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Correlation studies on yield and fibre traits in upland cotton (*Gossypium hirsutum* L.)*

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Summary. Two diverse parents of upland cotton namely J.34 and I.C. 1926 were crossed. A comparison between biparental intermated progenies and F_3 families indicated alteration of correlation coefficient between yield and halo length. The significant negative correlation in F_3 population between these two attributes changed to a positive but non significant one in biparental intermated progenies. A change in correlation coefficients was expected due to breakage of linkage upon intermating. An increase in the correlation coefficients could also be expected when linkages are predominantly in the repulsion phase. It is suggested that intermating in early generations coupled with selection of desirable segregants may prove a useful method for improving yield and quality simultaneously. The diallel selective mating system may also supplement intermating to improve yield and quality in cotton.

Key words: *Gossypium hirsutum* L. – Fibre traits – Correlations

Introduction

Fibre quality in cotton is equally as important as yield and involves growers, ginners and the textile industry simultaneously. A variety, good in yield but lacking in fibre quality may not find a place with the textile industry while a poor yielder variety will never be preferred by farmers. A high ginning percentage is advantageous to the ginning trade. It is, thus, very important to improve quality along with yield in cotton for a wider acceptability of a new variety. To affect this simultaneous improvement, an understanding of the nature and of the magnitude of the association of yield and fibre traits is necessary. The present study was, therefore, undertaken to assess the degree of association among quality traits and yield, to study the effect of intermating on these associations and to compare the F_3 and biparental populations.

Materials and methods

Two strains, J.34 and I.C. 1926, of different origins, were crossed. The F_1 was raised from the seed and bulk seed was harvested. A large F_2 population was grown from the bulk seed of the F_1 in the following season. Plants were selected randomly for intermating according to the North Carolina mating design-I. In all, 8 sets comprising 16 progenies each were prepared using 4 males and 16 females for each set. Thus, 128 biparental progenies were produced. Their parents (32 males and 128 females) were also selfed simultaneously to obtain an F_3 population. The 2 populations thus created were sown in a randomized block design with three repeats in two separate experiments in the same field. Within the random block design, 16 biparental intermated progenies in each set were randomized among themselves as a separate unit. The 8 sets were also randomized in each block. Thus, the total field arrangement was composed of 8 independent units, each unit being devoted to different set of progenies. Similarly in the F_3 experiment 20 selfed families (16 females and 4 males) were treated as 1 unit (set) and randomized among themselves. These 8 units of F_3 families were also randomized in each block. Each plot comprised a single row of 10 plants each spaced 30 cm apart. Space between 2 plots was kept 60 cm. Data were recorded on 5 randomly selected plants for seed cotton yield, ginning percentage, lint index, halo (fibre) length, fibre fineness and fibre maturity coefficient. The analysis of variance was carried out as suggested by Comstock and Robinson (1952) and Singh and Chaudhary (1977). Genotypic and phenotypic correlation coefficients were calculated as described by Al-Jiboury et al. (1958).

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Table 1. Analysis of variance for yield and quality characters in biparental progenies of upland cotton (*Gossypium hirsutum* L.)

Source of variation	d.f.	Yield/ plant	Ginning percentage	Lint index	Halo length	Fibre fineness	Fibre maturity coefficient
Sets	7	6,028.1	29.7	2.66	27.4	12,132.0	0.0784
Replications in sets	16	3,624.2	81.9	1.60	4.7	4,569.2	0.0313
Males in sets	24	596.9*	9.9**	0.97**	24.3**	2,917.3**	0.0192**
Females in males in sets	96	545.6**	4.9**	0.44**	9.9**	1,225.4**	0.0082**
Replications × female	240	536.4**	2.1**	0.28**	5.8**	873.6**	0.0034**
Error	1,536	388.4	1.4	0.19	2.0	32.2	0.0003

*, ** Significant at 0.05 and 0.01 probability levels, respectively

Table 2. Analysis of variance for yield and quality characters in F_3 families in upland cotton (*Gossypium hirsutum* L.)

Source of variation	d.f.	Yield/ plant	Ginning percentage	Lint index	Halo length	Fibre fineness	Fibre maturity coefficient
Sets	7	2,470.7	5.37	0.50	2.61	2,665.1	0.020
Replications in sets	16	1,006.2**	29.11**	0.50**	6.41*	1,024.4**	0.008**
F_3 progenies in sets	152	145.4**	2.82*	0.14*	3.30	299.2*	0.003*
Error	304	71.7	2.20	0.12	3.22	212.5	0.002

*, ** Significant at 0.05 and 0.01 probability levels, respectively

Table 3. Genotypic and phenotypic correlation coefficients among yield and quality characters in biparental intermated progenies of upland cotton (*Gossypium hirsutum* L.)

