EFFECTS OF DELAYED HARVEST, CULTIVAR, AND BOLL TYPE ON WEATHERING DAMAGE TO YIELD-RELATED TRAITS AND FIBER QUALITY IN UPLAND COTTON

By

GHOLAM ABBAS RANJBAR

Licentiate
Tehran University
Karadj, Iran
1970

Master of Science
Oklahoma State University
Stillwater, Oklahoma
1976

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of the Oklahoma State University
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Thesis Approved:

Laval M. Verhalen
Thesis Co-adviser

Ronald W. McNew
Thesis Co-adviser

James S. Kirby

Robert M. Reed

Richard R Frahm

Norman N Durham
Dean of the Graduate College

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Effects of Delayed Harvest, Cultivar, and Boll Type on Weathering Damage to Yield-Related Traits and Fiber Quality in Upland Cotton[1]

ABSTRACT

The purpose of this research was to investigate the effects of delayed harvest, cultivar, and boll type on field deterioration of (i.e., weathering damage to) yield-related traits and fiber quality in upland cotton (Gossypium hirsutum L.). Four stormproof, four storm resistant, and four open-boll cultivars were utilized in this study over 3 years at a single location. Each year when plant growth had totally ceased, random samples of 15 mature bolls were taken from each plot at approximately 2-week intervals. Seven traits associated with yield and six fiber quality characteristics were studied using analyses of variance and regression techniques.

In most cases, culitvars having the same boll type displayed similar trends for weathering effects on traits associated with yield and fiber quality. Interactions of boll type with duration of pre-harvest weathering were significant in approximately half the possible instances, indicating that trends were frequently different among the boll types studied.

All yield-related traits were reduced by delayed harvests in at

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least 2 of the 3 years. Adverse effects of weathering on most traits were more serious in open-boll cultivars than in the other two boll types, especially when compared to the stormproof cultivars. Storm resistant cultivars generally displayed intermediate responses between the open-boll and stormproof types, but did not differ significantly from the stormproof types for any yield-related trait in any year. Significant differences between storm resistant and open-boll types were occasionally detected. The three boll types did not differ in the rates at which their lint and seed indexes were reduced by weathering.

All fiber quality traits were reduced by delayed harvests in at least 2 of the 3 years. Differences in weathering trends among boll types were not as consistent for fiber quality as they were for the yield-related traits. Significant differences among boll types for such trends were not detected for 2.5% span length, micronaire, or T_1 fiber strength. In one year, storm resistant and open-boll types lost uniformity index more rapidly than did stormproof cultivars. In another year, open-boll cultivars suffered 50% span length reductions more rapidly than the other two; and open-boll cultivars lost T_0 fiber strength more quickly than did the storm resistant types.

The amounts of loss in each character that can be expected for each 2-week delay in harvest are provided for each boll type in this paper.

Additional index words: *Gossypium hirsutum* L., Boll size, Pulled lint percent, Picked lint percent, Lint index, Seed index, Lint weight/boll, Number of seed/boll, 2.5% span length, 50% span length, Uniformity index, Micronaire, T_0 fiber strength, T_1 fiber strength.

INTRODUCTION

Cotton (Gossypium hirsutum L.) has an indeterminate growth habit which results in fruit production over an extended portion of the growing season. When hand harvest was common, it was usually accomplished multiple times per season with the earlier harvests generally producing better quality fiber. Use of mechanical strippers (the currently most common method of harvest in Oklahoma and Texas) requires once-over harvest after plant growth has stopped completely (usually some 2 to 3 weeks after the first killing freeze, typically in Oklahoma during the second half of November). Even under such "normal" conditions, weathering and field deterioration of the early maturing bolls and some reductions in lint yield and fiber quality are inevitable. Due to the lack of available harvesting machinery and in some years proper weather conditions for harvest, cotton may remain in the field for considerable periods of time, which in extreme cases may extend into March of the following year.

The purpose of this research was to investigate the effects of delayed harvest, cultivar, and boll type on field deterioration of (i.e., weathering damage to) yield-related traits and fiber quality in upland cotton.

LITERATURE REVIEW

Pre-harvest deterioration in cotton of traits associated with yield and with fiber and seed quality may be influenced by temperature (10, 17), moisture (1, 5, 6, 17), alternative periods of wetting and drying (3, 9), microbiological activity (15, 19), and sunlight (2, 9, 10, 11). Loss of seedcotton is due largely to wind and can be reduced greatly by the use of storm resistant or stormproof cultivars (1).

Degradation of fiber quality occurs through changes in the chemical consitution and physical structure of the fiber. The changes are associated with depolymerization of cellulose in the fiber wall and with the release of extraneous materials (8, 16). These materials are primarily reducing constituents of the fiber (mainly water-soluble compounds, probably sugars), and their loss may be due partly to leaching from the fiber caused by rain and to utilization of sugars by microorganisms growing on the fiber (16).

With the loss of extraneous materials, cellulose percentage increases (10), free wax percentage increases, and melting range of the wax in the fiber decreases (14). Moisture regain (at constant relative humidity), an important property of cellulosic fiber, is lowered in weathered cotton (16). Oxidation (or complete rupture of the cellulose chain), which occurs as a result of high temperature and sunlight (7, 8, 10, 11), affects fiber strength (through production of weak points along the length of the fiber) and fiber color [through changes in the polar groups (carbonyl and carboxyl groups) in the cellulose molecule and through reduction of dye absorption (9, 10, 16)]. Cellulose in the fiber primary wall has a lower molecular weight and lower degree of polymerization than it does in the secondary wall and is degraded more rapidly (8). High temperature and sunlight also increase the rate of depolymerization (7, 8, 10). Hessler et al. (8) found that the rate of depolymerization by sunlight decreased with time. This may have been due to the failure of short light waves to penetrate the mass of cotton in the boll, thus causing greater deterioration on the surface of the fiber. They also found that the degree of polymerization was higher at the base of the cotton boll and that fiber was more resistant to weathering.

Under wet conditions, microbial activity is initiated on the fiber [as indicated by increases in pH of the aqueous fiber extracts following normal boll opening and fluffing of the fiber under humid conditions (1, 15)] resulting in the degradation of its constituents (e.g., cellulose) and darkening or graying of fiber color (19) through the production of pigments which are difficult to remove (4). Alternative periods of wetting and drying cause the disintegration of fiber constituents in a process analogous to dew retting of hemp, Cannabis sativa L. (9). (Wetting and drying with microorganism activity in hemp retting free the fiber from the encrusting materials.) Bolls affected by microorganisms before normal opening do not fluff completely, and fiber properties are markedly deteriorated. The non-fluffed fiber segments of the boll are often referred to as "tight locks"; and as their proportion to the total harvest increases, fiber quality, grade, and color of cotton are more seriously reduced (21). Wetting and drying also have a direct effect on fiber length, as discussed by Hessler et al. (9).

Parker and Caldwell (17) studied the joint effects of temperature and moisture on seedcotton quality. They exposed seedcotton for 8 weeks to controlled environmental conditions consisting of temperatures ranging from 50 to 60^{0}F (10.0 to 15.6^{0}C) and relative humidities of 20 to 100%. Deterioration of both lint and seed resulted when the sum of temperature and relative humidity exceeded 110. They also found that lint deterioration was more closely associated with relative humidity than with temperature, while seed quality deterioration was more closely related to temperature. Micronaire was affected only when both temperature and relative humidity were high. Lee and Finkner (11) found that cotton and fiber fabric which had weathered under full sunlight showed a marked reduction in strength and a less serious reduction in fiber elongation. Deterioration of both properties was least in the coarser, more mature fibers. They also showed that rate of deterioration was related significantly to incident solar energy. Lord and Anthony (13) demonstrated that loss in tensile strength was greatest at maximum exposure under summer conditions in Aden (i.e., hot and humid with a S. W. monsoon). The deterioration of fully exposed cotton was more rapid, and the drop in tensile strength approached 2%/week.

The inconsistent results reported by various authors suggest that rate of deterioration of yield-related components and fiber properties depends on the intensity of degradation factors and the duration of exposure. Thus, weathering effects would vary between different locations and between years at the same location. Hessler et al. (9) in an experiment on the Texas High Plains found that delayed harvest reduced fiber length and whiteness, but that fiber fineness and strength remained relatively unaffected. Ray and Minton (18) in a 3-year experiment also on the Texas High Plains found that fiber length, fiber strength, lint yield, lint index, and seed index were reduced while fiber fineness (i.e., micronaire) was not. Color damage was influenced greatly by delayed harvest. Loden et al. (12) on the Texas High Plains detected very little change in agronomic properties, seed quality, or fiber quality of cotton. Yarn strength was reduced about 5% during the 45 days of their experiment. Buxton et al. (3) in Arizona conducted field and greenhouse experiments simultaneously. In their field experiment, lint yield was unaffected (in fact, a slight increase in lint yield was noted due to contributions of late-maturing bolls) while fiber length, strength, and fineness were reduced significantly. In the greenhouse experiment, where open bolls were moistened with 0.50 ml water/boll weekly or twice weekly for 10 weeks (to simulate the wetting and drying cycles which occur in the field from rain and dew formation) and compared to an unwatered check, only fiber length was reduced.

Basinski et al. (2) studying pre-harvest weathering of cotton under mechanized production in a tropical area showed that fiber strength was markedly reduced. Fiber extensibility, length, and uniformity were less seriously affected; and micronaire values remained unchanged. Yarn strength was reduced, and yarn irregularity increased. Sunshine was demonstrated in their experiments to be the most important factor in fiber degradation. Basinski et al. (1) also showed that the occurrence of rainfall and high humidity during exposure had a greater effect on the deterioration of fiber quality than did the duration of exposure. Weathering under wet conditions led to lower yield along with an increase in pH of fiber extracts (suggesting microbial infection). The effects on fiber length and micronaire values were inconsistent, but prolonged exposure tended to lower fiber strength.

Grimes (6) found that weathering reduced length, grade, and staple. She suggested that the presence of more ultraviolet rays in sunlight at higher altitudes was a possible factor in the differential degradation of fiber length among the locations where her tests were conducted.

Inconsistency of results reported by different authors may also be due to the fact that most such reports have been based on 1 year-one cultivar experiments. Also, the possible effects of different boll types have apparently not been studied. The present experiment was conducted with four open-boll, four storm resistant, and four stormproof cultivars over 3 years in an attempt to remedy those two possible deficiencies in previous weathering experiments.

MATERIALS AND METHODS

Four stormproof ('Westburn M', 'GSA-71', 'Paymaster 202', and 'Rilcot 90A'), four storm resistant ('Lankart LX 571', 'Stripper 31A', 'Lockett BXL', and 'Deltapine Land SR-4'), and four open-boll ('Deltapine Land 61', 'Stoneville 256', 'Coker 310', and 'Delcot 277') cultivars were utilized in this study. The cultivars were planted in a randomized complete-block experimental design with six replications for 3 years (1977, 1978, and 1979) at Perkins, Okla., on a Teller loam soil (a fine-loamy, mixed thermic Udic Argiustolls). Plots were single rows 50 feet (15.2 m) long and 40 inches (1.02 m) apart. Plants within rows were spaced approximately 8 inches (20.3 cm) apart. No border rows between plots were employed.

Each year from the time when stripper harvest would normally have been conducted (some 2 to 3 weeks after that year's first killing freeze), usually in the second half of November, random samples of 15 mature bolls were taken from each plot at approximately 2-week intervals until the first week of March. Due to drifted snow, sampling was halted during the period between 10 Jan. 1978 through 8 Mar. 1978 in the first year of the study. In 1978 and 1979, sampling was started approximately 2 calendar weeks later than in 1977. Sampled bolls were taken from the middle portion of the plants and were completely matured with fluffy locks. Sampling dates and available weather data (mean daily minimum and maximum temperatures and total precipitation) for the periods between consecutive sampling dates for each year are presented in Table 1.

The sampled bolls were ginned; and after ginning, the following measurements were obtained directly or by computation from sample values:

1. Boll size: Seedcotton weight in grams/boll;
2. Pulled lint percent: Lint weight divided by sample weight, expressed as a percentage;
3. Picked lint percent: Lint weight divided by seedcotton weight, expressed as a percentage;
4. Lint index: Lint weight in grams/100 seed;
5. Seed index: Weight in grams of 100 seed;
6. Lint weight/boll: Lint weight in grams divided by number of bolls in sample;
7. Number of seed/boll: Portion of seed in small sample weighed and number counted, calculated for entire seed sample weight, divided by number of bolls in sample;

8-9. Fiber length (2.5 and 50% span lengths): Lengths at which 2.5 and 50%, respectively, of the fibers in a sample (caught at random along their lengths) are of that length or longer, as measured on the digital fibrograph in inches (converted into mm);

10. Uniformity index: Ratio of 50 to 2.5% span lengths, expressed as a percentage;

11. Micronaire: Fineness, as measured on the micronaire instrument, expressed in standard micronaire units (i.e., μg/inch); and

12-13. Fiber strength (T_0 and T_1): Strength of a bundle of fibers, as measured on the stelometer with the jaws holding the fiber bundle separated by a zero and a 1/8-inch (0.32 cm) spacer, respectively, in grams/tex (converted into mN/tex).

Analyses of variance were performed for each trait to test for possible effects of delayed harvest (i.e., sampling dates), cultivars, boll types, and interactions among them. Each trait in each year was regressed on sampling dates; and regression coefficients were calculated (based on individual observations) for cultivars, boll types (over cultivars), and traits (over cultivars and boll types). Pairwise comparisons among the regression values for boll types (over cultivars) in each year were accomplished using a t-test (20).

