EFFECTS OF SELECTED MORPHOLOGICAL TRAITS IN COTTON ON NATURAL INSECT INFESTATIONS, LINT YIELD, LINT PERCENT, AND FIBER QUALITY

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INTRODUCTION

The first and second chapters of this dissertation are separate and complete manuscripts to be submitted for publication in the journals of <u>Environmental Entomology</u> and of <u>Crop Science</u>, respectively. The formats of the two manuscripts conform to the styles of those respective journals.

Natural Infestations of the Cotton Fleahopper (Hemiptera: Miridae) and Bollworm (Lepidoptera: Noctuidae) on Selected Morphological Traits in Cotton

Natural Infestations of the Cotton Fleahopper (Hemiptera: Miridae) and Bollworm (Lepidoptera: Noctuidae) on Selected Morphological Traits in Cotton[1]

ABSTRACT This study was conducted to evaluate the responses of natural insect infestations to selected morphological traits in near-isogenic lines of cotton, *Gossypium hirsutum* L. Five morphological traits (i.e., okra leaf, nectariless, frego bract, smooth leaf, and glandless) versus the normal check were compared in each of eight genetic backgrounds (i.e., 'Deltapine 16', 'Stoneville 213', 'Auburn 56', 'Delcot 277', 'Coker 310', 'Coker 201', 'TH 149', and Pee Dee 2165). Replicated experiments were conducted under irrigation and without insecticide applications at two locations in Oklahoma for 3 years. Cotton fleahoppers, *Pseudatomoscelis seriatus* (Reuter); eggs and larvae of the bollworm, *Heliothis zea* (Boddie); and bollworm-damaged squares were counted. In most cases, interactions of morphological traits X genetic backgrounds were not significant for insect response. The smooth-leaf trait reduced cotton fleahopper populations by 54% compared with

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normal cotton when averaged over years, locations, backgrounds, and sampling dates. Frego bract increased fleahopper numbers by 64% over the same variables compared to normal cotton. The okra-leaf, nectariless, and glandless traits occasionally influenced fleahopper infestations, but a consistent pattern was not discernible. Probably as a result of relatively mild bollworm infestations, no significant differences between morphological traits and normal cotton were detected for bollworm-damaged squares or for bollworm larvae. Smooth leaf did suppress, to some extent, bollworm oviposition; but the other morphological traits appeared to have little effect on oviposition of that insect.

INTRODUCTION

Resistance to insecticides and concern for environmental pollution relating to the use of those insecticides have increased the interest in developing host plant resistance. Considerable efforts have been made to evaluate morphological traits for their influence on insect populations in cotton, Gossypium hirsutum L. Among such traits have been the okra-leaf, nectariless, frego-bract, smooth-leaf, and glandless traits studied herein.

The okra-leaf trait is a leaf shape mutant, L_2^o, characterized by palmately lobed leaves with less surface area per leaf than normal-leaf cotton. Reddy (1974) found that boll weevil, Anthonomus grandis (Boheman), survival was lower under okra- and super-okra-leaf canopies than under normal-leaf canopies during hot, dry periods. From other field studies in Louisiana, Jones et al. (1975) concluded that the okra- and super-okra-leaf traits were also associated with a high degree of resistance to the bandedwing whitefly, Trialeurodes abutilonea (Haldeman).

Nectariless cotton, ne_1ne_2, has no leaf or extrafloral nectaries to secrete the nectar which attracts and furnishes food for insects. Therefore, this trait is effective in suppressing several insect species. Schuster and Maxwell (1974) evaluated the nectariless trait in large plots of

7 3/4 acres (3.1 ha) and reported that it reduced tarnished plant bug, Lygus lineolaris (Palisot de Beauvois), and cotton fleahopper, Pseudatomoscelis seriatus (Reuter), populations when compared to nectaried cotton. In field studies conducted by Wilson and Wilson (1976), the nectariless trait also showed resistance to the pink bollworm, Pectinophora gossypiella (Saunders). Lukefahr et al. (1975) found that although the nectariless character conferred some resistance in cage tests to the bollworm, Heliothis zea (Boddie), it did not suppress the bollworm in the field, probably because of the flight habits of the adult moths.

Frego bract is a mutant trait, fg, which is characterized by narrow, elongated, and twisted bracts which flare away from the flower bud and boll. Boll-weevil resistance associated with frego bract was first reported by Jones et al. (1964). Jenkins and Parrott (1971) found that in a large field where resistance was measured over three or four insect generations, boll-weevil oviposition in frego-bract cotton was suppressed from 66 to 94% below that in nonfrego types. However, a drawback of this trait is its greater susceptibility to the cotton fleahopper and tarnished plant bug (Jones et al. 1969, Cowan and Lukefahr 1970).

With reduced numbers of leaf and stem trichomes, smooth-leaf cotton, Sm_2, suppresses oviposition and damage of the bollworm (Lukefahr et al. 1971). During 5 years of evaluating smooth-leaf cotton strains in field tests, oviposition of Heliothis spp. was reduced from 36 to 80%, resulting in significantly fewer larvae and damaged fruiting forms. Lukefahr et al. (1970) also reported that fleahopper populations on smooth-leaf cotton were reduced more than 50% when compared with the commercial standard. However, Meredith and Schuster (1979) found that smooth-leaf cottons were more sensitive to tarnished plant bugs than were pubescent cottons.

The glandless trait, gl_2gl_3, appears to be more susceptible to a number of insect species than is normally glanded cotton. Lukefahr et al. (1966) found that larval growth of the bollworm was greater on glandless than on glanded cotton strains. Murray et al. (1965) also demonstrated that glandless cotton was more susceptible than the corresponding glanded cotton to the striped blister beetle, Epicauta vitatta (F.), an insect which normally does not attack cotton at all.

Whether or not the above morphological traits prove to be favorable depends, to a large extent, upon the environments in which they are grown, including the insect species and population pressures to which they are exposed. This study was conducted to evaluate the responses of natural insect infestations (without insecticides) to five selected morphological traits in eight genetic backgrounds of cotton when grown under irrigated Oklahoma conditions. Most previous studies have compared cottons with contrasting morphological traits; but when such materials are compared, the researcher does not really know whether the differential responses observed, if any, were due to the trait itself or to other inherent differences in the materials. These studies were conducted with near-isogenic lines of cotton. Therefore, differences observed are likely due to the genes conditioning those traits.