Sr. no.	Characters		Ginning %	Lint index	Fibre length	Fibre fineness	Fibre maturity coefficient
1.	Yield	g	0.401	0.376	−0.453	0.386	0.312
		p	0.144**	0.171**	0.043	0.035	0.009
2.	Ginning percentage	g		0.759	−0.566	0.472	0.497
		p		0.141**	−0.194**	0.110*	0.080
3.	Lint index	g			0.096	0.304	0.316
		p			0.115*	0.076	0.052
4.	Fibre length	g				−0.405	−0.461
		p				−0.090	−0.088
5.	Fibre fineness	g					0.915
		p					0.680**

g = genotypic, p = phenotypic
*, ** Significant at 0.05 and 0.01 probability levels, respectively

Results and discussion

Randomized block design analysis (ignoring sets) for biparental intermated progenies and F_3 families showed enough variability for further selection. Analysis of variance for mating design in biparental intermated progenies and F_3 families (Tables 1 and 2) shows that males in sets and F_3s in sets were significant to highly significant indicating that there was enough additive genetic variability for further exploitation. Males in females in sets (Table 1) were also significant to highly significant, demonstrating the presence of dominance variance.

It was observed that genotypic correlations in general were higher than corresponding phenotypic correlations in intermated progenies (Table 3) and F_3 families (Table 4). This was in agreement with the results obtained by Sing et al. (1968) and several others. Phenotypic association in biparental intermated progenies

Table 4. Genotypic and phenotypic correlation coefficients among yield and quality characters in F_3 families of upland cotton (*Gossypium hirsutum* L.)

Sr. no.	Characters		Ginning %	Lint index	Fibre length	Fibre fineness	Fibre maturity coefficient
1.	Yield	g	0.218	0.184	−0.840	−0.183	0.196
		p	−0.126*	−0.099*	−0.135**	−0.087	−0.104*
2.	Ginning percentage	g		0.539	−0.889	0.265	0.279
		p		0.124*	−0.348*	0.068	−0.099*
3.	Lint index	g			0.062	0.121	0.297
		p			0.091	−0.137**	0.035
4.	Fibre length	g				−0.847	−0.616
		p				−0.109*	−0.098*
5.	Fibre fineness	g					0.803
		p					0.357**

g = genotypic, p = phenotypic
*, ** Significant at 0.05 and 0.01 probability levels, respectively

showed that the yield had a strong positive correlation with ginning percentage and lint index. Fibre length, fibre fineness and fibre maturity coefficient had positive but non-significant correlations with this character. The phenotypic correlation coefficients in F_3 families were quite different.

Yield had a significant negative correlation with all the above characters except fibre fineness where it was negative but non-significant. Thus, it appears that in intermated progenies, some undesirable, repulsion phase linkages have emerged with intermating and new combinations have formed. Contrary to the previous reports of Miller and Rawlings (1967) of adverse correlated response betweeen yield and quality traits, it has been found that considerable improvement in the association between characters had taken place in intermated progenies. Fibre length, for example, in F_3 families had highly significant negative correlation with yield (Table 4) but this inverse correlation was reduced to almost half at the genotypic level and was positive but non-significant at the phenotypic level in intermated progenies (Table 3).

Ginning percentage had a significant and positive association with lint index and fibre fineness but had a highly significant negative correlation with fibre length in intermated progenies. In F_3 families these associations were little different. It was noteworthy that F_3s' ginning percentage was significant but negatively correlated with the fibre maturity coefficient while this association was positive but non-significant in intermated progenies. Similarly, fibre fineness was significantly negatively associated with lint index in F_3s while a positive non-significant correlation was observed between these two characters in intermated progenies. Fibre length had a significant negative association with fibre fineness and fibre maturity in F_3s but it changed to a non-significant negative association upon intermating. Feaster and Turcotte (1968), however, reported that yield was not associated with ginning percentage or its components and was positively correlated with fibre length.

Keeping in mind the change in association, though marginal, in yield and fibre traits upon intermating, it could be said that a few more cycles of planned intermating could dissipate the negative association among fibre characters and seed cotton yield and that a simultaneous improvement in yield and quality would be possible. Character association in these populations may be explained on the basis of linkage and pleiotropy. In the case where the favourable and unfavourable genes are linked together, it is expected that with the breakage of linkage by intermating in the F_2 or further segregating generations or in a population where linkage is at equilibrium, the negative associations are likely to be minimised. Thus, in the present investigation the reduction or complete disappearance of negative associations in intermated progenies as compared to plain F_3 families may be due to the breakage of linkage upon intermating in biparental progenies. Meredith and Bridge (1971) compared the character association in an original and the intermated population of upland cotton and showed that the negative genetic correlation between lint yield and fibre strength was decreased by intermating. They also observed an increase in one or two character associations in the intermated population. This was explained on the basis of the linkage involved. An increase in a genetic correlation coefficient can be obtained if linkages were in a predominant repulsion phase. Similar results were reported by Miller and Rawlings (1967) and Bains (1971) in an intermated population of a cross in upland cotton.

It is therefore suggested that intermating in early generations coupled with selection of desirable segregants in the following generations and repeating the procedure till desired results are obtained may prove to be a breeding method by which a rational improvement in yield and quality could be achieved. Another method which could also bring desired results after intermating may be a diallel selective mating system as suggested by Jensen (1970). This could supplement intermating in the further handling of segregants and achieve a greater genetic advance through selection.

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