RESULTS AND DISCUSSION

Tables 2, 3, and 4 present the results from analyses of variance for each trait in 1977, 1978, and 1979, respectively. These tables indicate that within boll types, cultivar by sampling date interactions in 43 of the 117 character-boll type-year combinations were significant (for linear, quadratic, or remainder trends), suggesting that cultivar having the same boll type in most cases weathered with similar trends for yield-related traits and fiber quality. Interactions of boll type (averaged over cultivars) with sampling dates (linear, quadratic, or remainder trends) were significant in 20 of the 39 character-year combinations, suggesting numerous instances of different trends in weathering among the three boll types studied. Table 5 presents the pertinent mean squares from analyses of variance testing for possible trends over sampling dates for individual boll types within each year. Because significant linear trends were observed for these traits in 77 of the 117 cases, linear regression coefficients were calculated for boll types (averaged over cultivars) for the yield-related traits (Table 6) and for fiber quality (Table 7). In the latter two tables are also included regression coefficients for individual cultivars and for traits (averaged over boll types and cultivars). Figs. 1 through 13 were also constructed to illustrate the general linear trends observed in each year for the respective traits by boll types (averaged over cultivars). It should be noted that 54 of the 117 possible character-boll type combinations also displayed significant quadratic trends in their data over sampling dates (Table 5). Though only the linear trends are illustrated in the figures, for some of those 54 combinations, significant losses were not detected until later in the season; but for others, losses were more rapid at first, then decreased as sampling progressed. For the latter case, early in the season, weathering for such combinations was underestimated by the linear regression coefficient; late in the season, weathering effects were overestimated. For the former case, the opposite was true.

Weathering Damage to Yield-Related Traits

Boll Size. Table 6 and Fig. 1 summarize the boll size responses for the three boll types (averaged over cultivars) to pre-harvest degradation in each year of these experiments. In 1977 within all three boll types, individual cultivars differed significantly for their trends in boll size reduction over sampling dates (Table 2). The three boll types (on the average) were also different in their patterns of deterioration in this trait (Tables 2 and 6). Open-boll and storm resistant types exhibited a significant negative linear trend; whereas, the stormproof type (over cultivars) did not (Tables 5 and 6). The difference between the open-boll and stormproof types was significant with losses in the open-boll types being substantially greater.

In 1978, storm resistant and open-boll cultivars displayed significant, inconsistent patterns of boll size degradation within boll type (Table 3). Generally, all three boll types (averaged over cultivars) were significantly reduced for this trait with linear trends, although fluctuations (quadratic plus remainder trends) around the linear regression line were pronounced for the stormproof and open-boll types (Table 5). Open-boll types lost their effective boll size significantly more rapidly than did the other two in 1978 (Table 6).

In 1979 linear regression coefficients for this trait were not significant for any cultivar or for boll types over cultivars (Tables 5 and 6).

Because of the manner in which boll size is measured (grams of seedcotton/boll), the significantly greater losses in the open-boll type than in the stormproof type were expected. The stormproof type has a bur which holds seedcotton much more firmly than does the open-boll type. The storm resistant type is intermediate between the two and generally displayed an intermediate regression coefficient--though differences from the stormproof type were not significant in any year. Significant negative responses over boll types and cultivars were obtained in 1977 and 1978, but not in 1979. Losses in boll size/2 week period ranged from none to -0.10 g for the storm resistant and stormproof types (over cultivars) and from none to -0.16 g for open-boll types (Table 6).

Pulled Lint Percent. Duration of exposure prior to harvest had a significant negative effect on pulled lint percent over boll types and cultivars and within boll types over cultivars in all 3 years (Tables 5 and 6 and Fig. 2).

In 1977 no significant differences were observed among cultivars within similar boll types for their patterns of deterioration in pulled lint percent (Table 2); while in 1978 within stormproof and open-boll types (Table 3) and in 1979 within storm resistant and open-boll types (Table 4), at least some cultivars did differ in this regard.

Regression coefficients for this trait on duration of pre-harvest exposure were signficant and negative for most individual cultivars in most years, for the three boll types (over cultivars) in all 3 years, and over all boll types and cultivars in each of the 3 years (Table 6). The coefficients for the open-boll types (over cultivars) were significantly larger than those for the stormproof types in 1977 and 1978 and significantly larger than those for the storm resistant types in 1978 (Table 6 and Fig. 2). Seedcotton in open-boll cultivars is more exposed to the environment than in the other types and would be expected to lose or gain moisture more rapidly while the bur in all three boll types is more-or-less equally exposed and would thus lose or gain moisture with approximately equal rates. More important, open-boll bypes are much more likely to lose a lock or locks of seedcotton than are storm resistant and stormproof types. Loss of part or all of a lock from a boll would have a large effect on pulled lint percent because the weight of the bur would not be likely to change that dramatically. Losses in pulled lint percent/2-week period ranged from -0.14 to -0.28% for the storm resistant and stormproof types and from -0.26 to 0.43% for the open-boll types (Table 6).

Picked Lint Percent. In 1977 the picked lint percent of cultivars (with or without) similar boll types was in most cases affected by delayed harvest in similar patterns. Significant cultivar by quadratic trend over dates interaction was detected in the storm resistant and open-boll types (Table 2). Both linear and quadratic trends were significant in all three boll types (Table 5). The linear regression coefficients for this trait on duration of pre-harvest exposure in the three boll types (over cultivars) were not statistically different, although open-boll and storm resistant types appeared to have slightly larger slopes than did the stormproof types (Table 6 and Fig. 3).

In 1978 stormproof cultivars exhibited different linear trends for their responses to weathering; but cultivars within the storm resistant and open-boll types showed similar trends in picked lint percent degradation (Table 3). Open-boll cultivars on the average had significantly larger losses per unit of time (Table 6) than did the other boll types. In addition to the general linear trend, quadratic and remainder trends within boll types were also significant (Table 5).

In 1979 only open-boll cultivars showed significantly different responses within boll type for this trait to delayed harvest. On the average, all three boll types exhibited similar and pronounced deviations from linearity (Fig. 3 and Tables 5 and 6). The open-boll types were the only ones not exhibiting a significant quadratic trend for sampling dates over all 3 years. Losses in picked lint percent ranged from -0.12 to -0.24% for storm resistant and stormproof types and from -0.18 to -0.29% for open-boll types (over cultivars) for each 2-week delay in harvest (Table 6).

Lint Index. Cultivars with or without similar boll types significantly declined in similar patterns for lint index because of delayed harvests in all 3 years of this experiment (Tables 2, 3, 4, 5, and 6 and Fig. 4). The only exceptions to this general rule were a significant interaction between boll type and the remainder trend in 1977 (Table 2), in 1978 only stormproof cultivars showed a significant interaction with linear trends (Table 3), and in 1979 only open-boll cultivars exhibited a significant interaction with quadratic trends of degradation for this trait (Table 4). Significant differences among boll types were not detected for this trait in any year (Table 6). Losses over cultivars and boll types ranged from -0.04 to 0.07 g/100 seed for each 2-week delay in harvest (Table 6).

Seed Index. Effect of pre-harvest exposure on seed index was inconsistent in the 3 years of these experiments (Fig. 5). In 1977 no significant changes were observed among boll types in the value of seed index (Table 6). In 1978 this trait was significantly reduced in stormproof and storm resistant boll types (over cultivars); but open-boll types were not significantly affected (Tables 5 and 6). In 1979 a significant increase in lint index was detected for storm resistant and open-boll types (Fig. 5 and Tables 5 and 6). As shown in Fig. 5, the values of seed index for each of the three boll types at the seventh sampling date were markedly increased. These apparently inflated values may have biased the regression coefficient estimates upward to become positive and significant. Ignoring that sampling date, seed index in 1979 appeared to be generally unchanged as harvesting was delayed. Changes in seed index/2-week delay in harvest ranged from -0.04 to 0.04 g when averaged over cultivars and boll types (Table 6).

Lint Weight/Boll. The weight of lint/boll, especially in open-boll cultivars, decreased markedly as harvesting was delayed (Fig. 6 and Table 6). In 1977 storm resistant cultivars differed significantly from each other in patterns of loss of lint/boll across sampling dates, but stormproof and open-boll types did not (Table 2). On the average, open-boll cultivars lost larger amounts of lint/boll from date to date than did stormproof cultivars (Table 6 and Fig. 6). In

1978 cultivars with similar boll types suffered lint weight/boll reductions with similar trends except for the open-boll type (Table 3). Open-boll cultivars in 1978 lost significantly higher amounts of lint weight/boll than did the other two types (Table 6 and Fig. 6). In 1979 cultivars with similar boll types were similar for all trends in loss of lint weight/boll except for quadratic trends in the open-boll types (Table 4). Open-boll cultivars again declined in lint weight/boll more than did the stormproof boll type (Table 6 and Fig. 6.). Because the seedcotton of open-boll cultivars is more exposed to weathering, such cultivars are expected to lose more locks or partial locks (thus, more lint/weight/boll) to the forces of wind and gravity. Losses in lint weight/boll for each 2-week delay in harvest ranged from none to -0.039 g for stormproof and storm resistant cultivars and from -0.022 to -0.068 g for open-boll cultivars (Table 6).

Number of Seed/Boll. In 1977 no significant interactions were observed for cultivars within a boll type (Table 2); in 1978 only open-boll types differed in their linear trends (Table 3), and in 1979 only stormproof types differed in their quadratic trends (Table 4). In 1977 only open-boll cultivars (on the average) lost a significant number of seed/boll by delayed harvest (Table 6 and Fig. 7). In 1978 a significant number of seed/boll were lost from all three boll types, but with significantly greater losses from the open-boll cultivars (Table 6 and Fig. 7). In 1979 no significant reductions were observed for any boll type. Loss of seed/boll in the open-boll cultivars (as in loss of lint weight/boll) can be attributed to wind and gravity as primary factors. Losses in number of seed/boll for each 2-week delay in harvest ranged from none to -0.3 for the stormproof and storm resistant boll types and from none to -0.8 for the open-boll types (Table 6).

The results obtained for the yield-related traits indicated that all were generally reduced by delayed harvest. Ray and Minton (18) also found that lint yield, lint index, and seed index were adversely affected by delayed harvest. Their results and those from this study are apparently contradictory to those obtained by Buxton et al. (3) who observed a slight increase in lint yield because of late-maturing bolls. However, it should be noted that these experiments were initiated from the time when plant growth had totally ceased, and only reductions in lint yield and its associated traits were expected. The adverse effects of delayed harvest on yield-related traits were more serious in open-boll types than in storm resistant or stormproof cultivars. If significant differences between boll types were detected, the open-boll cultivars suffered greater losses than did the stormproof types. More rarely were the differences between storm resistant and open-boll types significant. Storm resistant cultivar values were generally intermediate between those for stormproof and open-boll cultivars, but they did not differ significantly from the stormproof types for any trait in any year. Damage to yield-related traits was much more severe in 1978 than in 1977 and 1979. Temperature in 1979 was considerably milder than in the other 2 years (Table 1). Less ice formed and stayed on the plants that year for a shorter period of time. In 1977 a heavy snow covered the experiment for an extended period of time between the 10 Jan. 1978 and 8 Mar. 1978 sampling dates, which probably retarded the adverse effects of weathering on yield-related traits in that year. A comparison of Figs. 1, 6, and 7 shows that boll size, lint weight/boll, and number of seed/boll have very similar patterns of degradation in each boll type and year. This merely emphasizes how closely the three traits are interrelated. The three boll types did not differ in the rates at which their lint and seed indexes were reduced by weathering.

Weathering Damage to Fiber Quality

2.5% Span Length. Cultivars with the same boll type generally displayed similar patterns for this measure of fiber length in all 3 years (Tables 2, 3, and 4). In 1978 the open-boll cultivars did show significantly different trends at the 0.10 probability level, but other trends were not significantly different from zero (Table 3). Fig. 8 and Table 7 show that only in 1978 were the three types of cultivars significantly degraded for this trait and that differences among boll types were statistically nonexistent (Table 7). Changes in 2.5% span length between years ranged from none to -0.10 mm on the average for each 2-week delay in harvest (Table 7).

50% Span Length. In 1977 this measure of fiber length exhibited a common pattern of response for cultivars within each of the three boll types to delayed harvest except for a significant remainder trend in the storm resistant types (Table 2). A significant quadratic trend across sampling dates was noted for the open-boll cultivars (Table 5). In 1978 only the storm resistant cultivars showed significantly different responses (Table 3); but on the average, the three boll types exhibited approximately similar patterns of fiber length degradation (Table 7 and Fig. 9). In 1979 cultivars within the storm resistant and open-boll types differed for this trait in response to delayed harvest (Table 4). All three boll types were significantly reduced for 50% span length in 1979, but the open-boll types sufferend significantly larger losses than did the other two (Table 7 and Fig. 9). Losses in 50% span length ranged from none to -0.08 mm for the stormproof and storm resistant boll types (over cultivars) and from none to -0.09 for the open-boll types (Table 7).

Uniformity Index. In 1977 cultivars within the same boll type displayed statistically identical patterns for uniformity index over the sampling period (Table 2). All three boll types likewise showed similar significant and negative trends because of delayed harvests (Table 7). In 1978 uniformity index was again significantly reduced in all three boll types. Storm resistant and open-boll cultivars on the average had significantly larger regression slopes than did the stormproof types (Table 7). Cultivars in 1978 within the storm resistant category did display significantly different linear trends (Table 3). In 1979 this trait was again significantly degraded by delayed harvest in all three boll types, but this time with statistically equal effects (Table 7). Within boll types, only the open-boll cultivars possessed significantly different linear trends (Table 4 and Fig. 10). The storm resistant cultivars displayed a significant interaction with quadratic trends (Table 4). Increased irregularity of fiber length ranged from -0.06 to -0.17% for the stormproof type (over cultivars) and from -0.06 to -0.25% for the storm resistant and open-boll types as a result of each 2-week delay in harvest during the 3 years of this research (Table 7). Linear or quadratic trends or both were noted for this trait in all boll types every year (Table 5).

<u>Micronaire</u>. In 1977 and 1978, micronaire values were significantly reduced by delayed harvest with common trends for all cultivars within boll types and between boll types (Tables 2, 3, 5, and 7 and Fig. 11). Losses in micronaire for each 2-week delay in harvest ranged from -0.01 to -0.07 μg/in during those 2 years (Table 7). Significant interactions in 1979 were noted for linear trends with open-boll cultivars and for quadratic trends with stormproof cultivars (Table 4). In 1979 the trait was not significantly reduced in any of the three boll types over cultivars (Table 7).

