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A Correlation and Path Coefficient Analysis of Components in *G. hirsutum* L. Hybrids by Usual and Fibre Quality Grouping

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Abstract: Improvement in fibre length is important for the textile industry in utilising high speed yarn spinning technology and in expanding the array of yarn products. High tensile strength fibre is needed for good spinning, especially with fast modern spinning machines. The usual practice of estimating correlation coefficients and the direct and indirect effects of component traits of seed cotton yield is without grouping the genetic material on the basis of fibre length and strength. Hence, the present investigation was carried out on these aspects by grouping the 20 F_1 hybrids into 3 sets on the basis of fibre length and strength, viz, (i) 10 hybrids of low fibre strength (≤20 g tex^{-1}) and medium staple length (≤25.0 mm), (ii) 10 hybrids of high fibre strength (≥24 g tex^{-1}) and longer fibre length (≥28 mm), and (iv) 20 hybrids, i.e. all the 10 hybrids of set 1 and set 2 of *Gossypium hirsutum* L. cotton for agronomic and fibre quality traits. Significant genotypic difference existed among the hybrids in all the sets for all the characters studied. The direction of association coefficient of the traits and direct effects on seed cotton yield differed for all the traits except for the number of bolls per plant, boll weight and fibre strength in set 1 and set 2. Set 1 gave the same direction of association with seed cotton yield as obtained in set 3 of usual practice except for the traits ginning out turn (GOT) and days to flowering, whereas set 2 gave similar information to the usual practice for the traits days to flowering, total bolls, boll weight and GOT, and differed for other traits. The present study, therefore, indicates that the hybrid population needs to be grouped on the basis of fibre length and fibre strength prior to estimation of correlation coefficients and direct and indirect effects of other traits on seed cotton yield.

Key Words: Cotton, correlation coefficient, direct and indirect effects, fibre quality

Introduction

In India more than 40% of the cultivated area is covered by *Gossypium hirsutum* L. hybrids. For achieving increased production in *G. hirsutum* cotton having high fibre strength and length it is essential to evolve high yielding hybrids with fibre length >28 mm and fibre strength >25 g tex^{-1} as very few such improved hybrids have been evolved so far. Planning of a breeding programme for the development of high fibre strength and high fibre length hybrids requires information on the nature of the association among the characters influencing yield. Path coefficient analysis provides an effective means of finding the direct and indirect causes of the association. Numerous studies (Sambamurthy et al., 1995; Amudha et al., 1996; Sambamurthy and Rao, 1998; Rao, et al., 2001; Kaushik, et al., 2003; Gururajan and Sunder, 2004; Gite et al., 2006) conducted so far are available on the genotypes of varying fibre length and fibre strength as a whole. Information on separate analysis for character association and their partitioning for seed cotton yield and its components in context with high fibre strength and high fibre length and low fibre strength and medium fibre strength is lacking. The present study was conducted to provide information on interrelationships of seed cotton yield with yield components and to partition the genotypic and phenotypic correlations into their direct and indirect effects by grouping the 20 F_1 hybrids on the basis of fibre length and strength.

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Materials and Methods

The experiments, in the 2003-04 and 2004-05 crop seasons, were laid out in a randomised block design on 42 hybrids with 3 replications in plot size of 3 rows each of 5.4 m length. Row to row distance was 100 cm while plants within a row were spaced at 30 cm. Recommended agronomic practices and plant protection measures were undertaken to raise the crop. One hundred gram samples of 42 genotypes of 3 replications were submitted to the Central Institute for Research on Cotton Technology (CIRCOT) unit at Sirsa, Haryana, India, for analysis of fibre quality traits, 2.5% span length (mm) and fibre strength (g tex^{-1}). On the basis of 2 years' (2003 and 2004) fibre quality analysis, it was possible to identify 10 hybrids that had constantly superior medium fibre length (22.73 to 25.07 mm) and fibre strength (18.7 to 20.90 g tex^{-1}), namely CISV-24 x SGNR-16, CISV-24 x CISV-29, RS-2013 x 2-2-3, RS-2013 x SGNR-6, RS-2013 x CIT (7-2) H.77, H-1242 x CISV-29, RS-2083 x RACH-11-3, RS-2083 x SGNR-10, Supriya x SGNR-10 and RS-2013 x PIL-8. Similarly, 10 hybrids, namely H-1242 x 2-2-3, Supriya x PIL-43, GSH-17 x H-1098, TCH-4557 x CISV-24, TCH-4557 x RS-810, 2144CC x CISV-24, TCH-1569 x CISV-24, TCH-1569 x H-1098, TCH-1152 x CISV-24 and CSH-14 x CISV-24, with long fibre length (27.70 to 30.80 mm) and high fibre strength (24.10 to 25.40 g tex^{-1}) were identified as 2 distinct groups or sets.

Ten competitive plants were randomly tagged in each replication of each genotype and observations were recorded on the traits as given in Table 1. The mean values obtained from 2 years' data were used for estimating the analysis of variance as suggested by Panse and Sukhatme (1978). The 20 F_1 hybrids were grouped into 3 sets on the basis of fibre length and strength: (i) set 1: 10 hybrids of low fibre strength ($\leq$20 g tex^{-1}) and medium staple length ($\leq$25.0 mm), (ii) set 2: 10 hybrids of high fibre strength ($\geq$24 g tex^{-1}) and longer fibre length ($\geq$28 mm) and (iii) set 3: 20 hybrids, i.e. all the 10 hybrids of set 1 and set 2 of *G. hirsutum* L. The estimates of phenotypic and genotypic correlation coefficient were worked out separately for each set by using the formulae suggested by Singh and Chaudhary (1985). Genotypic and phenotypic correlations were partitioned into path coefficient using the technique outlined by Dewey and Lu (1959). This technique involves partitioning of the correlation coefficient to determine direct (unidirectional pathways 'P') and indirect influence through alternate pathways (pathway 'P' x correlation coefficient 'r') of various variables over seed cotton yield per plant. Seed cotton yield was considered as the resultant variable and the others as casual variables. The statistical significance of genotypic and phenotypic correlations was calculated according to Fisher and Yates (1938) through a t-test using:

$$t = r\ (n - 2/1 - r^2)^{1/2}$$

where 'r' denotes the correlation coefficient and 'n' is total number of observations. The 't' value was tested against the table value of 't' for 'n – 2' degrees of freedom.