MATERIALS AND METHODS

The plant materials used in this study consisted of germplasm lines of five morphological traits (i.e., okra leaf, nectariless, frego bract, smooth leaf, and glandless) and the normal cotton check in each of eight genetic backgrounds (i.e., 'Deltapine 16', 'Stoneville 213', 'Auburn 56', 'Delcot 277', 'Coker 310', 'Coker 201', 'TH 149', and Pee Dee 2165). The eight germplasm lines of frego-bract, nectariless, smooth-leaf, and glandless cotton were developed by Shepherd (1982a,b,c,d) and of okra-leaf cotton by Shepherd and Kappelman (1982) after usually five to six backcrosses to the recurrent parents. All recurrent parents were commercial cultivars except for Pee Dee 2165, a germplasm line with high fiber strength.

The tests were conducted as split-plots with whole plots arranged in a randomized complete block design with four replications (one replication was discarded at Tipton in 1982 because of extensive plant loss) at Tipton and Chickasha, Okla., in 1982, 1983, and 1984. Whole plots were randomly assigned to genetic backgrounds, and subplots were randomly allocated to the morphological traits and check within that genetic background. The subplots consisted of single-rows 15.2 m long (except for 12.1 m at Chickasha in 1983) and 1.0 m apart in all experiments. Plants within subplots were in an approximate commercial spacing. Due to a lack of seed, the glandless germplasm lines could not be tested in any genetic background at Tipton in 1982 and in the Stoneville 213 background at Chickasha in 1982. The soils were a Reinach silt loam (a coarse-silty, mixed, thermic Pachic Haplustoll) at Chickasha and a Tipton silt loam (a fine-loamy, mixed, thermic Pachic Argiustoll) at Tipton. Fertilizers were applied according to soil test recommendations. Plants were grown under irrigation, and no insecticides were applied to control the natural insect populations. Both measures were followed to enhance natural insect pest population buildup.

The numbers of cotton fleahoppers were counted weekly during July and August (as time and labor were available) on the terminals of 10 plants randomly sampled in each subplot at both locations in 1982, 1983, and 1984. Twenty randomly sampled squares in each subplot were examined to determine the infestations of bollworms at both locations in 1982 and at Chickasha in 1983. Bollworm-damaged squares were not sampled at Tipton in 1983 due to a low infestation of that insect. The numbers of eggs and larvae of the bollworm were counted on the terminals of 10 plants at the same time as fleahoppers were counted at both locations in 1984.

In the analyses the total counts of fleahoppers, eggs and larvae of the bollworm, and bollworm-damaged squares in each subplot were used. Data were analyzed within each year and location separately. When an experiment had more than one sampling date and the variances of experimental errors on those dates were not heterogeneous, data were analyzed over sampling dates (e.g., Tipton in 1982). If the morphological traits X sampling dates interactions in those analyses were significant, sampling dates were reported separately. When the variances were heterogeneous (as they were in all other experiments with more than one sampling date), data were analyzed within each sampling date. Means for the morphological traits were compared using the 0.05 probability level for the protected least significant difference (LSD). Though all possible comparisons among means are presented in the tables, the ones of interest and discussed herein were of the morphological traits versus their normal checks.

RESULTS AND DISCUSSION

Cotton Fleahopper. The responses of cotton fleahopper populations (per 10 plants per plot) to the five selected morphological traits in cotton versus the normal check at Tipton and Chickasha, Okla., in 1982 are presented in Table 1. No significant interactions between morphological traits X genetic backgrounds were detected for fleahopper infestations at either location in that year. Fleahopper populations were significantly reduced at every sampling date on the smooth-leaf cotton compared with the check (-91% at Tipton over dates and -30% at Chickasha). Fleahopper numbers were significantly higher on frego bract than on the normal at all sampling dates at both locations (73% at Tipton over dates and 45% at Chickasha). The okra-leaf and nectariless near-isogenic lines did not differ from the normal in fleahopper infestations at any date at either location. The glandless trait was compared at Chickasha only, but it did not differ from the normal check.

In the 1983 experiments (Table 2), the interaction between morphological traits X genetic backgrounds was not significant at Tipton on any sampling date, but it was at Chickasha. In the Tipton experiment, the smooth-leaf cotton, compared with the normal, had fewer fleahoppers (-55% over sampling dates) than the check. The difference was significant at all three sampling dates. Frego-bract cotton had 49% more fleahoppers than the check over all sampling dates. Differences at the first two sampling dates were significant for frego bract. Nectariless cotton had significantly fewer fleahoppers on one sampling date than did the normal. The okra-leaf and glandless traits did not differ significantly from the normal in fleahopper infestations at any sampling date. In the Chickasha experiment, the frego-bract cottons had significantly higher fleahopper populations than their corresponding normals in four of the eight genetic backgrounds. Though not significant, three of the four remaining combinations also displayed higher fleahopper populations in frego bract as compared with the check. Averaged over genetic backgrounds, the frego-bract trait increased fleahopper counts by 112%. Fleahopper populations on the okra-leaf, nectariless, glandless, and smooth-leaf cottons were similar to those on their corresponding normals in all except one, zero, two, and one genetic backgrounds, respectively, which had significantly higher fleahopper populations. Even though not significant, six of the eight smooth-leaf cottons had lower mean fleahopper populations than their respective normals. When averaged over genetic backgrounds, the smooth-leaf trait reduced fleahopper numbers by 26%.

The responses of fleahoppers to the morphological traits at Tipton in 1984 are given in Table 3. The interaction of morphological traits X genetic backgrounds was not significant for fleahopper infestations on the 31 July or 14 August sampling dates, but it was significant on 7 August. The smooth-leaf cotton significantly reduced fleahopper populations on 31 July and 14 August and in two of the eight genetic backgrounds on 7 August. Averaged over sampling dates and genetic backgrounds, the reduction was 59%. The frego-bract cotton had significantly higher fleahopper populations than the normal on 14 August and in two genetic backgrounds on 7 August and significantly lower populations in one background on 7 August. Averaged over dates and backgrounds, the increase was 55%. The okra-leaf, nectariless, and glandless cottons did not differ from the normal cotton in fleahopper infestations on 31 July or 14 August. Significantly lower fleahopper populations were found on the okra-leaf, nectariless, and glandless cottons in one genetic background apiece on 7 August while a significantly higher fleahopper population was detected only for the nectariless cotton in one genetic background.

The responses of fleahoppers to the five morphological traits at Chickasha in 1984 are given in Table 4. No significant interaction of morphological traits X genetic backgrounds was detected for fleahopper infestations on 25 July, 1 August, or 8 August; but the interaction was significant on 15 August. The smooth-leaf cotton had significantly smaller fleahopper populations than the normal on the first three sampling dates, and in three of the eight genetic backgrounds on 15 August with an overall average of

62% fewer fleahoppers. Significantly higher fleahopper populations were found on the frego-bract cotton than on the normal on the first three sampling dates, and in three genetic backgrounds on 15 August with an overall average of 50% more insects. The okra-leaf, nectariless, and glandless cottons did not differ from the normal in fleahopper infestations on 25 July, 1 August, or 8 August; but significantly fewer fleahoppers were found on one okra-leaf and two nectariless cotton genetic backgrounds on 15 August.

