**0.87**	**0.85**	**0.84**

Conclusions

In general, the following conclusions can be drawn from Tables 9-17. Cultivar parents produced more consistent (stable) results than exotic parents and their hybrids. Exotic parents performed better in the dry year (environments 5 and 6) than in the more normal years. Some of these crosses could be used for their yield heterosis combined with improvement of fiber length and fiber strength. Some crosses also could be used for pure line development. Selection across environments should be done in use of heterosis or development of pure lines. There seems to be an opportunity to select some drought-resistant hybrids or pure lines among these populations.

Correlations between F2 and F3 hybrids indicated that lint percentage, boll size, elongation, fiber strength, and 2.5% span length was highly correlated, while seed cotton yield and lint yield were poorly related (Table 18). This result is in agreement with what Meredith and Bridge (1973) reported. Results suggested that selection at early generations could be conducted for lint percentage, boll size, elongation, fiber strength, and 2.5% span length, and that selection at late generations should be conducted for seed cotton yield and lint yield.

The results of this study will aid cotton breeders in utilizing these lines derived from exotic germplasm that have high fiber strength.

Table 18. Correlations between F2 and F3 hybrids for nine yield, yield component, and fiber traits.[1]

F3	F2								
	YLD	LYLD	L%	BS	Mic	E1	T1	SL50	SL2.5
YLD	0.17	0.11	-0.23+	0.15	0.38**	-0.10	-0.10	-0.10	-0.27*
LYLD	0.05	0.09	0.07	0.03	0.35**	-0.02	-0.13	-0.12	-0.29*
L%	-0.36**	-0.08	0.84**	-0.33	-0.06	0.20	-0.06	-0.05	-0.06
BS	-0.07	-0.16	-0.23+	0.69**	-0.03	-0.12	-0.16	0.33**	0.24
Mic	0.07	0.00	-0.22+	-0.04	0.77**	-0.22+	0.12	-0.36**	-0.61**
E1	0.12	0.19	0.20	0.06	-0.32**	0.68**	-0.50**	0.04	0.10
T1	-0.17	-0.17	0.02	-0.07	-0.05	-0.45**	0.65**	0.05	0.08
SL50	0.07	0.12	0.19	0.13	-0.31**	0.11	-0.14	0.38**	0.30*
SL2.5	-0.27*	-0.23+	0.24*	0.19	-0.54**	-0.08	0.02	0.60**	0.75**

[1]Traits: YLD – seed cotton yield; LYLD – lint yield; L% – lint percentage; BS – boll size; Mic – micronaire; E1 – fiber elongation; T1 – fiber strength; SL50 – span length 50 percent; and SL2.5 – span length 2.5 percent. +, *, ** — Significant at 0.10, 0.05, and 0.01 probability levels, respectively.

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