<u>T_0 Fiber Strength</u>. In 1977 this trait was reduced at different linear trends in storm resistant cultivars (Table 2), but not in stormproof or open-boll types. On the average, the three boll types in 1977 did not differ significantly in their trends for loss of T_0 fiber strength (Table 7). In 1978 significant trends for weathering were not detected for this trait among the three boll types (Tables 5 and 7 and Fig. 12). Such differences in weathering trends were detected among the open-boll cultivars in 1978 (Table 3) and in 1979 (Table 4). In 1979 the stormproof and open-boll cultivars as a group suffered significant reductions in T_0 fiber strength across sampling dates (Table 7 and Fig. 12). Losses in T_0 fiber strength ranged from none to -2.7 mN/tex for open-boll types (over cultivars) and from none to -1.5 mN/tex in stormproof and storm resistant types (Table 7).

<u>T_1 Fiber Strength</u>. With one exception in each year, cultivar by date interactions within boll types were not significant for T_1 fiber strength in any of these experiments (Tables 2, 3, and 4) indicating generally parallel effects for pre-harvest weathering of this trait within the three types of cultivars. In 1977 only storm resistant

cultivars displayed significantly different linear trends over sampling dates (Table 2). In 1978 the same was true for linear trends in the open-boll types (Table 3); and in 1979, for the quadratic trends in the open-boll types (Table 4). Losses in T_1 fiber strength (averaged over cultivars and boll types) ranged from none to -1.6 mN/tex for each 2-week delay in harvest (Table 7).

Differences in weathering trends among boll types were not as consistent for fiber quality as they were for the yield-related traits. Significant differences among boll types for such trends were not detected for 2.5% span length, micronaire, or T_1 fiber strength. In 1978 storm resistant and open-boll types lost uniformity index more rapidly than did stormproof cultivars. In 1979 open-boll cultivars suffered 50% span length reductions more rapidly than did the other two; and open-boll cultivars lost T_0 fiber strength more quickly than did the storm resistant types.

REFERENCES

1. Basinski, J. J., L. J. Phillips, and M. J. T. Norman. 1964. The effect of frequency of picking on the yield and quality of rain-grown cotton at Katherine, N. T. Aust. J. Exp. Agric. Animal Husb. 4:300-302.

2. __________, G. Robinson, and N. J. Thomson. 1973. Pre-harvest weathering on cotton under mechanized production in a tropical area. Cotton Grow. Rev. 50:193-217.

3. Buxton, D. R., H. N. Stapleton, Y. Makki, and R. E. Briggs. 1973. Some effects of field weathering of seed cotton in a desert environment. Agron. J. 65:14-17.

4 Crawley, T. V., Jr., J. D. Towery, B. K. Power, and L. E. Hessler. 1952. Now you can grade cotton with a laboratory instrument. Textile World 102(9):100-101, 335-336, 338-339.

5. Evenson, J. P. 1967. Effect of atmospheric humidity on grade of cotton lint in the Ord Valley, north Western Australia. Cotton Grow. Rev. 44:29-38.

6. Grimes, M. A. 1936. The effect of exposure in the field on grade, strength, and color of raw cotton. Texas Agric. Exp. Stn. Bull. 538.

7. Hawkins, R. S., and W. I. Thomas. 1948. The effect of moisture content, field exposure, and processing on the spinning value of Arizona upland cotton. Arizona Agric. Exp. Stn. Tech. Bull. 115.

8. Hessler, L. E., G. V. Merola, and E. E. Berkley. 1948. Degree of polymerization of cellulose in cotton fibers. Textile Res. J. 18:628-634.

9. __________, J. D. Towery, and B. K. Power. 1954. The effect of weathering in the field on the fiber properties of cotton. Textile Res. J. 24:1010-1013.

10. __________, and D. J. Upton. 1955. Chemical properties of field-weathered cotton. Textile Res. J. 25:1029-1034.

11. Lee, J. S., and M. D. Finkner. 1968. Differences in outdoor weathering of cottons. Textile Res. J. 38:1044-1047.

12. Loden, H. D., Q. Adams, S. C. Mayne, Jr., and H. G. Lewis. 1962. Weathering effects on Texas Plains' cotton. Cotton Gin and Oil Mill Press 63(19):32-33.

13. Lord, E., and K. R. M. Anthony. 1960. Effect of exposure to the Aden climate on cotton lint strength. Empire Cotton Grow. Rev. 37: 10-14.

14. Marsh, P. B., H. D. Barker, T. Kerr, and M. L. Butler. 1950. Wax content as related to surface area of cotton fibers. Textile Res. J. 20:288-297.

15. __________, L. R. Guthrie, and M. L. Butler. 1951. The influence of weathering and of microorganisms on the aqueous-extract pH of cotton fiber. Textile Res. J. 21:565-579.

16. __________, G. V. Merola, M. L. Butler, and M. E. Simpson. 1958. The influence of weathering prior to harvest on certain properties of cotton fibers. Textile Res. J. 28:95-111.

17. Parker, R. E., and W. P. Caldwell. 1967. Behavior of seed cotton exposed to certain atmospheric conditions. Mississippi Agric. Exp. Stn. Bull. 746.

18. Ray, L. L., and E. B. Minton. 1973. Effects of field weathering on cotton lint yield - seed quality - fiber quality. Texas Agric. Exp. Stn. Misc. Pub. MP-1118.

19. Simon, S. A., and C. Harmon. 1954. Color in cotton. Textile Res. J. 24:12-16.

20. Steel, R. G. D., and J. H. Torrie. 1960. Principles and procedures of statistics. McGraw-Hill Book Co., Inc., New York.

21. Williams, J. M. Jr. 1970. Field-degradation effects on cotton fiber and yarn quality. USDA Tech. Bull. 1417.

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Table 1. Mean daily minimum and maximum temperatures and total precipitation for the periods between consecutive sampling dates in each year.

Sample No.	1977 Sample date	1977 Mean daily temp. Min.	1977 Mean daily temp. Max.	1977 Total ppt.	1978 Sample date	1978 Mean daily temp. Min.	1978 Mean daily temp. Max.	1978 Total ppt.	1979 Sample date	1979 Mean daily temp. Min.	1979 Mean daily temp. Max.	1979 Total ppt.
		°C	°C	cm		°C	°C	cm		°C	°C	cm
1	11/15				-				-			
		1.7	15.6	0.0		-	-	-		-	-	-
2	11/29				11/27				11/26			
		-3.3	9.4	0.8		-4.4	8.3			-1.7	11.7	0.0
3	12/13				12/11				12/10			
		-2.8	13.3	0.0		-2.8	11.7	0.0		-1.8	12.2	0.0
4	12/28				12/25				12/24			
		-6.1	5.6	0.1		-9.4	3.3	1.5 + S†		-1.1	8.9	5.5 + S
5	1/10				1/10				1/7			
		-	-	-		-6.7	2.2	3.2 + S		-1.1	10.6	5.4
6	-				1/22				1/25			
		-	-	-		-13.9	-1.1	0.7 + S		-7.7	1.7	S
7	-				2/5				2/4			
		-	-	-		-8.9	3.9	0.6 + S		-1.1	3.9	2.2
8	-				2/24				2/18			
		-7.2	2.2	10.5		-1.1	13.3	2.3		-2.8	12.2	0.0
9	3/8				3/8				3/3			

†S designate trace of snow.

Table 2. Analyses of variance for yield-related traits and fiber quality in 1977.

Source of variation	df	Mean squares												
		Boll size	Lint percent		Lint index	Seed index	Lint wt./boll	No. of seed/boll	Span length		Uniformity index	Micronaire	Fiber strength	
			Pulled	Picked					2.5%	50%			T_0	T_1
Replication (R)	5	1.07**	3.36*	5.29**	1.14**	1.57*	0.1369**	21.18**	6.01**	2.13**	2.76†	0.31**	1835.19**	347.86**
Cultivar (C)	11	10.83**	16.77**	54.11**	12.82**	18.11**	1.7944**	189.87**	145.19**	16.15**	63.70*	8.06**	5681.14**	4200.47**
R x C(E_a)	55	0.20	1.54	1.99	0.42	0.69	0.0337	6.61	0.96	0.50	0.83	0.11	335.20	119.11
Sampling date (D)	5	1.03**	34.72**	39.53**	3.06**	2.97**	0.4716**	10.93	6.68**	2.99**	35.80*	1.91**	1024.91	296.34
Date linear (D_L)	(1)	4.28**	109.06**	68.78**	10.75**	1.75†	1.5601**	13.56	3.86*	0.06	22.16**	8.97**	2738.98†	43.79
Date quadratic (D_Q)	(1)	0.13	60.92**	95.53**	1.63**	8.97**	0.4694**	23.01	3.13*	8.57**	126.29**	0.03	29.20	689.68†
Date remainder (D_R)	(3)	0.75*	1.28	11.11**	0.98*	1.37†	0.0195	5.38	8.80**	2.10†	10.19**	0.19	784.31	249.42
R x D (E_b)	25	0.20	0.69	1.26	0.23	0.47	0.0242	7.11	0.53	0.71	1.69	0.11	721.15	186.96
C x D	55	0.21**	1.01	1.75†	0.29	0.66	0.0292	6.30	0.65	0.55	1.09	0.08	269.43	114.87
D_L x Boll Type (BT)	(2)	0.49*	3.93*	1.00	0.00	0.16	0.0918*	17.89**	0.26	0.10	0.46	0.08	170.14	142.57
D_Q x BT	(2)	0.23	0.99	1.63	0.16	0.38	0.0264	2.66	4.79**	1.12	1.06	0.05	190.75	77.10
D_R x BT	(6)	0.12	1.03	2.31	0.81*	0.53	0.0107	11.35*	0.56	0.67	0.81	0.10	38.30	103.10
C x D_L in BT_1§	(3)	0.41*	0.81	0.44	0.36	1.87*	0.0404	8.08	0.39	0.25	0.87	0.12	117.11	96.46
C x D_Q in BT_1	(3)	0.23	0.42	0.10	0.00	0.03	0.0303	6.57	0.28	0.04	0.32	0.07	118.88	36.73
C x D_R in BT_1	(9)	0.19	0.68	0.74	0.09	0.43	0.0090	7.05	0.73	0.08	0.73	0.03	79.84	73.13
C x D_L in BT_2	(3)	0.43*	0.72	0.68	0.71	1.59*	0.0792*	1.17	0.08	1.08	3.63	0.14	1276.08**	462.75**
C x D_Q in BT_2	(3)	0.42*	1.38	5.44**	0.28	0.74	0.0917**	9.76	0.11	1.08	0.96	0.15	230.27	184.28
C x D_R in BT_2	(9)	0.06	1.40	2.09	0.32	0.84	0.0026	5.34	0.30	1.46**	1.33	0.05	242.31	44.73
C x D_L in BT_3	(3)	0.39*	0.32	0.96	0.02	0.39	0.0356	4.53	0.16	0.19	1.30	0.15	133.06	40.93
C x D_Q in BT_3	(3)	0.06	1.06	2.94†	0.52	0.56	0.0135	7.33	0.28	0.05	0.03	0.11	82.28	182.42
C x D_R in BT_3	(9)	0.13	0.70	2.20	0.14	0.53	0.0042	1.77	0.99	0.43	1.33	0.03	566.07*	132.05
R x C x D (E_c)	275‡	0.12	1.10	1.34	0.35	0.55	0.0240	4.98	0.55	0.55	1.33	0.07	281.26	92.85

†, *, ** Significant at the 0.10, 0.05, and 0.01 levels of probability, respectively.

‡ R x C x D (E_c) mean squares for lint index, seed index, and no. of seed/boll have one less df due to missing data.

§ BT_1 = stormproof, BT_2 = storm resistant, and BT_3 = open-boll types.

Table 3. Analyses of variance for yield-related traits and fiber quality in 1978.

Source of variation	df	Mean squares: Boll size	Lint percent: Pulled	Lint percent: Picked	Lint index	Seed index	Lint wt./boll	No. of seed/boll	Span length: 2.5%	Span length: 50%	Uniformity index	Micronaire	Fiber strength: T_0	Fiber strength: T_1
Replication (R)	5	6.53**	5.80**	4.83**	0.29	0.53†	0.1742**	49.91**	0.64*	0.31*	2.60**	0.06	1814.67**	144.33
Cultivar (C)	11	18.21**	58.55**	60.44**	11.41**	20.27**	2.5438**	583.35**	197.75**	27.68**	66.52**	11.82**	14576.24**	10844.10**
R x C (E_a)	55	0.32	2.18	1.72	0.40	1.10	0.0486	5.67	1.37	0.48	1.62	0.11	194.28	156.64*
Sampling date (D)	7	7.74**	44.60**	46.42**	3.21**	4.81**	1.0256**	165.26**	10.99**	4.84**	28.30**	0.29**	725.72	1022.25**
Date linear (D_L)	(1)	36.37**	181.06**	94.04**	15.02**	6.45**	6.4738**	590.07**	30.84**	18.33**	45.19**	0.83**	309.84	4158.48**
Date quadratic (D_Q)	(1)	5.72**	26.71**	50.95**	3.16**	0.08	0.2650**	233.51**	1.39†	1.18**	45.21**	0.49**	167.40	31.40
Date remainder (D_R)	(5)	2.80**	21.96**	35.33**	0.81**	5.43**	0.1404**	76.46**	17.11**	2.53*	21.39**	0.16**	918.40	541.81**
R x D (E_b)	35	0.34	1.55	1.87	0.16	0.46	0.0357	9.96	0.38	0.21	1.28	0.04	848.42	122.38
C x D	77	0.33**	2.51**	1.28	0.15	0.34	0.0491**	10.05**	0.22	0.12	1.03‡	0.04	294.00	82.90
D_L x Boll type (BT)	(2)	1.59**	22.05**	8.80**	0.24	0.38	0.3160**	60.54**	0.43	0.09	4.26**	0.03	231.99	217.25
D_Q x BT	(2)	1.28**	2.99*	1.39	0.00	0.29	0.1616**	32.70**	0.76†	0.44*	0.91	0.03	132.77	71.77
D_R x BT	(10)	0.36**	2.31**	0.84	0.20	0.25	0.0513**	9.86†	0.28	0.17	0.98	0.02	308.26	116.46
C x D_L in BT_1§	(3)	0.12	3.13*	2.60†	0.37†	0.48	0.0211	6.18	-0.02	0.06	0.87	0.06	359.36	182.67
C x D_Q in BT_1	(3)	0.01	0.87	1.09	0.16	0.30	0.0058	1.46	0.28	0.10	0.05	0.02	117.78	18.51
C x D_R in BT_1	(15)	0.13	0.61	0.48	0.13	0.53*	0.0168	6.17	0.32	0.15	0.99	0.03	233.34	81.73
C x D_L in BT_2	(3)	0.37†	1.21	0.63	0.12	0.77*	0.0432	1.10	0.53	0.47**	2.67*	0.04	101.28	54.01
C x D_Q in BT_2	(3)	0.05	0.12	0.20	0.07	0.46	0.0053	1.16	0.13	0.08	1.49	0.03	399.65	53.86
C x D_R in BT_2	(15)	0.14	1.34	1.47	0.17	0.23	0.0276	4.43	0.30	0.11	0.80	0.05	287.17	97.91
C x D_L in BT_3	(3)	0.66**	4.63*	0.98	0.03	0.19	0.0569†	17.59*	0.62†	0.06	0.72	0.07	1115.91**	223.85†
C x D_Q in BT_3	(3)	0.50*	6.48*	1.76	0.22	0.16	0.0889**	7.26	0.36	0.25	1.05	0.01	217.33	5.08
C x D_R in BT_3	(15)	0.23†	1.41	1.19	0.18	0.19	0.0324	7.82	0.19	0.06	0.65	0.04	218.94	76.12
R x C x D (E_c)	385‡	0.15	0.95	1.10	0.16	0.28	0.0220	6.08	0.27	0.12	0.81	0.04	244.15	101.39