During these experiments, fleahopper populations were considered to be sufficient to evaluate the effects of morphological traits upon them. Significant differences in fleahopper populations among morphological traits were obtained at all 17 sampling dates over the two locations and 3 years. Fleahopper responses to the morphological traits were generally consistent over all genetic backgrounds. Only in three of the 17 sampling dates for this insect were significant interactions for morphological traits X genetic backgrounds obtained. The smooth-leaf cotton exhibited lower fleahopper populations, as has also been reported by Lukefahr et al. (1971). Compared with normal cotton, the smooth-leaf trait reduced fleahopper populations by 54% as an average over the 3 years, two locations, eight genetic backgrounds, and 17 sampling dates. The frego-bract cotton attracted 64% more fleahoppers over the same variables than did normal cotton. This trend agrees with previous work (Jones et al. 1969, Cowan and Lukefahr 1970). Although

Schuster and Maxwell (1974) reported that nectariless cotton reduced fleahopper populations in large-plot tests, the trait did not significantly reduce fleahopper populations in most of these small-plot experiments. The okra-leaf and glandless cottons did not show a consistent and significant influence on fleahopper infestations in these experiments.

Bollworm. Means of bollworm-damaged squares (per 20 squares examined per plot) for the morphological traits at Tipton and Chickasha in 1982 and at Chickasha in 1983 are given in Table 5. Squares were not sampled at Tipton in 1983 due to a low infestation of the insect. No significant interactions of morphological traits X genetic backgrounds were detected for bollworm-damaged squares in any of the three experiments sampled. No differences were significant in the comparisons among morphological traits at Tipton in 1982. At Chickasha in 1982 and 1983, the only significant differences in square damage were between glandless (with higher damage) versus smooth leaf and nectariless. However, neither was significantly different from the normal check in either experiment.

Bollworm larvae were counted at Tipton and Chickasha in 1984, but the populations were too low to distinguish effects of the morphological traits. Those data are not included herein.

The effects of morphological traits on bollworm oviposition (per 10 plants per plot) at Tipton in 1984 are shown in Table 6. The interaction of morphological traits X genetic backgrounds was significant on 31 July, but not on 7 August or 14 August. Significantly fewer bollworm eggs were found on the smooth-leaf and okra-leaf cottons in two genetic backgrounds and on the frego-bract, nectariless, and glandless traits in one background on 31 July, while the glandless trait had significantly more bollworm eggs in another background. No significant differences in bollworm eggs were found on 7 August or 14 August presumably because of insufficient insect pressure. In five backgrounds, none of the morphological traits differed significantly from the normal in bollworm eggs.

In the 1984 experiment at Chickasha (Table 7), no interactions of morphological traits X genetic backgrounds were significant for bollworm oviposition on any of the four sampling dates. Significantly fewer bollworm eggs were found on the smooth-leaf than on the check on the 25 July and 1 August sampling dates and on the frego-bract and glandless cottons on 25 July. No significant differences were found for bollworm eggs on the 8 August and 15 August sampling dates presumably because few eggs were present.

During these experiments, natural infestations of the bollworm were so mild that no differences could be detected for bollworm-damaged squares and bollworm larvae between the morphological traits versus the normal. Fewer damaged squares were found at Chickasha in 1982 and 1983 on smooth-leaf and nectariless than on glandless cotton. However, smooth-leaf cotton suppressed, to some extent, bollworm oviposition at both locations in 1984. When considering the potential for future increases in bollworm infestations in Oklahoma, further evaluations of that morphological trait should be conducted under more severe bollworm infestations.

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Table 1. Mean cotton fleahopper counts per 10 plants for selected morphological traits in cotton over eight genetic backgrounds at Tipton and Chickasha, 1982

Morphological traits[a]	Tipton					Chickasha
	23 July	30 July	6 Aug.	13 Aug.	20 Aug.	4 Aug.
FR	13.8a[b]	11.2a	14.1a	10.0a	10.6a	6.8a
OK	8.5b	8.2b	6.6b	5.5b	4.9b	4.4b
NE	6.5b	5.9b	5.3b	4.3b	4.0b	4.3b
GL[c]	–	–	–	–	–	4.6b
SM	0.2c	1.5c	0.4c	0.4c	0.5c	3.3c
NR	8.1b	8.5b	5.9b	6.3b	5.7b	4.7b

[a]Morphological traits are as follows: FR, frego bract; OK, okra leaf; NE, nectariless; GL, glandless; SM, smooth leaf; and NR, the normal check.

[b]Means within a column followed by the same letter are not significantly different at the P = 0.05 level (protected LSD test).

[c]Due to a lack of seed, GL was not included for any background in the 1982 experiment at Tipton. For the same reason, it was not included for the Stoneville 213 background at Chickasha in 1982.

Table 2. Mean cotton fleahopper counts per 10 plants for selected morphological traits in cotton over eight genetic backgrounds at Tipton and by separate backgrounds at Chickasha, 1983

Morphological traits[a]	Tipton			Chickasha (18 Aug.)							
	3 Aug.	10 Aug.	17 Aug.	DPL16[b]	ST213	AUB56	DEL277	C310	C201	TH149	PD2165
FR	3.5a[c]	3.9a	2.3a	3.3a	5.8a	3.8a	2.5ab	4.5a	2.8ab	4.0a	4.8a
OK	2.7b	2.4b	1.5b	1.0ab	3.8ab	1.3b	1.0b	3.8ab	1.5ab	3.8a	3.3ab
NE	1.7c	1.6c	1.3bc	2.3ab	1.5bc	2.3ab	1.3b	1.8bc	3.8a	3.3ab	3.3ab
GL	2.2bc	2.8b	1.9ab	1.3ab	1.5bc	2.0ab	4.0a	2.5abc	2.8ab	4.3a	5.5a
SM	0.9d	1.3c	0.7c	0.3b	0.8c	3.8a	0.8b	2.3abc	1.0b	1.0b	1.0b
NR	2.0bc	2.7b	1.8ab	2.0ab	2.5bc	0.8b	1.5b	1.0c	2.8ab	3.0ab	1.3b

[a]Morphological traits are as follows: FR, frego bract; OK, okra leaf; NE, nectariless; GL, glandless; SM, smooth leaf; and NR, the normal check.

[b]Genetic backgrounds are as follows: DPL16, \`Deltapine 16´; ST213, \`Stoneville 213´; AUB56, \`Auburn 56´; DEL277, \`Delcot 277´; C310, \`Coker 310´; C201, \`Coker 201´; TH149, \`TH 149´; and PD2165, Pee Dee 2165.

[c]Means within a column followed by the same letter are not significantly different at the P = 0.05 level (protected LSD test).

Table 3. Mean cotton fleahopper counts per 10 plants for selected morphological traits in cotton over eight genetic backgrounds at two sampling dates and by separate backgrounds at another date at Tipton, 1984

Morphological traits[a]	31 July	7 Aug. DPL16[b]	ST213	AUB56	DEL277	C310	C201	TH149	PD2165	14 Aug.
FR	1.7a[c]	1.0a	2.3ab	1.0b	2.8ab	4.3a	2.3abc	4.5a	3.5a	5.6a
OK	1.3a	1.3a	3.5a	1.8ab	3.8a	1.8bc	1.3bc	0.3c	2.3ab	3.4b
NE	1.4a	1.0a	0.8b	1.3b	3.0ab	1.8bc	4.0a	1.5bc	2.5ab	2.7b
GL	1.4a	0.5a	1.8ab	1.3b	1.0b	3.0ab	2.5ab	2.3bc	2.0ab	2.8b
SM	0.6b	0.5a	0.8b	0.8b	1.8ab	0.5c	0.3c	0.5c	0.8b	1.4c
NR	1.4a	0.8a	1.8ab	3.8a	1.8ab	1.0bc	1.3bc	2.8ab	1.0b	3.3b

[a]Morphological traits are as follows: FR, frego bract; OK, okra leaf; NE, nectariless; GL, glandless; SM, smooth leaf; and NR, the normal check.

[b]Genetic backgrounds are as follows: DPL16, \`Deltapine 16´; ST213, \`Stoneville 213´; AUB56, \`Auburn 56´; DEL277, \`Delcot 277´; C310, \`Coker 310´; C201, \`Coker 201´; TH149, \`TH 149´; and PD2165, Pee Dee 2165.

[c]Means within a column followed by the same letter are not significantly different at the P = 0.05 level (protected LSD test).

Table 4. Mean cotton fleahopper counts per 10 plants for selected morphological traits in cotton over eight genetic backgrounds at three sampling dates and by separate backgrounds at another date at Chickasha, 1984

Morphological traits[a]	25 July	1 Aug.	8 Aug.	15 Aug.							
				DPL16[b]	ST213	AUB56	DEL277	C310	C201	TH149	PD2165
FR	6.2a[c]	5.3a	7.1a	4.5a	3.3a	2.0a	2.3a	4.5a	2.3ab	4.8a	2.5a
OK	4.2bc	2.8b	4.2b	1.0c	3.0a	1.3a	1.5a	2.3b	0.5c	2.0bc	2.5a
NE	3.8c	2.7b	4.8b	2.5b	0.8b	0.8a	1.0a	1.5b	1.5bc	2.3b	1.0bc
GL	5.4ab	2.6b	4.5b	1.0c	2.8a	1.0a	1.3a	1.5b	2.8ab	1.5bc	1.8ab
SM	1.7d	1.0c	2.2c	0.8c	0.3b	1.0a	0.5a	1.3b	0.3c	0.8c	0.0c
NR	4.6bc	2.9b	4.9b	2.0bc	3.0a	1.3a	2.0a	2.0b	3.5a	1.8bc	2.3ab

[a]Morphological traits are as follows: FR, frego bract; OK, okra leaf; NE, nectariless; GL, glandless; SM, smooth leaf; and NR, the normal check.

[b]Genetic backgrounds are as follows: DPL16, \`Deltapine 16´; ST213, \`Stoneville 213´; AUB56, \`Auburn 56´; DEL277, \`Delcot 277´; C310, \`Coker 310´; C201, \`Coker 201´; TH149, \`TH 149´; and PD2165, Pee Dee 2165.

[c]Means within a column followed by the same letter are not significantly different at the P = 0.05 level (protected LSD test).

Table 5. Mean number of bollworm-damaged squares per 20 squares examined for selected morphological traits in cotton over eight genetic backgrounds at Tipton and Chickasha, 1982, and at Chickasha, 1983

Morphological	1982		1983
traits[a]	Tipton (18 Aug.)	Chickasha (18 Aug.)	Chickasha (25 Aug.)[b]
FR	2.3a[c]	2.0ab	0.5b
OK	2.3a	2.1ab	0.4b
NE	2.1a	1.9b	0.3b
GL[d]	-	3.0a	1.1a
SM	1.6a	1.5b	0.5b
NR	2.5a	2.5ab	0.7ab

[a]Morphological traits are as follows: FR, frego bract; OK, okra leaf; NE, nectariless; GL, glandless; SM, smooth leaf; and NR, the normal check.

[b]Bollworm-damaged squares were not sampled at Tipton in 1983 due to a low infestation of that insect.

[c]Means within a column followed by the same letter are not significantly different at the P = 0.05 level (protected LSD test).

[d]Due to a lack of seed, GL was not included for any background in the 1982 experiment at Tipton. For the same reason, it was not included for the Stoneville 213 background at Chickasha in 1982.

Table 6. Mean number of bollworm eggs per 10 plants for selected morphological traits in cotton over eight genetic backgrounds at two sampling dates and by separate backgrounds at another date at Tipton, 1984

Morphological traits[a]	31 July									
	DPL16[b]	ST213	AUB56	DEL277	C310	C201	TH149	PD2165	7 Aug.	14 Aug.
FR	2.5b[c]	2.3abc	2.0a	0.5cd	0.8b	2.3a	1.8a	2.5a	0.1a	0.2a
OK	1.3bc	0.8c	0.8a	2.3bc	0.5b	1.5a	2.3a	1.3a	0.3a	0.1a
NE	1.8bc	3.3a	0.5a	2.5b	2.8a	2.0a	1.8a	1.5a	0.3a	0.1a
GL	0.5c	2.0abc	2.3a	4.5a	1.3ab	1.5a	2.5a	1.8a	0.3a	0.2a
SM	1.8bc	1.3bc	1.5a	0.0d	1.0ab	1.8a	1.5a	1.3a	0.2a	0.1a
NR	5.3a	2.8ab	0.5a	2.0bc	1.3ab	2.0a	1.5a	1.3a	0.3a	0.1a

[a]Morphological traits are as follows: FR, frego bract; OK, okra leaf; NE, nectariless; GL, glandless; SM, smooth leaf; and NR, the normal check.