†, *, ** Significant at the 0.10, 0.05, and 0.01 levels of probability, respectively.
‡ R x C x D (E_c) mean squares for all characters have nine less df due to missing data.
§ BT_1 = stormproof, BT_2 = storm resistant, and BT_3 = open-boll types.

Table 4. Analyses of variance for yield-related traits and fiber quality in 1979.

		Mean squares												
		Boll	Lint percent		Lint	Seed	Lint	No. of	Span length		Uniform-ity	Micro-	Fiber strength	
Source of variation	df	size	Pulled	Picked	index	index	wt./boll	seed/boll	2.5%	50%	index	naire	T_0	T_1
Replication (R)	5	2.40**	3.40**	3.92*	0.67*	2.58**	0.2495**	20.17**	1.68**	0.29†	1.24	0.10	626.04*	122.74
Cultivar (C)	11	21.25**	21.46**	30.12**	11.24**	31.06**	2.7655**	144.21**	194.90**	17.21**	148.54**	13.01**	6973.18**	7218.48**
R x C (E_a)	55	0.39	3.04	3.29	0.37	0.69	0.0549	9.53	0.54	0.29	2.95	0.31	521.87	197.87
Sampling date (D)	7	2.04**	52.64**	56.22**	1.68**	7.28**	0.1538**	22.23*	1.49**	4.84**	50.53**	0.69**	3222.97*	2037.65**
Date linear (D_L)	(1)	0.11	242.81**	152.53**	5.40**	5.52**	0.4357**	3.17	0.17	8.06**	112.22**	0.23	7054.47**	1818.58*
Date quadratic (D_Q)	(1)	0.11	0.35	22.88**	2.59**	0.08	0.2148**	1.45	1.31†	16.30**	175.41**	0.47*	6048.12*	361.70
Date remainder (D_R)	(5)	2.81**	25.00**	218.09**	0.76†	9.08**	0.0836*	29.79**	1.92**	2.01**	12.12**	0.81**	1890.79	2414.69**
R x D (E_b)	35	0.28	0.70	2.14	0.36	0.49	0.0311	7.12	0.38	0.15	1.00	0.11	993.54	409.80
C x D	77	0.15	1.01†	1.48	0.21	0.24	0.0245	3.37	0.24	0.18*	0.97	0.08	352.77*	182.23
D_L x Boll type (BT)	(2)	0.40†	2.06†	1.65	0.09	0.11	0.0742*	9.26	0.45	0.61**	2.20†	0.02	1019.55*	203.98
D_Q x BT	(2)	0.11	0.27	0.14	0.03	0.07	0.0086	2.61	0.42	0.29	0.17	0.13	124.05	278.94
D_R x BT	(10)	0.04	0.47	0.97	0.17	0.20	0.0117	0.85	0.44	0.24	1.10	0.07	266.30	164.94
C x D_L in BT_1 §	(3)	0.11	0.38	1.00	0.25	0.40	0.0202	1.36	0.03	0.05	1.42	0.03	478.55	148.36
C x D_Q in BT_1	(3)	0.43*	0.35	1.46	0.17	0.13	0.0269	10.15†	0.23	0.15	0.30	0.16†	525.05†	99.99
C x D_R in BT_1	(15)	0.14	0.61	0.54	0.11	0.24	0.0206	4.60	0.19	0.08	0.52	0.08	280.68	146.63
C x D_L in BT_2	(3)	0.00	2.26*	1.82	0.28	0.19	0.0056	2.71	0.02	0.08	0.89	0.05	213.78	2.73
C x D_Q in BT_2	(3)	0.15	0.82	1.12	0.05	0.07	0.0033	4.19	0.07	0.33†	2.06†	0.03	135.96	180.08
C x D_R in BT_2	(15)	0.15	1.31	1.95	0.27	0.36	0.0335	2.23	0.04	0.22	1.22	0.09	334.80	153.06
C x D_L in BT_3	(3)	0.02	1.32	4.36*	0.49	0.07	0.0136	3.00	0.07	0.33†	3.08*	0.15†	947.28**	243.54
C x D_Q in BT_3	(3)	0.23	3.18**	5.17*	0.70*	0.49	0.0492†	3.26	0.06	0.12	0.73	0.13	275.79	693.44**
C x D_R in BT_3	(15)	0.18	0.95	1.22	0.21	0.21	0.0265	2.86	0.19	0.08	0.62	0.05	358.59	186.01
R x C x D (E_c)	385‡	0.15	0.80	1.49	0.24	0.37	0.0225	4.49	0.23	0.13	0.89	0.07	233.70	158.65

†, *, ** Significant at the 0.10, 0.05, and 0.01 levels of probability, respectively.
‡ R x C x D (E_c) mean squares for all characters except boll size and pulled lint percent have two less df due to missing data.
§ BT_1 = stormproof, BT_2 = storm resistant, and BT_3 = open-boll types.

Table 5. Pertinent mean squares from analyses of variance for trends within years and boll types as exhibited by yield-related traits and fiber quality.

				Mean squares												
Year	Boll type‡	Trend	df	Boll size	Lint percent Pulled	Lint percent Picked	Lint index	Seed index	Lint wt./boll	No. of seed/boll	Span length 2.5%	Span length 50%	Uniformity index	Micronaire	Fiber strength T_0	Fiber strength T_1
1977	BT_1	D_L	1	0.36	18.27**	13.28**	3.22**	1.49†	0.1876**	2.98†	0.32†	0.19	18.27**	2.14**	597.43	227.14
		D_Q	1	0.54	11.51	19.09**	0.36	1.37	0.2871**	21.56†	1.74†	1.48	11.51*	0.00	156.00	95.16
		D_R	3	0.12	0.64	2.20	0.11	0.56	0.0045	4.33	1.42	0.99	0.64	0.17	172.36	154.34
	BT_2	D_L	1	1.06*	31.74**	27.13**	3.62**	0.37	0.4806**	2.15	2.19†	0.07	3.98	2.86**	2038.47	25.98
		D_Q	1	0.00	28.20**	47.96**	1.41**	2.66**	0.1877**	2.62	1.94	0.90	35.36**	0.12	189.20	108.95
		D_R	3	0.06	1.73	5.15*	1.00*	0.89	0.0203	4.76	2.88**	0.90	4.41	0.15	395.72	8.17
	BT_3	D_L	1	3.84**	66.91**	30.37**	3.93**	0.21	1.0754**	45.05**	1.87†	0.07	11.16*	4.13**	443.31	75.82†
		D_Q	1	0.04	23.20**	31.75**	0.18	5.75**	0.0474	4.63†	9.03**	8.45**	34.14**	0.01	65.52	639.78
		D_R	3	0.32	0.90	8.39**	1.49**	0.97	0.0160	19.10	5.63**	1.55	2.70	0.07	259.65	221.09
		Error	25	0.20	0.69	1.26	0.23	0.47	0.0204	7.11	0.53	0.71	1.69	0.11	721.15	186.96
1978	BT_1	D_L	1	6.52**	24.04**	13.98**	3.79**	3.58**	1.1468**	69.33**	15.78**	5.67**	3.08	0.31*	693.00	2715.49**
		D_Q	1	3.38**	16.59**	30.15**	1.11*	0.59	0.1383	117.59**	2.64*	0.02	8.57*	0.31*	397.17	3.95†
		D_R	5	0.82†	11.22**	13.82**	0.53*	1.40*	0.0220	29.73*	5.24**	0.67*	8.63*	0.08	835.02	275.35
	BT_2	D_L	1	9.21**	29.77**	17.86**	4.09**	3.12*	1.5727**	123.06**	8.13**	5.24**	512.26**	0.12†	67.55	18.27
		D_Q	1	0.01	15.67**	10.61*	1.14*	0.07	0.0195	5.56	0.01	0.84	20.21**	0.05	30.93	17.18
		D_R	5	0.71†	7.58**	13.73**	0.30	1.56*	0.0171	17.23	4.52**	0.87**	235.98**	0.05	203.75	8.95
	BT_3	D_L	1	25.11**	171.60**	75.61**	7.50**	0.65	4.5458**	555.08**	8.19**	8.67**	34.21**	0.69**	0.00	1231.39**
		D_Q	1	4.76**	1.04	14.36**	1.21**	0.03	0.4088**	179.41**	0.34	1.04*	21.33**	0.18*	17.85	120.87†
		D_R	5	1.97**	7.78**	9.25**	0.38†	3.06**	0.2007**	48.50**	7.85**	1.27**	6.34**	0.07	464.18	260.81†
		Error	35	0.34	1.55	1.87	0.16	0.46	0.0357	9.96	0.40	0.21	1.28	0.04	848.42	122.38
1979	BT_1	D_L	1	0.36	60.50**	33.58**	1.18*	1.21	0.0342	9.41	0.16	1.30**	28.06**	0.11	1176.78	438.55
		D_Q	1	0.02	0.09	8.24†	0.01	0.81	0.0220	3.29	0.01†	3.28**	53.35**	0.29	2115.27	180.35
		D_R	5	1.14**	5.62**	11.03**	2.72**	0.63	0.0553	16.20	0.90	2.30**	1.92	0.21	613.66	540.42
	BT_2	D_L	1	0.27	76.38**	56.27**	1.75*	2.51*	0.1015†	4.28	0.37	1.41**	27.31**	0.10	655.77	152.21
		D_Q	1	0.03	0.01	9.01*	1.12†	0.09	0.0665	3.34	0.48	4.96**	58.14**	0.51*	3323.16†	39.94
		D_R	5	0.95*	8.18**	13.70**	0.10	3.28**	0.0310	8.26	0.64	0.62**	6.63**	0.62**	650.03	929.06
	BT_3	D_L	1	0.29	110.94**	66.08**	2.76**	1.75†	0.4728**	6.18	0.47	6.61**	62.83**	0.02	7251.68*	1633.42†
		D_Q	1	0.27	0.76	5.68	0.60	0.04	0.1221†	1.27	1.67*	8.59**	65.96**	0.00	1068.70	675.29
		D_R	5	0.80*	12.07**	20.77**	0.37	3.53**	0.0231	8.27	1.22*	1.41**	5.85**	0.15	1175.74	1286.37
		Error	35	0.28	0.70	2.14	0.36	0.49	0.0311	7.12	0.38	0.15	1.00	0.11	993.54	409.80

†, *, ** Significant at the 0.10, 0.05, and 0.01 levels of probability, respectively.

‡ BT_1 = stormproof, BT_2 = storm resistant, and BT_3 = open-boll types.

Table 6. Linear regression coefficients for yield-related traits by cultivars, by boll types (over cultivars), and by traits (over boll types and cultivars) in each year.