[b]Genetic backgrounds are as follows: DPL16, \`Deltapine 16´; ST213, \`Stoneville 213´; AUB56, \`Auburn 56´; DEL277, \`Delcot 277´; C310, \`Coker 310´; C201, \`Coker 201´; TH149, \`TH 149´; and PD2165, Pee Dee 2165.

[c]Means within a column followed by the same letter are not significantly different at the P = 0.05 level (protected LSD test).

Table 7. Mean number of bollworm eggs per 10 plants for selected morphological traits in cotton over eight genetic backgrounds at four sampling dates at Chickasha, 1984

Morphological traits[a]	25 July	1 Aug.	8 Aug.	15 Aug.
FR	0.8bc[b]	1.0ab	0.6a	0.2a
OK	1.2ab	1.4a	0.8a	0.3a
NE	1.6a	1.1ab	0.8a	0.3a
GL	0.7c	0.8bc	0.6a	0.3a
SM	0.5c	0.3c	0.4a	0.3a
NR	1.3a	0.9ab	0.3a	0.1a

[a]Morphological traits are as follows: FR, frego bract; OK, okra leaf; NE, Nectariless; GL, glandless; SM, smooth leaf; and NR, the normal check.

[b]Means within a column followed by the same letter are not significantly different at the P = 0.05 level (protected LSD test).

Effects of Selected Morphological Traits in Cotton on Lint Yield, Lint Percent, and Fiber Quality

Effects of Selected Morphological Traits in Cotton on Lint Yield, Lint Percent, and Fiber Quality[1]

ABSTRACT

This study was conducted to evaluate the effects of selected morphological traits in near-isogenic lines of cotton (Gossypium hirsutum L.) on lint yield, lint percent, and fiber quality under natural insect infestations. Five morphological traits (i.e., okra leaf, nectariless, frego bract, smooth leaf, and glandless) were compared to the normal checks in eight genetic backgrounds (i.e., 'Deltapine 16', 'Stoneville 213', 'Auburn 56', 'Delcot 277', 'Coker 310', 'Coker 201', 'TH 149', and Pee Dee 2165). Replicated experiments were conducted under irrigation and without insecticide applications at two locations in Oklahoma for 3 years. In the analyses combined over years within each location, the interactions of morphological traits X genetic backgrounds were significant at each location for lint yield, were inconsistent between locations for picked lint percent and fiber length, and were not significant at either location for fiber length uniformity, fineness, or strength. The nectariless lines were comparable to the checks for lint

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yield and lint percent. The okra-leaf lines were also comparable to the checks for lint yield, but were frequently lower for lint percent. The large and consistently significant reductions in lint yield and lint percent of the frego-bract lines were at least partly due to their greater susceptibility to the cotton fleahopper [*Pseudatomoscelis seriatus* (Reuter)]. The smooth-leaf lines, despite their suppression of fleahopper infestations and bollworm [*Heliothis zea* (Boddie)] oviposition, often displayed lower lint yield than the checks, possibly resulting from lower lint percent (a component of lint yield). The lint yield and lint percent of the glandless lines were reduced in some genetic backgrounds. Differences in fiber length were few and inconsistent in direction. No significant differences were found in fiber length uniformity, fineness, or strength at either location.

Based on these results as well as their insect responses, the frego-bract trait should not be incorporated in the Oklahoma cotton breeding program. The smooth-leaf and glandless traits appear unpromising, and probably should not be used. The nectariless and okra-leaf traits should probably receive some attention.

Additional index words: *Gossypium hirsutum* L., Okra leaf, Nectariless, Frego bract, Smooth leaf, Glandless, Fiber length, Fiber length uniformity, Fiber fineness, Fiber strength.

INTRODUCTION

Insect pests are a major limiting factor in cotton (Gossypium hirsutum L.) production over most of the world. Chemical insecticides have been the most powerful tools available for use in insect management. However, due to high costs and several other undesirable effects of those chemicals, emphasis has shifted toward the breeding of cotton cultivars with host-plant resistance. Several morphological traits which influence insect infestations have been identified in cotton. Among them are included the okra-leaf, nectariless, frego-bract, smooth-leaf, and glandless traits studied herein for their possible utility in Oklahoma and surrounding states.

The okra-leaf trait suppresses bandedwing whitefly [Trialeurodes abutilonea (Haldeman)], pink bollworm [Pectinophora gossypiella (Saunders)], boll weevil (Anthonomus grandis Boheman), and boll rot by opening up the plant canopy (1, 9, 16, 23). The effects of okra leaf on agronomic properties was studied in Arizona by Wilson and George (23) using isogenic lines under natural insect infestations. Seed damage by the pink bollworm was significantly reduced in the okra-leaf isolines and agronomic properties of the isolines were comparable to those of the normal types. The only negative effect of okra leaf observed was an 8% lower lint yield in that high-yield environment. In a Louisiana study, Andries et al. (1) reported that the okra-leaf trait caused a significant reduction in boll rot incidence and that it was associated with a significant increase in lint yield, earliness, lint percent, and fiber fineness.

Nectariless cotton is known to significantly reduce populations of the tarnished plant bug [*Lygus lineolaris* (Palisot de Beauvois)], cotton fleahopper [*Pseudatomoscelis seriatus* (Reuter)], and pink bollworm (17, 24). Meredith et al. (14) compared three nectariless strains with their recurrent parent cultivars for yield, yield components, and fiber properties in six Mississippi environments. A slight decrease in yield (4.3%) for nectariless 'Stoneville 7A' and a slight increase (3.8%) for nectariless 'Deltapine Smooth Leaf' were detected. Nectaried and nectariless 'Dixie King' did not differ in yield. In their fiber properties, nectaried and nectariless strains were essentially the same.

The smooth-leaf trait confers resistance to the bollworm [*Heliothis zea* (Boddie)], cotton fleahopper, and pink bollworm and decreases trash in ginned lint (7, 12, 13, 23). However, certain smooth-leaf alleles are associated with reduced lint percent and lint yield as well as several fiber quality deficiencies (2, 10, 11).

Frego-bract cotton is generally known to be associated with boll weevil and boll rot suppression (7). In trials of near-isogenic lines of frego- vs. normal-bract types on three cultivar backgrounds, Jones et al. (8) reported that in Louisiana yield of the frego-bract strains was unfavorable when moderate-to-high populations of the tarnished plant bug or cotton fleahopper occurred, but that they equaled or exceeded the yield of normal-bract strains when those pests were not a problem. The frego-bract trait was associated with a reduction in boll rot incidence and a slight increase in fiber fineness, but showed no apparent effects on lint percent, fiber length, or fiber strength.