Type of coefficient	Boll size 1977	Boll size 1978	Boll size 1979	Pulled lint percent 1977	Pulled lint percent 1978	Pulled lint percent 1979	Picked lint percent 1977	Picked lint percent 1978	Picked lint percent 1979
Cultivar		g							
Westburn M	0.00	-0.06*	0.04	-0.13*	-0.13†	-0.22**	-0.12*	-0.10	-0.20*
GSA-71	-0.04	-0.11**	0.03	-0.21**	-0.22**	-0.24**	-0.16**	-0.13	-0.14*
Paymaster 202	0.02	-0.07*	0.01	-0.07	-0.01	-0.22**	-0.14*	0.01	-0.12
Rilcot 90A	-0.07**	-0.08**	-0.01	-0.14**	-0.26**	-0.30**	-0.06	-0.24**	-0.26**
Lankart LX 571	-0.08*	-0.15**	0.02	-0.14*	-0.08	-0.16	-0.15*	-0.06	-0.18
Stripper 31A	0.00	-0.07**	0.01	-0.13	-0.17*	-0.25**	-0.10	-0.14	-0.14
Lockett BXL	-0.05†	-0.09**	0.02	-0.24**	-0.22**	-0.30**	-0.23**	-0.16*	-0.31**
Deltapine Land SR-4	0.00	-0.07**	0.02	-0.22**	-0.23*	-0.40**	-0.19*	-0.18*	-0.32**
Deltapine Land 61	-0.08**	-0.20**	-0.01	-0.27**	-0.41**	-0.29*	-0.16**	-0.22**	-0.20
Stoneville 256	-0.04†	-0.10**	-0.03	-0.29**	-0.37**	-0.25**	-0.25**	-0.37**	-0.10
Coker 310	-0.02	-0.10*	-0.02	0.21†	-0.25*	-0.39**	-0.19	-0.24†	-0.39*
Delcot 277	-0.11**	-0.24**	-0.01	-0.28**	-0.69**	-0.39**	-0.10	-0.32**	-0.33
Boll type (Over cultivars)									
Stormproof	-0.02 a‡	-0.08**a	0.02 a	-0.14**a	-0.15**a	-0.24**a	-0.12** a	-0.12**a	-0.18**a
Storm resistant	-0.03* ab	-0.10**a	0.02 a	-0.18**ab	-0.17**a	-0.28**a	-0.17** a	-0.13**a	-0.24**a
Open-boll	-0.06**b	-0.16**b	-0.02 a	-0.26**b	-0.43**b	-0.33**a	-0.18** a	-0.29**b	-0.26**a
Trait (Over boll types and cultivars)									
See column heading	-0.04**	-0.11**	0.01	-0.19**	-0.25**	-0.28**	-0.15**	-0.18**	-0.23**

Type of coefficient	Lint index 1977	Lint index 1978	Lint index 1979	Seed index 1977	Seed index 1978	Seed index 1979	Lint wt./boll 1977	Lint wt./boll 1978	Lint wt./boll 1979	No. of seed/boll 1977	No. of seed/boll 1978	No. of seed/boll 1979
Cultivar					g							
Westburn M	-0.02	-0.07**	-0.01	0.03	-0.09*	-0.09†	-0.006	-0.026**	0.001	0.0	-0.0	0.1
GSA-71	-0.04	-0.09**	-0.04	0.02	-0.10*	0.00	-0.021	-0.045**	0.002	-0.1	-0.4†	0.2†
Paymaster 202	-0.07†	-0.01	-0.01	-0.04	-0.01	0.05	-0.001	-0.027*	-0.006	0.3†	-0.4*	-0.0
Rilcot 90A	-0.11**	-0.07**	-0.08**	-0.16*	-0.03	0.00	-0.028**	-0.038**	-0.019*	0.1	-0.3†	0.1
Lankart LX 571	-0.13**	-0.09**	-0.02	-0.14*	-0.13**	0.08	-0.042**	-0.058**	-0.009	0.0	-0.4*	-0.0
Stripper 31A	-0.01	-0.05*	-0.01	0.02	-0.04	0.04	-0.004	-0.028**	-0.004	-0.0	-0.3*	0.0
Lockett BXL	-0.07*	-0.07**	-0.08**	-0.01	-0.05	0.02	-0.034**	-0.040**	-0.014	-0.1	-0.3*	0.2
Deltapine Land SR-4	-0.03	-0.04†	-0.06*	0.04	-0.00	0.06	-0.010	-0.032**	-0.012	-0.0	-0.3†	0.1
Deltapine Land 61	-0.07**	-0.09**	-0.02	-0.04	-0.06	-0.06†	-0.038**	-0.079**	-0.015	-0.2	-1.0**	-0.1
Stoneville 256	-0.06*	-0.10**	-0.01	0.03	-0.01	0.03	-0.030**	-0.052*	-0.016†	-0.2	-0.4*	-0.2
Coker 310	-0.06	-0.05	-0.09**	0.01	0.01	0.05	-0.019	-0.047**	-0.030*	-0.0	-0.5*	-0.0
Delcot 277	-0.07†	-0.09**	-0.09**	-0.05	-0.00	0.02	-0.048**	-0.096**	-0.025†	-0.4*	-1.1**	0.1
Boll type (Over cultivars)												
Stormproof	-0.06**a	-0.06**a	-0.03* a	-0.04 a	-0.06**a	0.03 a	-0.014* a	-0.034**a	-0.008 a	0.1 a	-0.3**a	0.1 a
Storm resistant	-0.06**a	-0.06**a	-0.04* a	-0.02 a	-0.06* a	0.05*a	-0.022**ab	-0.039**a	-0.010†ab	-0.0 a	-0.3**a	0.1 a
Open-boll	-0.06**a	-0.09**a	-0.05* a	-0.01 a	-0.02 a	0.04*a	-0.034**b	-0.068**b	-0.022**b	-0.2**b	-0.8**b	-0.1 a
Trait (Over boll types and cultivars)												
See column heading	-0.06**	-0.07**	-0.04**	-0.02†	-0.04**	0.04**	-0.023**	-0.047**	-0.012**	-0.1	-0.5**	0.0

†, *, **Significant at the 0.10, 0.05, and 0.01 levels of probability, respectively.

‡ Coefficients for boll types (over cultivars) within a column followed by the same letter were not significantly different at the 0.05 level of probability.

Table 7. Linear regression coefficients for fiber quality by cultivars, by boll types (over cultivars), and by traits (over boll types and cultivars) in each year.

Type of coefficient	2.5% span length 1977	2.5% span length 1978	2.5% span length 1979	50% span length 1977	50% span length 1978	50% span length 1979	Uniformity index 1977	Uniformity index 1978	Uniformity index 1979	Micronaire 1977	Micronaire 1978	Micronaire 1979	T_0 fiber strength 1977	T_0 fiber strength 1978	T_0 fiber strength 1979	T_1 fiber strength 1977	T_1 fiber strength 1978	T_1 fiber strength 1979
	mm						%			μg/in			mN/tex					
Cultivar																		
Westburn M	0.07	-0.13**	0.01	0.03	-0.09**	-0.04	-0.01	-0.13†	-0.15*	-0.02	-0.00	0.02	0.1	-0.0	1.0†	-0.5	-1.8*	0.4
GSA-71	-0.02	-0.11*	0.06	-0.04	-0.07**	-0.04	-0.11	-0.04	-0.15*	-0.34**	-0.03*	0.02	-1.3	-1.6	-1.8†	0.7	-0.4	-1.5*
Paymaster 202	0.01	-0.13**	0.01	-0.02	-0.06**	-0.02	-0.10	-0.07	-0.09	-0.06**	-0.02	-0.00	-3.5	-0.4†	-1.4	0.9	-2.1**	-0.8
Rilcot 90A	0.08	-0.12**	0.03	-0.03	-0.06**	-0.05*	-0.15	0.01	-0.27**	-0.07**	-0.02	0.00	-1.4	2.1†	-2.0	0.8	-2.3**	-0.9
Lankart LX 571	0.03	-0.16**	0.03	-0.04	-0.13**	-0.01	-0.22**	-0.21**	-0.10	-0.08**	-0.01	0.00	-3.4**	-0.1	-0.6†	-0.3	-1.4*	-0.3
Stripper 31A	0.04	-0.08*	0.02	0.02	-0.05**	-0.05*	0.01	-0.04	-0.22**	-0.03	-0.01	0.00	-3.5**	-0.3	-2.2†	-1.5*	-0.4	-0.5
Lockett BxL	0.06	-0.06	0.01	0.04	-0.09*	-0.05	0.06	-0.22**	-0.14†	-0.06**	-0.03*	-0.00	1.0	1.1	-0.5	1.7*	-0.3	-0.4
Deltapine Land SR-4	0.06	-0.06	0.02	0.00	-0.03	-0.04	-0.11	-0.06	-0.20*	-0.05**	-0.00	0.04	0.1	0.3	-0.1	0.8	-0.7	-0.5†
Deltapine Land 61	0.08	-0.10*	-0.03	-0.03	-0.09**	-0.07*	-0.16	-0.15*	-0.19**	-0.08**	-0.05**	0.03†	-0.8	-0.3	-4.5**	-0.4	-0.5	-1.5
Stoneville 256	0.07	-0.10*	-0.04	0.02	-0.11**	-0.12**	-0.05	-0.23**	-0.35**	-0.08**	-0.03*	-0.03	0.1	-2.6*	-0.4	0.3	-2.0**	-2.1**
Coker 310	0.05	-0.13*	-0.01	0.01	-0.09**	-0.10**	-0.04	-0.12	-0.33**	-0.03	0.01	-0.01	-1.7	0.8	-1.7	-0.7	-1.7*	-1.7*
Delcot 277	0.04	-0.01	-0.00	-0.03	-0.05	-0.04	-0.18†	-0.22**	-0.13	-0.06**	-0.03	0.00	-0.4	2.6*	-4.1	-0.3	-0.1	0.2
Boll type (Over cultivars)																		
Stormproof	0.02 a‡	-0.13**a	0.01 a	-0.01 a	-0.08**a	-0.04**a	-0.09‡a	-0.06† a	-0.17**a	-0.05**a	-0.02† a	0.01 a	-0.8 a	0.8 a	-1.1† ab	0.5 a	-1.6**a	-0.7 a
Storm resistant	0.05*a	-0.09**a	0.02 a	0.01 a	-0.07**a	-0.04**a	-0.06† a	-0.13**b	-0.17**a	-0.06**a	-0.01† a	0.01 a	-1.5*a	0.3 a	-0.9 a	0.2 a	-0.7 a	-0.4 a
Open-boll	0.08 a	-0.09**a	-0.02 a	-0.01 a	-0.09**a	-0.08**b	-0.11*a	-0.18**b	-0.25**a	-0.07**a	-0.03**a	0.00 a	-0.7 a	-0.0 a	-2.7**b	-0.3 a	-1.1**a	-1.3*a
Trait (Over boll types and cultivars)																		
See column heading	0.04*	-0.10**	0.00	-0.00	-0.08**	-0.05**	-0.09**	-0.12**	-0.19**	-0.06**	-0.02**	0.01	-1.0**	0.4	-1.5**	0.1	-1.1**	-0.8**

†, *, **Significant at the 0.10, 0.05, and 0.01 levels of probability, respectively.

‡ Coefficients for boll types (over cultivars) within a column followed by the same letter were not significantly different at the 0.05 level of probability.

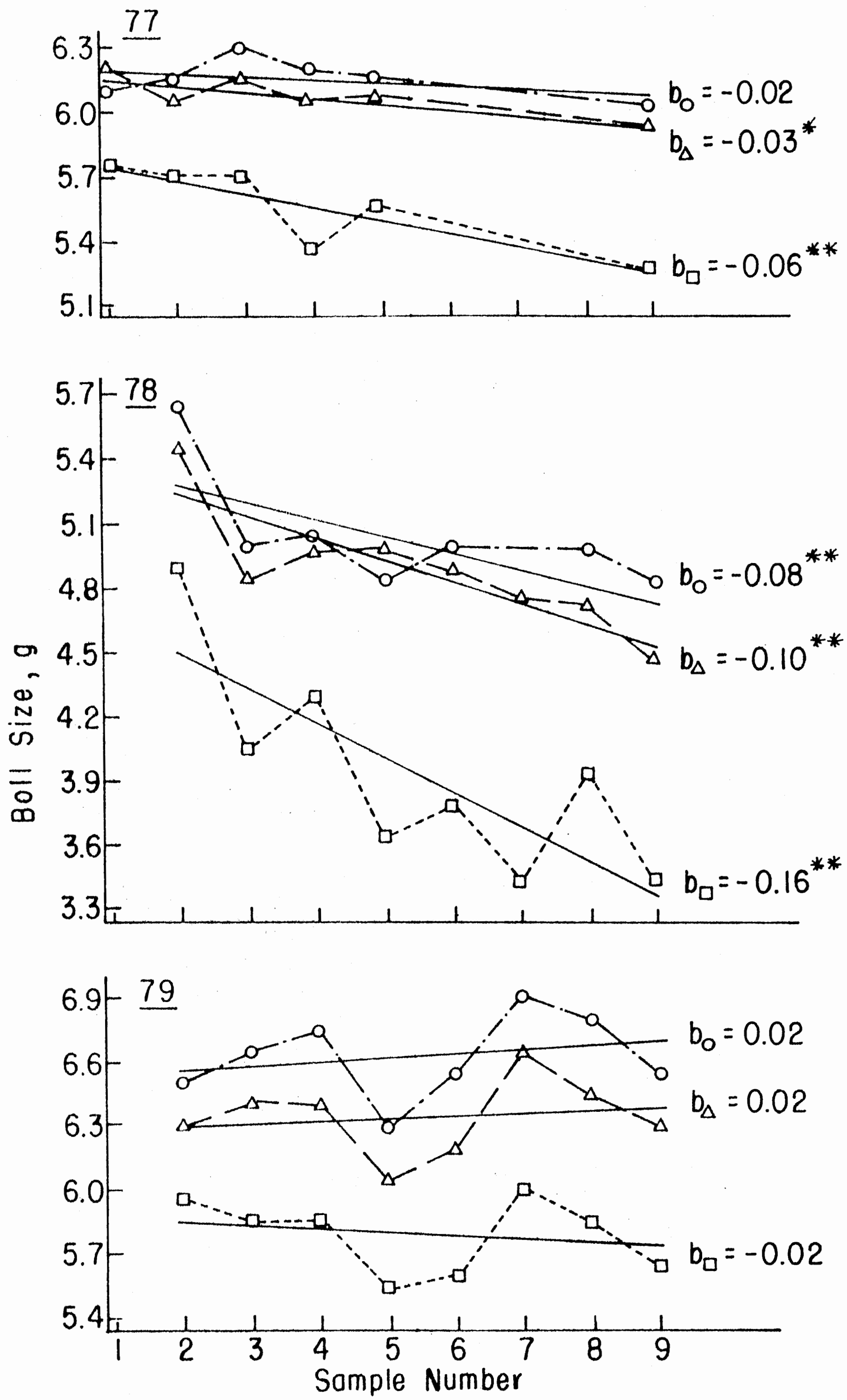

Fig. 1. Mean boll size by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1979; their linear regression coefficients; and regression lines.

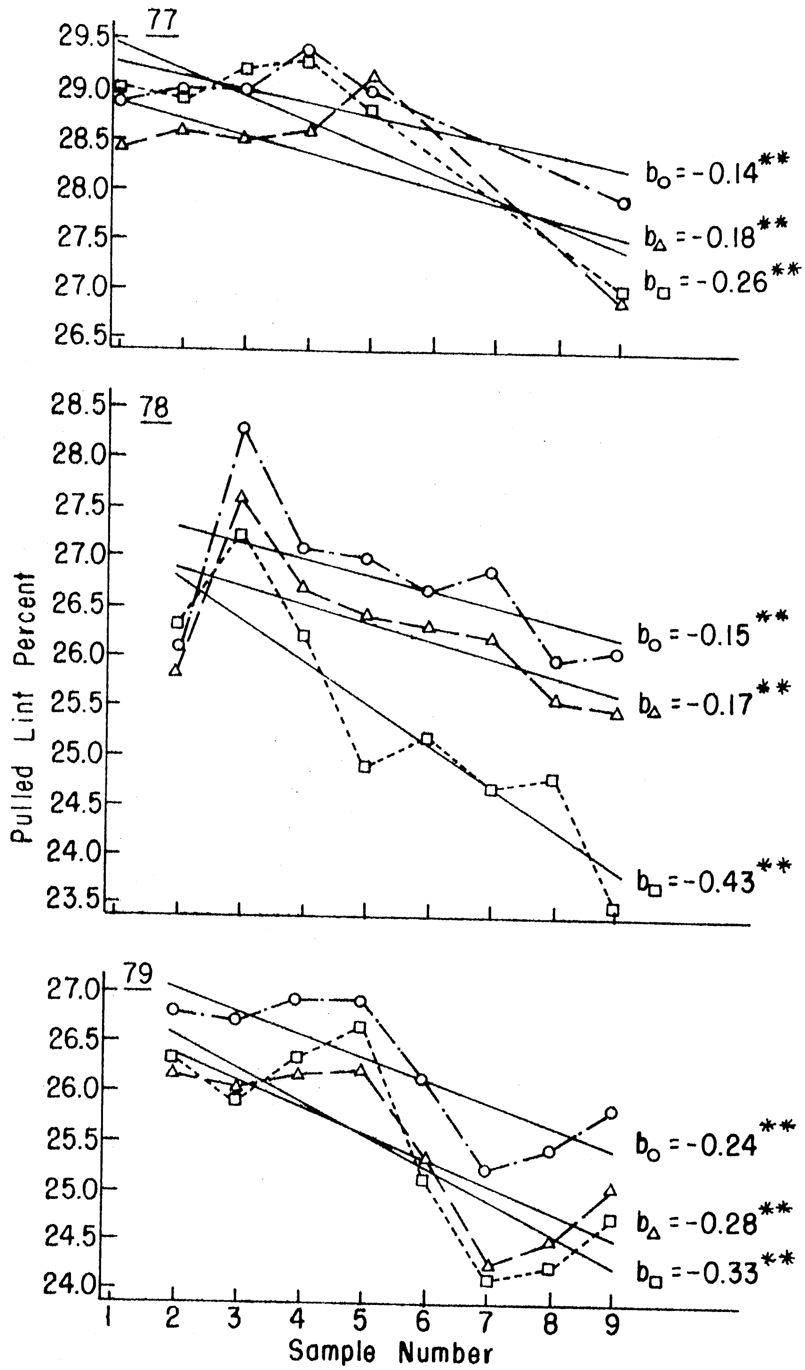

Fig. 2. Mean pulled lint percent by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1979; their linear regression coefficients; and regression lines.

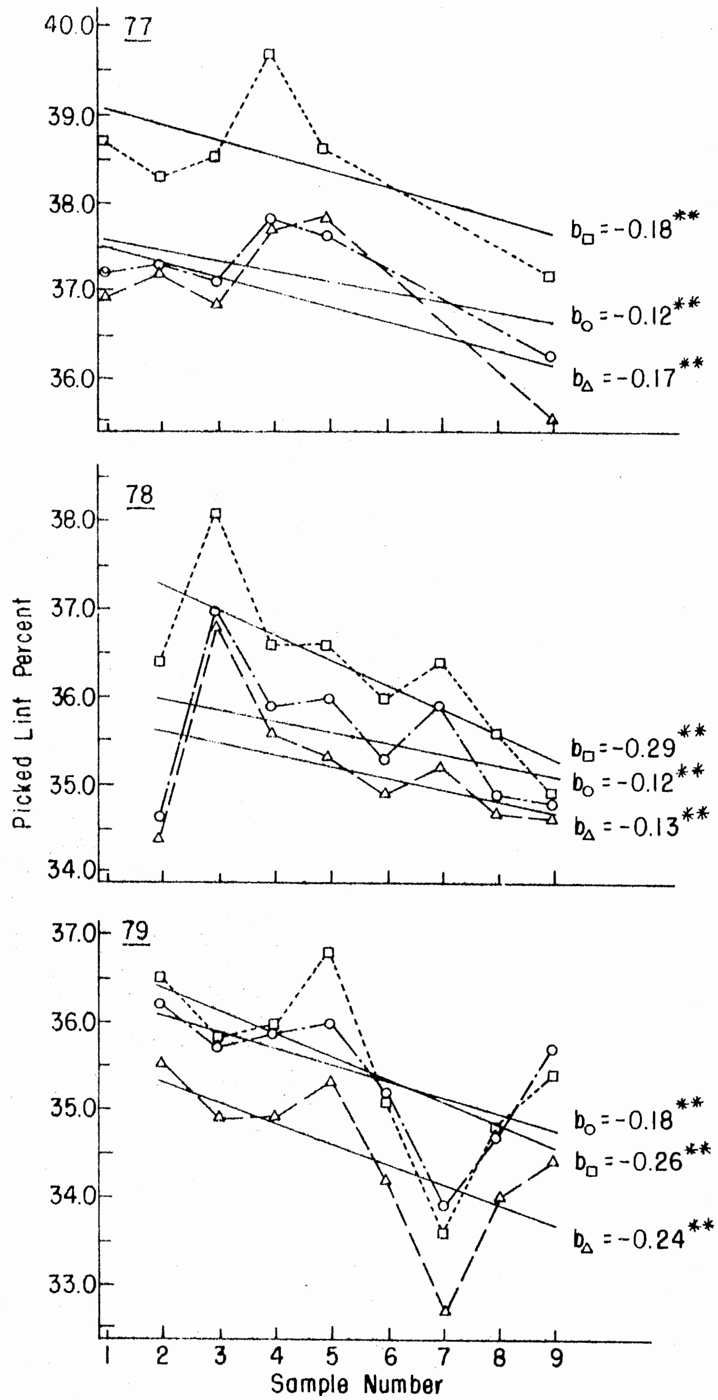

Fig. 3. Mean picked lint percent by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1979; their linear regression coefficients; and regression lines.

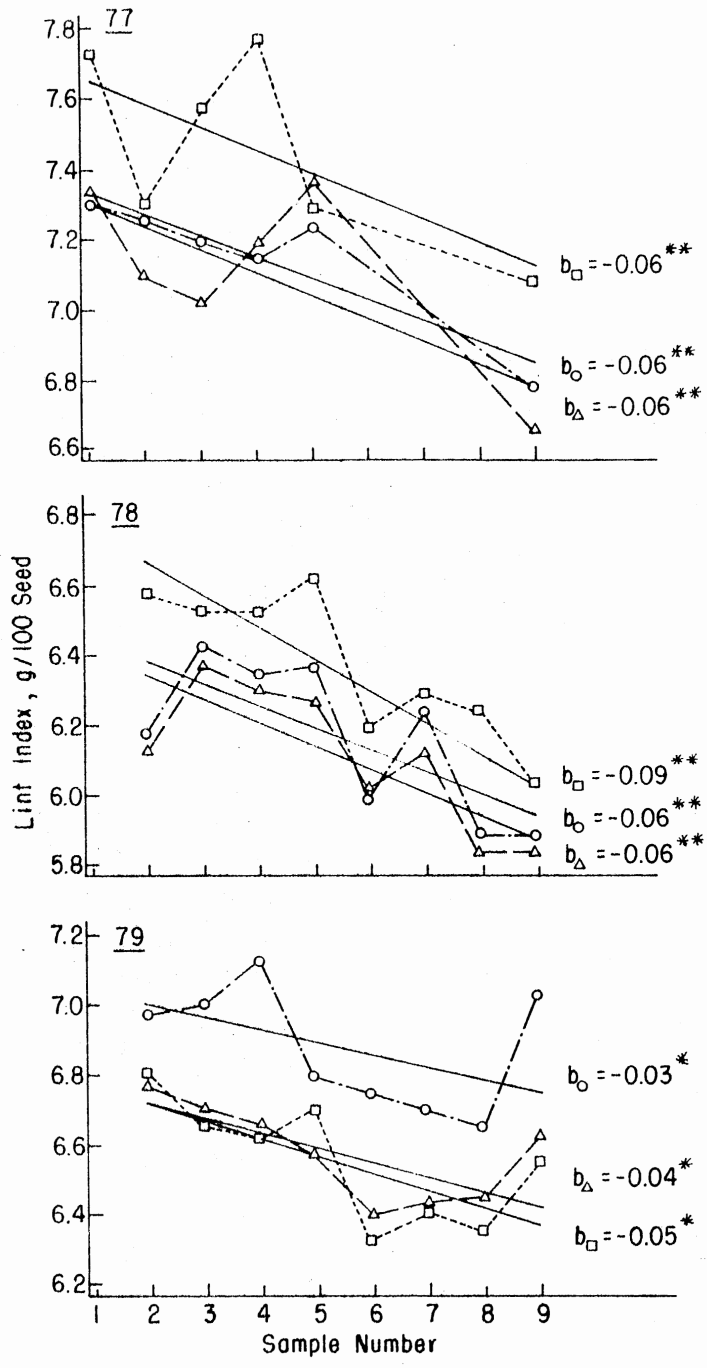

Fig. 4. Mean lint index by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1979; their linear regression coefficients; and regression lines.

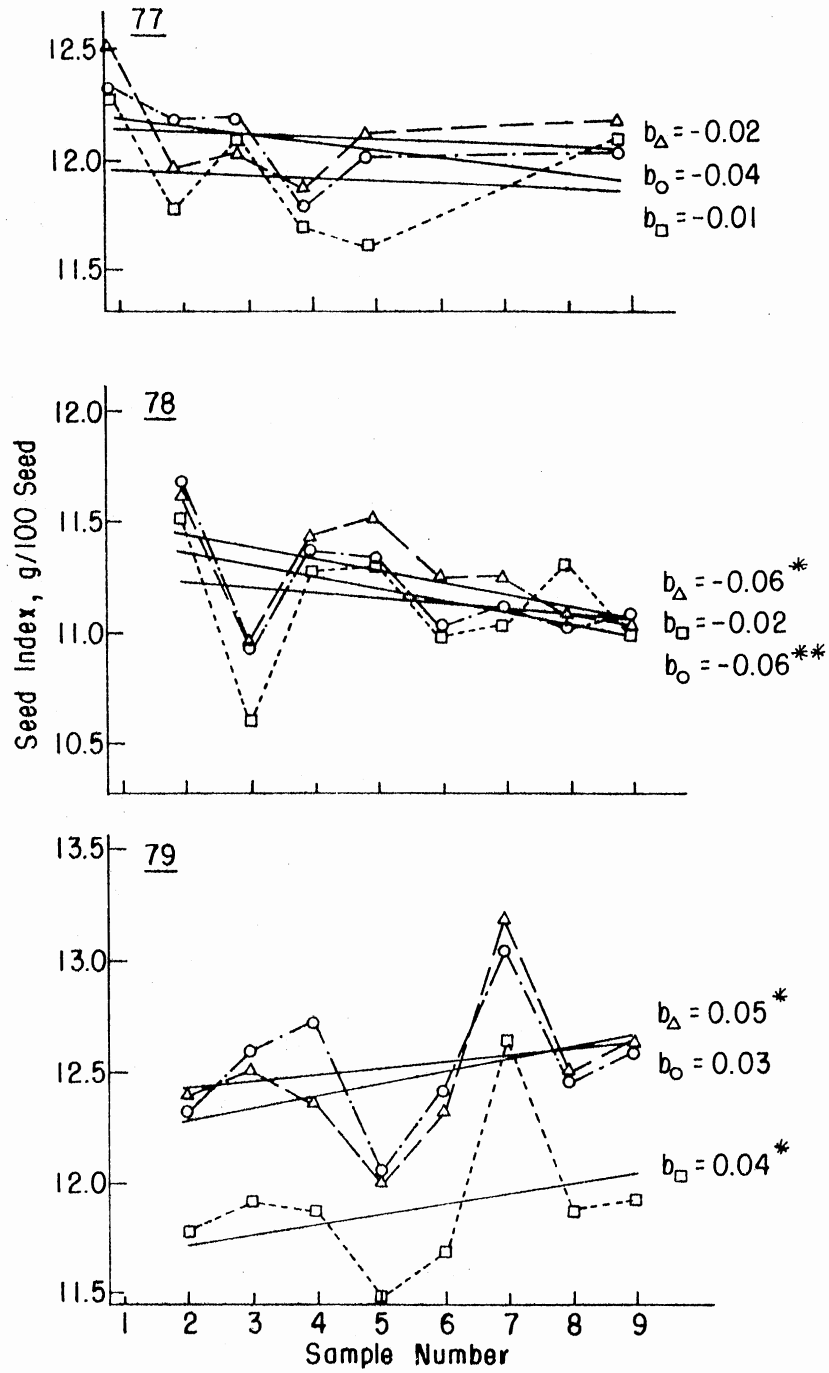

Fig. 5. Mean seed index by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1949; their linear regression coefficients; and regression lines.