The potential value of glandless cotton lies in the production of high-quality cottonseed with little gossypol. However, the reduction of gossypol leads to increased susceptibility to the bollworm, cotton leafworm [Alabama argillacea (Hübner)], and even some insects not previously known to attack cotton (6, 15). In a study comparing recurrent backcross selections of glanded vs. glandless cotton, Hosfield et al. (4) found that glandless cottons were significantly lower in lint yield than glanded cottons. However, studies in California showed yields of glandless cottons comparable to those obtained with glanded cultivars (5). Halloin et al. (3) reported that glandless cottons had higher lint percent than glanded cottons, but that no differences were found in fiber properties.

As Jones (7) pointed out, the ultimate value of morphological traits depends on their effects on the overall pest complex in the environment and their relationships to lint yield and fiber quality. The responses of natural insect infestations to the morphological traits studied herein under Oklahoma conditions were studied in the previous paper of this thesis. This study was conducted to evaluate the effects of those selected morphological traits in near-isogenic lines of cotton on lint yield, lint percent, and fiber quality under natural insect infestations. Information derived from these experiments should be useful in deciding which morphological traits to incorporate into the Oklahoma cotton breeding program as well as into those in surrounding states.

MATERIALS AND METHODS

These experiments were the same as those for which insect responses were as reported in the previous paper of this dissertation. These experiments for lint yield, lint percent, and fiber quality were conducted under irrigation, natural insect infestations, and no insecticides at Tipton and Chickasha, OK, in 1982, 1983, and 1984. The germplasm lines of five morphological traits (i.e., okra leaf, nectariless, frego bract, smooth leaf, and glandless) vs. the normal check in eight genetic backgrounds (i.e., 'Deltapine 16', 'Stoneville 213', 'Auburn 56', 'Delcot 277', 'Coker 310', 'Coker 201', 'TH 149', and Pee Dee 2165) of cotton (18, 19, 20, 21, 22) were grown as split-plots with whole plots arranged in a randomized complete block design with four replications (except that one replication was discarded at Tipton in 1982 because of extensive plant loss). Whole plots were genetic backgrounds, and subplots were the morphological traits within that genetic background. The subplots consisted of single rows 15.2 m long (except for 12.1 m at Chickasha in 1983) and 1.0 m apart in all experiments. Plants within subplots were in an approximate commercial spacing. The soils were a Reinach silt loam (a coarse-silty, mixed, thermic Pachic Haplustoll) at Chickasha and a Tipton silt loam (a fine-loamy, mixed, thermic Pachic Argiustoll) at Tipton. Fertilizers were applied according to soil test recommendations.

Lint yield (kg/ha) was obtained by multiplying snapped cotton weights per subplot by the appropriate lint percent and conversion factor. Fifteen mature bolls were randomly sampled from each subplot to estimate lint percent at each harvest whether there were one (Tipton, 1983 and 1984, and Chickasha, 1982) or two harvests (Tipton, 1982, and Chickasha, 1983 and 1984). Picked lint percent was calculated as the percent lint in a sample of seedcotton. Fiber from those samples was then used to measure fiber properties. The fiber traits estimated in the Oklahoma State Univ. Cotton Qual. Res. Lab. were fiber length on the digital fibrograph as 2.5% span length (in inches converted into mm); fiber length uniformity index, the ratio of 50 to 2.5% span length, expressed as a percent; fiber fineness on the micronaire in standard curvilinear micronaire units; and fiber strength as 1/8 inch (3.175 mm) gauge stelometer (T_1) (in grams-force/tex converted into mN/tex).

Analyses of variance were conducted for each agronomic and fiber trait over years within each location. In those analyses, year effects were considered random while the effects of morphological traits and genetic backgrounds were assumed to be fixed. When the interaction of morphological traits X genetic backgrounds was significant, means for morphological traits were presented in each genetic background as averaged over 3 years. When the interaction was not significant, means were averaged over the 3 years and eight genetic backgrounds. Data were not reported in separate years, even when interactions involving years were significant, because reponses over time were the primary considerations in these studies. Means for morphological traits were compared at the 0.05 probability level using the protected least significant difference (LSD). Though all possible comparisons among means are presented, the ones of major interest and which are discussed herein were of the morphological traits vs. their normal checks.

RESULTS

Chickasha Experiments

The effects of the five morphological traits on lint yield at Chickasha are given over years in Table 1. A significant interaction of morphological traits X genetic backgrounds was detected. Therefore, results were presented for each background separately, rather than over backgrounds. The okra-leaf and nectariless lines significantly differed from their corresponding normal checks in two of the eight genetic backgrounds. Each trait had significantly higher yield in one genetic background with significantly lower yield in the other. The frego-bract lines showed a significantly lower lint yield than the normal lines in all genetic backgrounds. The smooth-leaf lines, when compared with their normals, were lower for lint yield in three genetic backgrounds. The glandless lines had a significantly lower lint yield in four of the eight genetic backgrounds with a significantly higher lint yield in another.

Mean picked lint percents for the morphological traits in eight genetic backgrounds are given in Table 2 at Chickasha as averaged over 3 years. A significant interaction of morphological traits X genetic backgrounds was detected. The okra-leaf lines had significantly lower picked lint percent than their corresponding checks in four of the eight genetic backgrounds. The nectariless lines, when compared with the checks, were significantly higher in only one genetic background. The frego-bract, smooth-leaf, and glandless lines showed significantly lower picked lint percent than their normal checks in six, three, and two genetic backgrounds, respectively.

Mean fiber lengths for the morphological traits in the eight genetic backgrounds at Chickasha are given over years in Table 3. A significant interaction of morphological traits X genetic backgrounds was detected. The okra-leaf and nectariless lines had significantly shorter fiber length than their normal checks in only one of the eight genetic backgrounds while the smooth-leaf lines displayed no significant differences. The frego-bract lines had significantly shorter fiber than the normal checks in one background and significantly longer fiber in another. The fiber length of the glandless lines was significantly longer than that of the checks in one genetic background.

The interactions of morphological traits X genetic backgrounds were not significant for fiber length uniformity, fineness, or strength at Chickasha in the combined analyses over years (Table 4). No significant differences were found either for the main effects of those traits.

Tipton Experiments

Mean lint yields for the five morphological traits vs. the normal check in the eight genetic backgrounds at Tipton are given over years in Table 5. A significant interaction of morphological traits X genetic backgrounds was detected for this trait. The okra-leaf and nectariless lines were significantly lower than their checks in only one genetic background while the glandless lines were significantly lower in two. The smooth-leaf lines displayed significantly lower lint yield than their normal checks in six of the eight backgrounds, while the frego-bract lines were significantly lower in all eight.