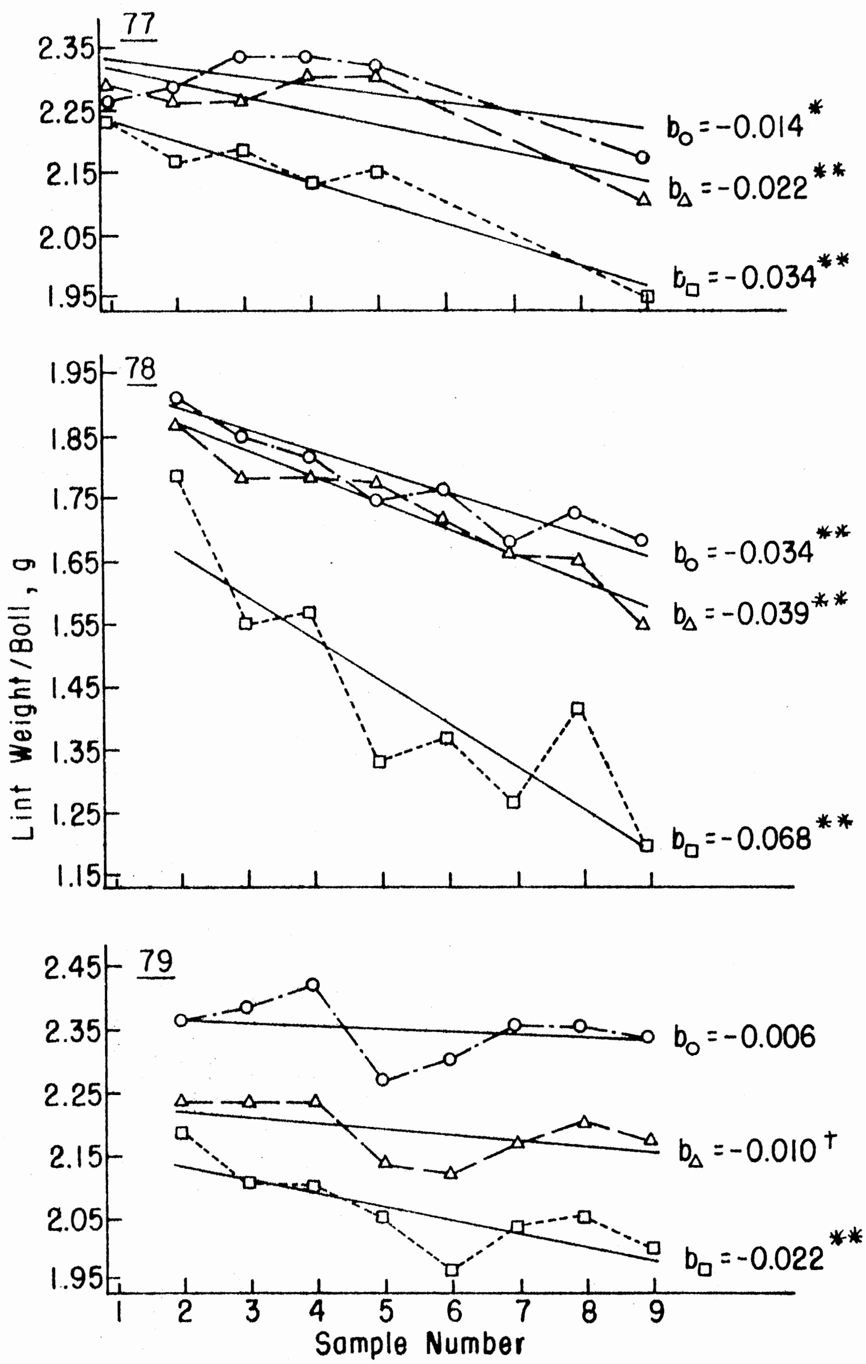

Fig. 6. Mean lint weight/boll by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1979; their linear regression coefficients; and regression lines.

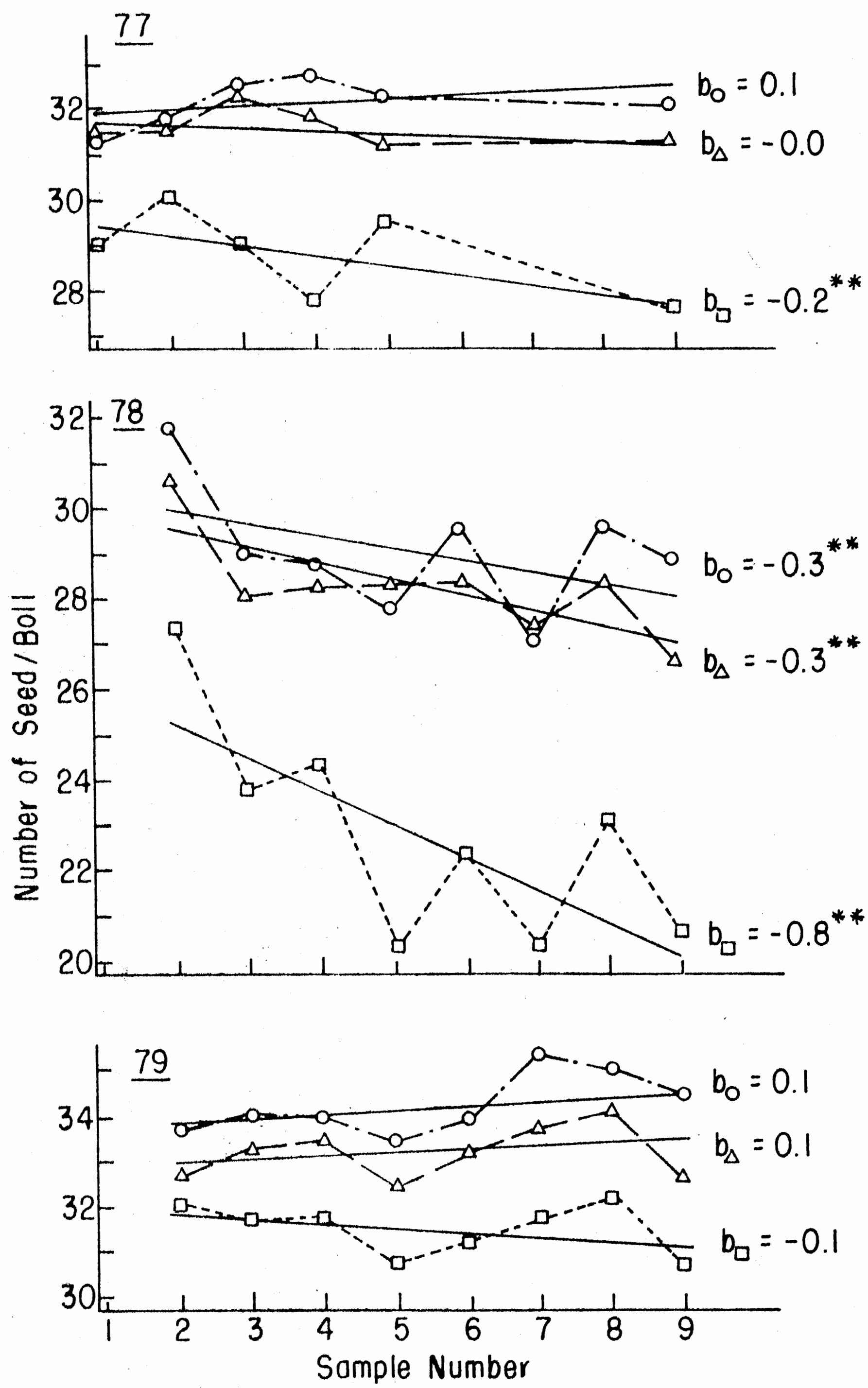

Fig. 7. Mean number of seed/boll by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1979; their linear regression coefficients; and regression lines.

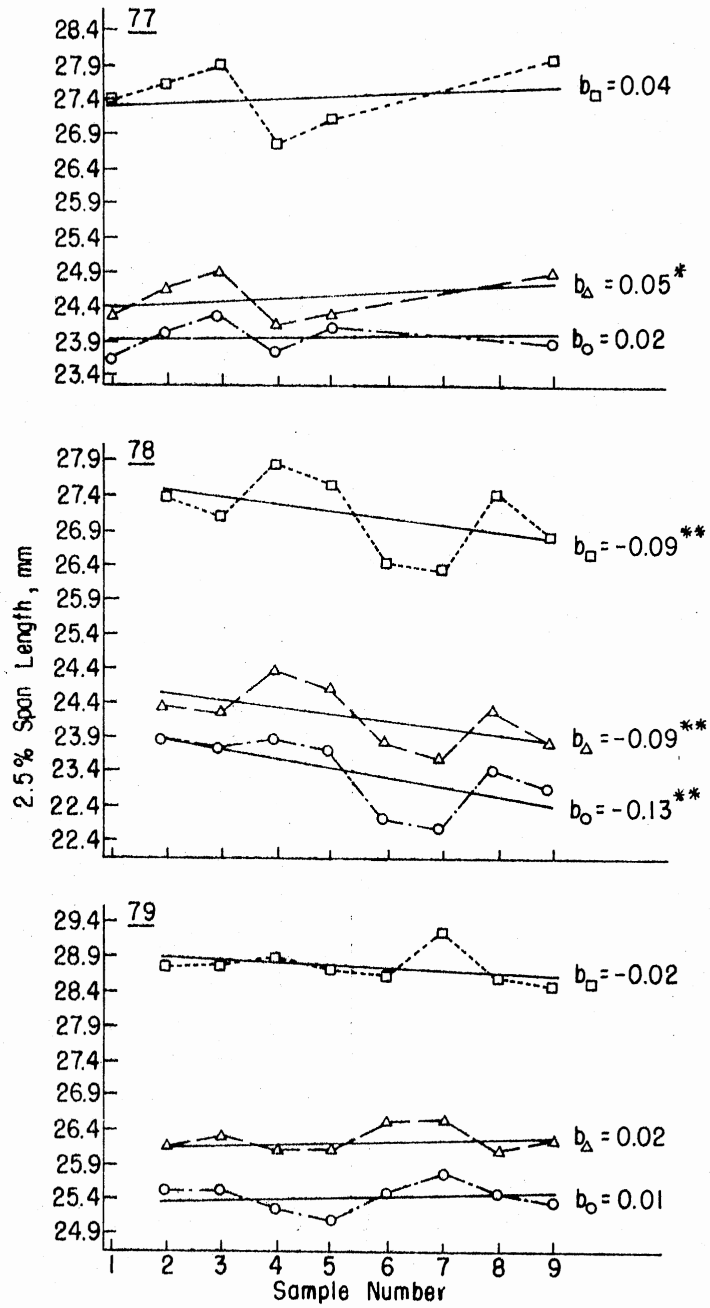

Fig. 8. Mean 2.5% span length by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1979; their linear regression coefficients; and regression lines.

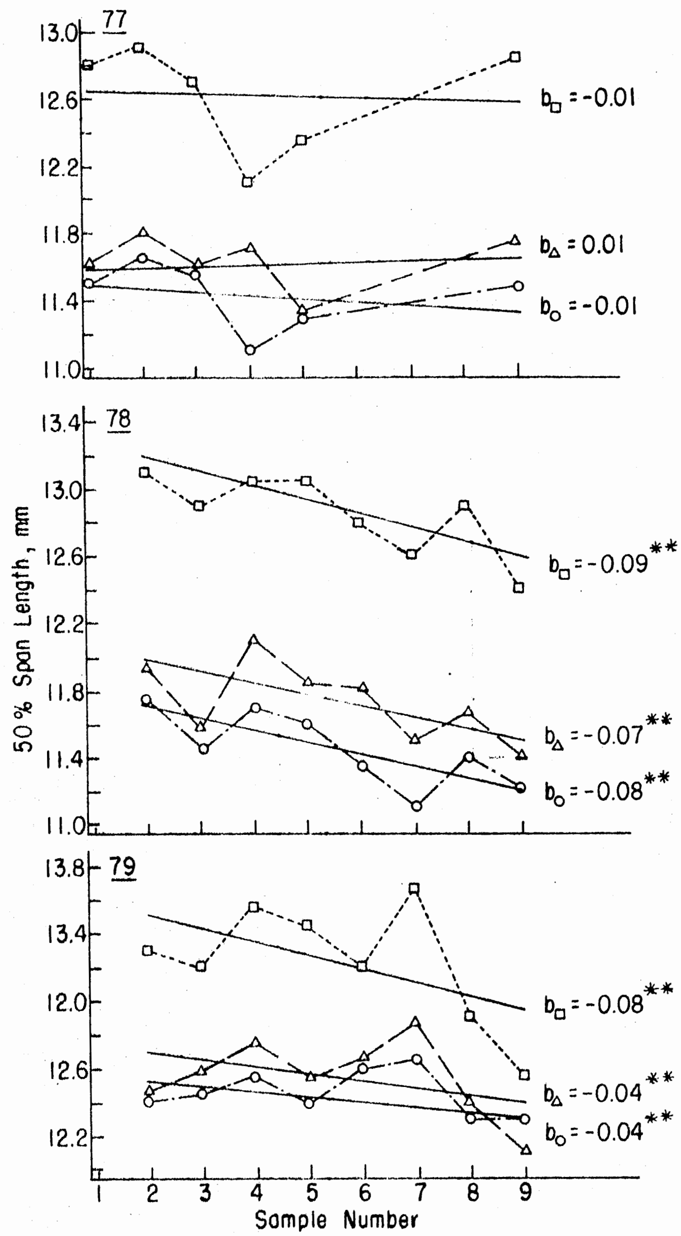

Fig. 9. Mean 50% span length by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1979; their linear regression coefficients; and regression lines.