When comparing the lint yield results at Tipton to those at Chickasha, the okra-leaf Stoneville 213 line was significantly lower than its check at both locations. Okra-leaf Pee Dee 2165 was not different from its normal at Tipton; whereas, it produced a positive effect on yield at Chickasha. The nectariless Coker 310 was significantly lower than the corresponding normal at both locations. Nectariless Pee Dee 2165 was not different from its check at Tipton, but it produced a higher lint yield at Chickasha. The frego-bract lines were all significantly less than their normal checks at both locations. The smooth-leaf Stoneville 213, Delcot 277, and TH 149 lines were significantly lower yielding than their normal counterparts at both locations. The Deltapine 16, Coker 201, and Pee Dee 2165 smooth-leaf lines were also lower yielding than the normals at Tipton with no significant differences being detected at Chickasha. The glandless Deltapine 16 and TH 149 lines were significantly lower yielding than their normal checks at both locations. Though significant differences were not observed at Tipton, the Delcot 277 and Coker 310 glandless lines showed a negative influence on lint yield at Chickasha and the Pee Dee 2165 glandless line produced a positive effect relative to the checks.

The effects of the selected morphological traits on picked lint percent and on fiber length, length uniformity, fineness, and strength at Tipton are given in Table 6. No interactions of morphological traits X genetic backgrounds were significant for any of the traits nor were significant differences found for their main effects. These results are in contrast to those obtained at Chickasha for lint percent and fiber length, but are the same as for the other three traits.

DISCUSSION

During these experiments, cotton fleahopper infestations were considered high while bollworm infestations were relatively mild. Other pests were present, but in very low numbers. The interactions of morphological traits X genetic backgrounds were significant for lint yield at both locations, inconsistent with locations for picked lint percent and fiber length, and not significant at either location for fiber length uniformity, fineness, or strength. The presence of the interactions for lint yield indicates that attention should be given to choosing proper genetic backgrounds in the breeding program when working with these traits.

For the agronomic traits, the nectariless lines were comparable to their normal counterparts in lint yield and picked lint percent. The okra-leaf lines were also comparable to their normal checks for lint yield, but their lint percent was significantly lower in four of the eight genetic backgrounds. The consistent and significant reductions in lint yield (eight of eight backgrounds at both locations) and in picked lint percent (six of eight at Chickasha) of the frego-bract lines may be at least partially due to the greater susceptibility of the frego-bract trait to the cotton fleahopper (reported in the previous study of this dissertation). The smooth-leaf lines suppressed cotton fleahopper infestations and, to a certain extent, bollworm ovipositions in the insect responses, but their lint yield was significantly reduced in three of eight genetic backgrounds at Chickasha and in six of eight at Tipton. Lee (10) reported that the $\underline{Sm}_2$ allele [possessed by the smooth-leaf lines in this study (20)] when homozygous, was associated with an unacceptable reduction in lint percent. Although the smooth-leaf lines also showed significantly lower lint percent in three genetic backgrounds at Chickasha, a lower lint percent did not necessarily result in a lower yield. When the lint percent results in the various genetic backgrounds at Chickasha were compared with their corresponding yields at that location, only one combination with reduced lint percent also displayed a reduced yield. Therefore, a simple one-to-one association between the two traits is unlikely. Lint yield (four of eight backgrounds at Chickasha and two of eight at Tipton) and lint percent (two of eight at Chickasha) were reduced in several genetic backgrounds of the glandless lines. However, these comparisons could not be made with the same precision of the other four morphological traits because only 2 years data were available at Tipton for all backgrounds and at Chickasha for the Stoneville 213 background.

For fiber length, the few significant differences and their inconsistency in direction from the check leads us to believe that few problems would be encountered for that fiber property for any trait. Fiber length uniformity, fineness, and strength results indicate that the five morphological traits studied herein do not have positive or negative effects on those fiber properties under Oklahoma conditions.

Based on the results for the agronomic and fiber traits (as well as the insect responses reported in the previous paper), the frego-bract trait should not be utilized in the Oklahoma cotton breeding program because of its greater susceptibility to the cotton fleahopper, which at least partially resulted in lower lint yield and lint percent. Attention should be given to the nectariless trait which was comparable to normal cotton in lint yield, lint percent, and fiber properties and which has the potential merit of suppressing fleahoppers when grown in large plots (17). With its comparable lint yields and fiber properties, but lower lint percents in some backgrounds, the okra-leaf trait also has potential value because of its known increased earliness and resistance to the boll weevil, an insect which has been a severe pest in Oklahoma and which may be again. The association of the smooth-leaf lines with lower lint yield and lint percent discourages the use of this trait for host-plant resistance unless bollworm infestations are particularly severe. The lower yield and lint percent of the glandless lines (which are susceptible to the bollworm) also discourages the use of that trait, especially when the potential for increase of bollworm populations in Oklahoma is considered.

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Table 1. Mean lint yield for selected morphological traits in cotton for eight genetic backgrounds over 3 years at Chickasha.

Morphological traits†	Genetic backgrounds‡							
	DPL16	ST213	AUB56	DEL277	C310	C201	TH149	PD2165
	kg/ha							
OK	497a*	261c	560a	551a	521ab	483a	594a	489a
NE	516a	577a	623a	595a	389c	545a	540ab	457a
FR	263b	197c	181b	297c	245d	261b	296c	180c
SM	458a	399b	545a	423b	505ab	541a	459b	231bc
GL	331b	502§	546a	439b	428bc	468a	454b	446a
NR	507a	507a	570a	588a	595a	485a	576a	326b

* Means within a column followed by the same letter are not significantly different at the 0.05 probability level using the protected LSD.

† Morphological traits are as follows: OK, okra leaf; NE, nectariless; FR, frego bract; SM, smooth leaf; GL, glandless; and NR, the normal check.

‡ Genetic backgrounds are as follows: DPL16, \`Deltapine 16´; ST213, \`Stoneville 213´; AUB56, \`Auburn 56´; DEL277, \`Delcot 277´; C310, \`Coker 310´; C201, \`Coker 201´; TH149, \`TH 149´; and PD2165, Pee Dee 2165.

§ Mean lint yield over 2 years only (1983 and 1984). The LSD is 120 kg/ha for a comparison of this trait with others in the ST213 background; otherwise, the LSD is 107 kg/ha.

Table 2. Mean picked lint percent for selected morphological traits in cotton for eight genetic backgrounds over 3 years at Chickasha.