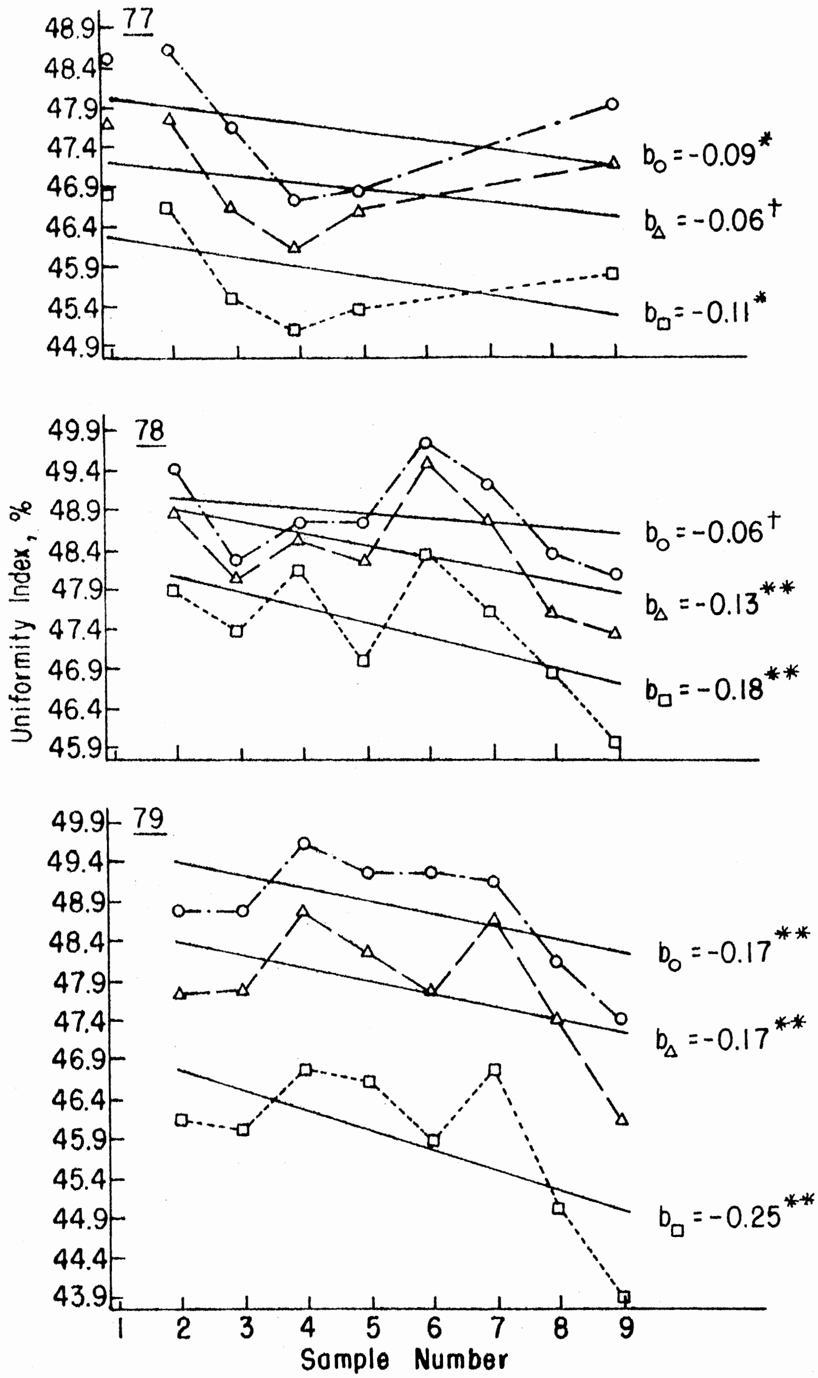

Fig. 10. Mean uniformity index by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1979; their linear regression coefficients; and regression lines.

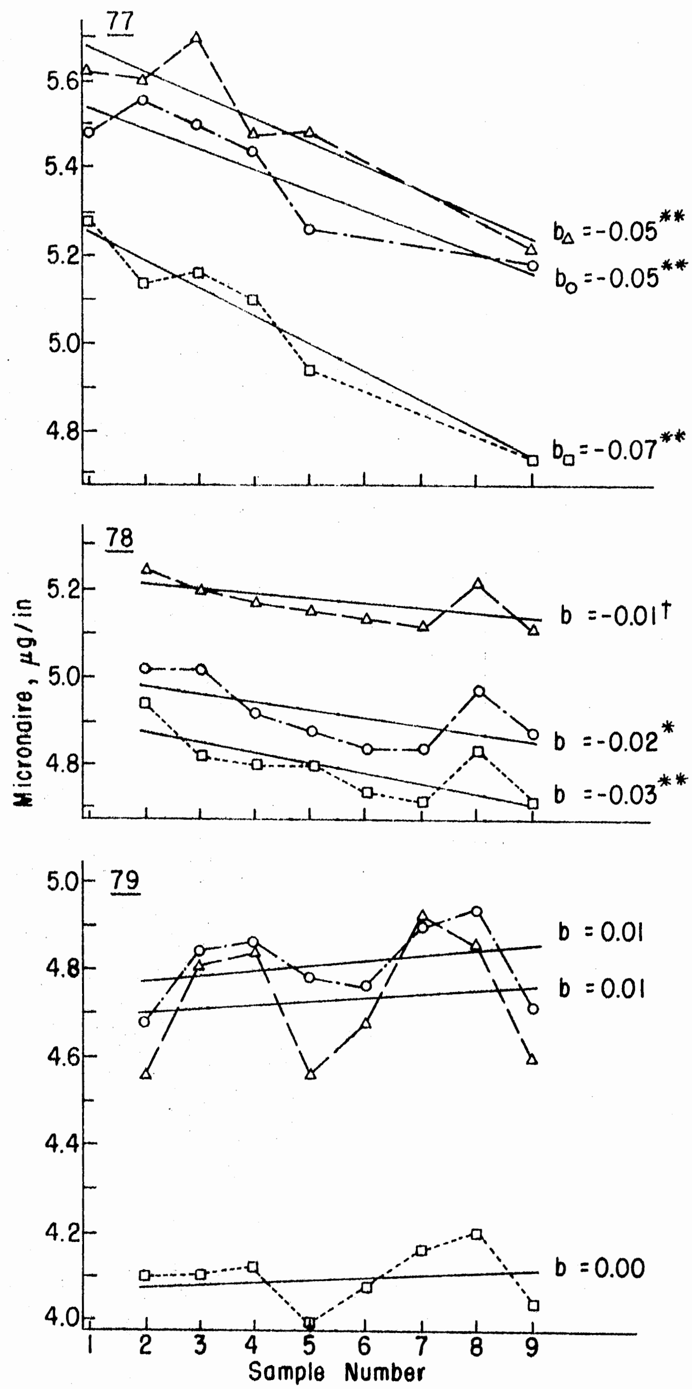

Fig. 11. Mean micronaire by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1979; their linear regression coefficients; and regression lines.

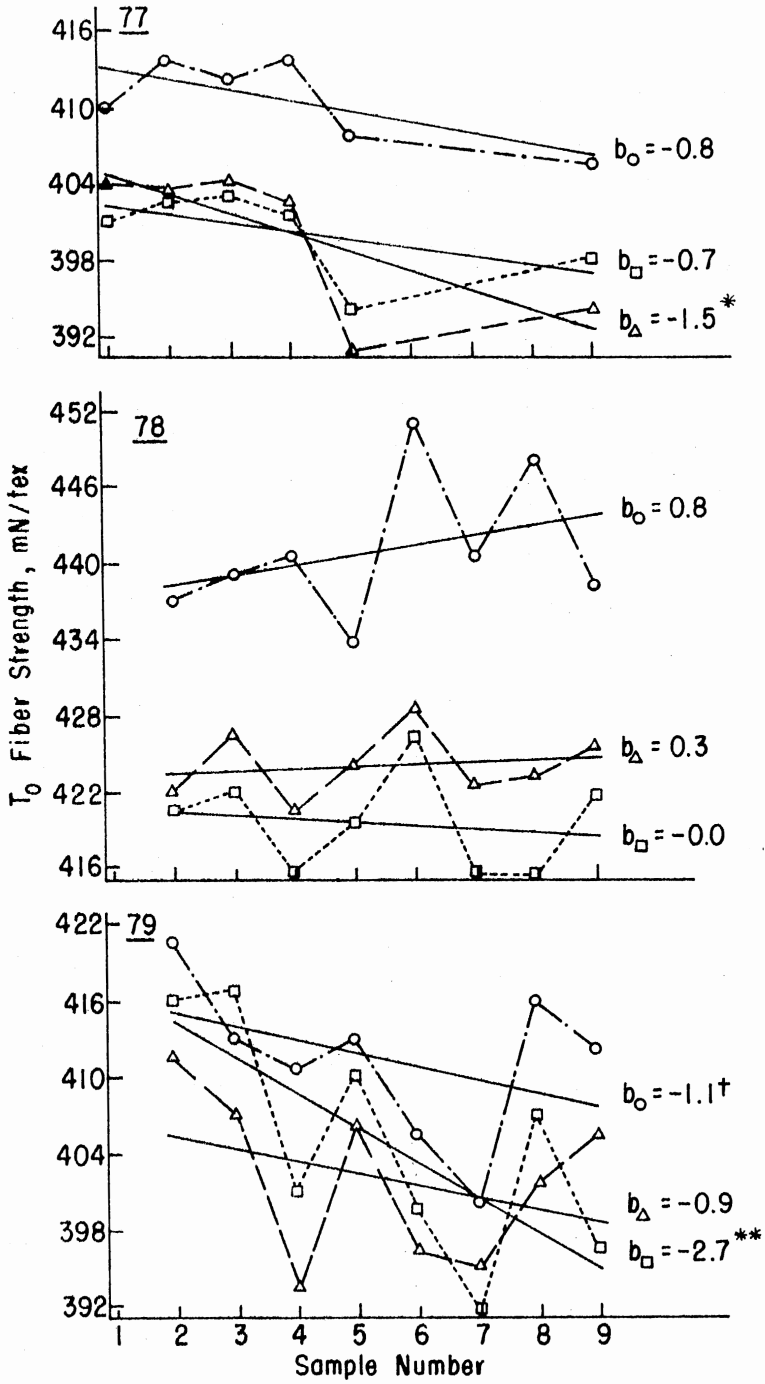

Fig. 12. Mean T_0 fiber strength by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1979; their linear regression coefficients; and regression lines.

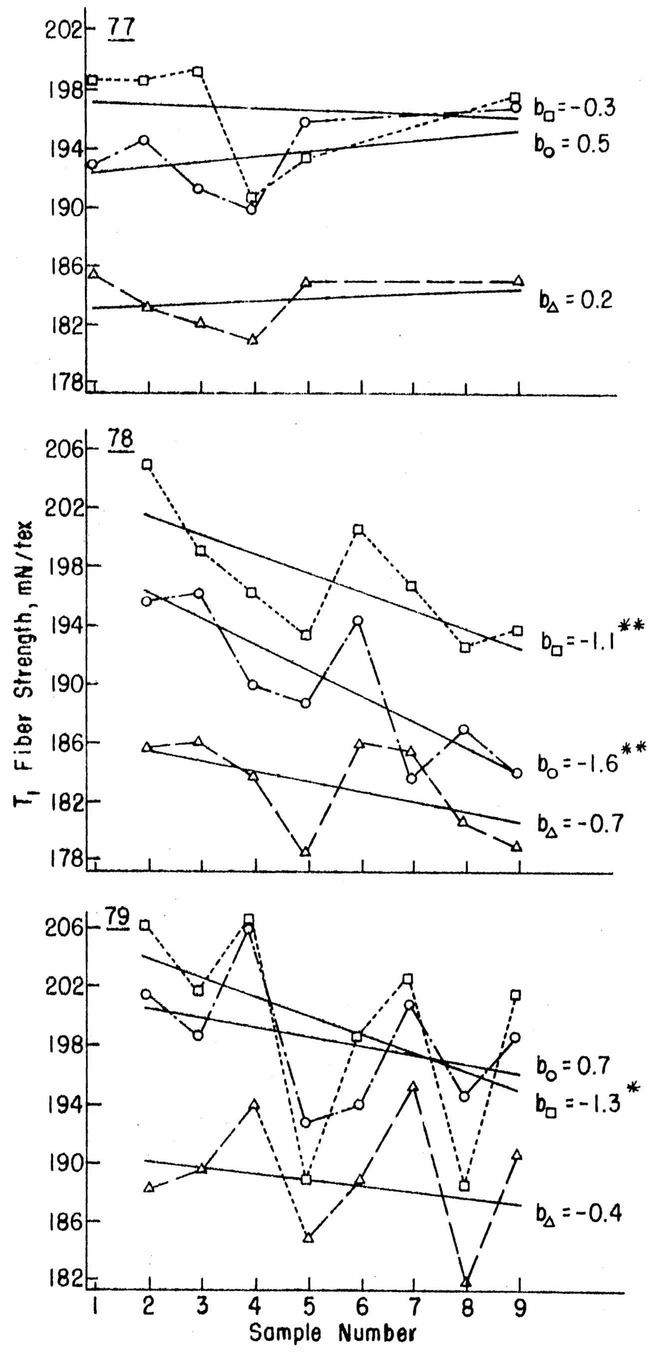

Fig. 13. Mean T_1 fiber strength by sample number in stormproof (○), storm resistant (△), and open-boll (□) cottons in 1977, 1978, and 1979; their linear regression coefficients; and regression lines.

VITA

Gholam Abbas Ranjbar

Candidate for the Degree of

Doctor of Philosophy

Thesis: EFFECTS OF DELAYED HARVEST, CULTIVAR, AND BOLL TYPE ON WEATHERING DAMAGE TO YIELD-RELATED TRAITS AND FIBER QUALITY IN UPLAND COTTON

Major Field: Crop Science Minor Field: Statistics

Biographical:

Personal Data: Born October 13, 1947, in Darab, Iran, the son of Javad and Fatemah Ranjbar.

Education: Graduated from Hemat High School, Shiraz, Iran, in May, 1966; received the Licentiate degree in Agronomy from Tehran University, Karadj, Iran, in June, 1970; received the Master of Science degree in Agronomy from Oklahoma State University in December, 1976; and completed requirements for the Doctor of Philosophy degree in Crop Science (with a minor in Statistics) from Oklahoma State University in December, 1980.

Professional Experience: Served in the Agricultural Extension Corps as a part of Military Service in 1970-1972; and employed by Extension Organization, Ministry of Agriculture, as Agronomy Affairs Expert in 1972-1974.

Member: Honor Society of Phi Kappa Phi, American Society of Agronomy, and Crop Science Society of America.