Morphological traits†	Genetic backgrounds‡							
	DPL16	ST213	AUB56	DEL277	C310	C201	TH149	PD2165
	%							
OK	35.2a*	32.0c	34.2a	34.9ab	36.1ab	35.1c	33.5b	33.5cd
NE	35.7a	34.9a	34.1a	35.7a	37.5a	38.9a	35.3a	36.0a
FR	33.0b	32.8bc	32.6b	32.7c	36.0b	36.7b	32.1bc	32.3d
SM	32.2bc	33.5ab	34.8a	34.8ab	35.7bc	37.5ab	31.0c	32.3d
GL	31.1c	32.6§	34.1a	33.9bc	34.5c	37.8ab	32.4bc	34.4bc
NR	35.3a	33.9ab	34.1a	34.8ab	35.7bc	38.7a	35.0a	35.4ab

* Means within a column followed by the same letter are not significantly different at the 0.05 probability level using the protected LSD.

† Morphlogical traits are as follows: OK, okra leaf; NE, nectariless; FR, frego bract; SM, smooth leaf; GL, glandless; and NR, the normal check.

‡ Genetic backgrounds are as follows: DPL16, \`Deltapine 16´; ST213, \`Stoneville 213´; AUB56, \`Auburn 56´; DEL277, \`Delcot 277´; C310, \`Coker 310´; C201, \`Coker 201´; TH149, \`TH 149´; and PD2165, Pee Dee 2165.

§ Mean picked lint percent over 2 years only (1983 and 1984). The LSD is 1.6% for a comparison of this trait with others in the ST213 background; otherwise, the LSD is 1.4%.

Table 3. Mean fiber length (2.5% span) for selected morphological traits in cotton for eight genetic backgrounds over 3 years at Chickasha.

Morphological traits†	Genetic backgrounds‡							
	DPL16	ST213	AUB56	DEL277	C310	C201	TH149	PD2165
	mm							
OK	28.0b*	27.7b	27.4b	28.9a	28.6ab	28.7a	28.4ab	27.7c
NE	28.6ab	28.5a	27.5ab	28.5a	28.2b	28.4ab	28.2ab	28.6ab
FR	28.9a	28.1ab	26.5c	28.2a	28.8ab	27.9b	28.9a	28.1bc
SM	29.1a	28.3ab	27.9ab	28.9a	28.7ab	28.5ab	28.8ab	29.1a
GL	28.1b	28.5§	28.2a	28.3a	29.1a	28.7a	28.7ab	27.9bc
NR	28.7ab	28.0ab	27.3b	28.9a	29.2a	28.0ab	28.1b	28.5ab

* Means within a column followed by the same letter are not significantly different at the 0.05 probability level using the protected LSD.

† Morphological traits are as follows: OK, okra leaf; NE, nectariless; FR, frego bract; SM, smooth leaf; GL, glandless; and NR, the normal check.

‡ Genetic backgrounds are as follows: DPL16, \`Deltapine 16´; ST213, \`Stoneville 213´; AUB56, \`Auburn 56´; DEL277, \`Delcot 277´; C310, \`Coker 310´; C201, \`Coker 201´; TH149, \`TH 149´; and PD2165, Pee Dee 2165.

§ Mean fiber length over 2 years only (1983 and 1984). The LSD is 0.8 mm for a comparison of this trait with others in the ST213 background; otherwise, the LSD is 0.7 mm.

Table 4. Mean fiber length uniformity, fineness, and strength for selected morphological traits in cotton over eight genetic backgrounds and 3 years at Chickasha.

Morphological traits†	Fiber length	Fiber fineness	Fiber strength
	Uniformity	Micronaire	T_1 gauge stel.
	%	unit	mN/tex
OK	47.9a*	4.3a	201a
NE	48.4a	4.3a	202a
FR	47.9a	4.2a	204a
SM	48.4a	4.3a	206a
GL	48.0a	4.2a	201a
NR	48.1a	4.4a	201a

* Means within a column followed by the same letter are not significantly different at the 0.05 probability level using the protected LSD.

† Morphological traits are as follows: OK, okra leaf; NE, nectariless; FR, frego bract; SM, smooth leaf; GL, glandless; and NR, the normal check.

Table 5. Mean lint yield for selected morphological traits in cotton for eight genetic backgrounds over 3 years at Tipton.

Morphological traits†	Genetic backgrounds‡							
	DPL16	ST213	AUB56	DEL277	C310	C201	TH149	PD2165
	kg/ha							
OK	391a*	169c	324a	377a	401a	302ab	424a	365a
NE	456a	325ab	292a	319ab	296b	309ab	359ab	262bc
FR	213b	171c	174b	150c	165c	125c	180c	101d
SM	249b	223bc	343a	223bc	342ab	224bc	291b	187cd
GL§	207	208	386	172	289	227	202	278
NR	414a	340a	369a	334a	427a	354a	420a	314ab

* Means within a column followed by the same letter are not significantly different at the 0.05 probability level using the protected LSD.

† Morphological traits are as follows: OK, okra leaf; NE, nectariless; FR, frego bract; SM, smooth leaf; GL, glandless; and NR, the normal check.

‡ Genetic backgrounds are as follows: DPL16, `Deltapine 16´; ST213, `Stoneville 213´; AUB56, `Auburn 56´; DEL277, `Delcot 277´; C310, `Coker 310´; C201, `Coker 201´; TH149, `TH 149´; and PD2165, Pee Dee 2165.

§ Mean lint yield over 2 years only (1983 and 1984). The LSD is 197 kg/ha for a comparison of this trait with others in the same background; otherwise, the LSD is 102 kg/ha.

Table 6. Mean picked lint percent and fiber length, length uniformity, fineness, and strength for selected morphological traits in cotton over eight genetic backgrounds and 3 years at Tipton.

Morphological traits†	Lint percent	Fiber length		Fiber fineness	Fiber strength
	Picked	2.5% span	Uniformity	Micronaire	T_1 gauge stel.
	%	mm	%	unit	mN/tex
OK	36.4a*	26.4a	48.9a	4.5a	203a
NE	36.7a	26.5a	48.4a	4.5a	202a
FR	35.7a	26.5a	48.5a	4.6a	202a
SM	35.0a	26.7a	48.6a	4.4a	203a
GL‡	35.9a	26.6a	47.5a	4.2a	196a
NR	36.6a	26.6a	48.5a	4.5a	201a

* Means within a column followed by the same letter are not significantly different at the 0.05 probability level using the protected LSD.

† Morphological traits are as follows: OK, okra leaf; NE, nectariless; FR, frego bract; SM, smooth leaf; GL, glandless; and NR, the normal check.

‡ Means for each trait over 2 years only (1983 and 1984).

VITA

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Doctor of Philosophy

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