Results and Discussion

The genotypes differed significantly ($P < 0.05$) for all the traits in all the sets, indicating the presence of sufficient genetic variability in the material. The mean performance of various characters is given in Table 1. The correlation coefficients and direct effects of 9 independent variables against seed cotton yield per plant for the material taken in sets 1, 2 and 3 are compared in Table 2. The direct and indirect effects with other characters are presented in Tables 3-5. The character-wise results are presented below.

1. Days to Flowering

Non-significant negative correlations in sets 1 and 3 and positive correlations in set 2 were obtained for this trait with seed cotton yield. The direct effect of days to flowering was negative at both phenotypic and genotypic levels in set 1 and at genotypic level only in sets 2 and 3. The direct effect was positive at phenotypic level in set 2. This indicated that the correlation explained the true relationship in sets 1 and 3, and direct selection through this trait in these sets will be effective as the correlation coefficient between days to flowering and its direct effect is almost equal. However, in set 2 indirect effects seem to be the cause of the correlation and causal factors such as total number of bolls and fibre length should be considered simultaneously for selection of this trait (Table 4). An indirect influence of days to flowering on seed cotton yield was also reported by Muthu et al. (2004).

2. Plant Height

The relationship between seed cotton yield per plant and plant height was positive both at genotypic and phenotypic levels in sets 1 and 3. However, it was

Table 1. Mean performance of the varieties of 2 groups for different characters.

Characters Genotype	Days to flowering	Plant height (cm)	No. of monopodial branches per plant	No. of sympodial branches per plant	No. of total bolls per plant	Boll weight (g)	Seed cotton yield per plant (g)	GOT (%)	Fibre length (mm)	Fibre strength (g per tex)
CISV-24 x SGNR-16	60.50	90.00	1.34	8.34	27.33	3.48	97.83	32.62	24.60	20.80
CISV-24 x CISV-29	71.00	110.84	1.33	8.00	27.67	3.81	75.91	33.35	24.70	20.33
RS-2013 x 2-2-3	72.00	119.34	2.17	10.17	33.67	3.60	108.47	34.00	24.90	2030
RS-2013 x SGNR-6	70.00	122.34	3.83	9.17	54.17	3.10	158.57	35.09	23.10	19.70
RS-2013 x CIT(7-2)H.77	76.00	115.00	3.84	7.34	44.50	3.86	140.18	36.29	22.73	18.50
H-1242 x CISV-29	71.33	118.34	2.56	9.00	37.55	3.70	182.87	33.63	23.50	20.20
RS-2083 x RACH-11-3	76.67	108.00	3.28	10.00	36.67	3.61	73.73	33.46	24.40	20.30
RS-2083 x SGNR-10	71.33	96.34	0.67	10.00	30.84	3.22	61.76	36.99	24.00	20.00
Supriya x SGNR-10	78.33	107.00	1.11	10.89	38.44	3.41	77.44	33.28	24.70	20.70
RS-2013x PIL-8	70.00	105.67	2.22	9.67	47.50	3.38	135.92	32.02	24.20	20.60
H-1242 x 2-2-3	74.33	109.17	3.84	6.83	32.84	3.04	67.63	33.50	28.00	25.20
Supriya x PIL-43	79.00	156.78	6.11	12.78	58.44	3.13	77.78	33.60	30.80	25.40
GSH-17 x H-1098	78.00	134.00	6.43	7.06	51.28	3.47	148.67	33.21	29.07	25.10
TCH-4557 x CISV-24	68.00	134.89	6.10	8.57	47.89	4.04	111.00	34.15	28.60	25.90
TCH-4557 x RS-810	71.67	144.78	5.44	9.21	49.12	4.40	125.33	36.50	28.37	24.40
2144CC x CISV-24	68.67	132.89	3.00	12.77	53.68	3.74	151.78	33.79	28.37	24.40
TCH-1569 x CISV-24	69.00	139.44	3.56	10.23	46.34	3.71	73.59	31.29	28.53	24.77
TCH-1569 x H-1098	71.00	141.33	8.34	9.21	61.56	4.13	54.67	33.21	27.77	24.70
TCH-1152 x CISV-24	76.33	145.00	4.00	13.00	78.00	3.34	190.00	31.65	30.83	24.10
CSH-14 x CISV-24	71.00	114.89	2.34	10.57	43.10	3.73	197.33	33.98	28.27	24.80
CV%	2.70	6.23	18.16	2.90	8.45	4.90	11.25	3.16	0.77	0.64
CD5%	3.12	12.19	1.04	1.98	6.10	0.27	20.80	1.71	0.31	0.2

Table 2. Comparative correlation (X) and direct effects (Y) of different characters on seed cotton yield in cotton at genotypic (G) and phenotypic (P) levels.

Characters	Set 1				Set 2				Set 3			
	G		P		G		P		G		P	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
Days to flowering	-0.11	-0.41	-0.17	-0.30	0.06	-0.26	0.06	0.46	-0.01	-0.11	-0.05	0.08
Plant height (cm)	0.68*	0.77	0.52	0.35	-0.18	-0.69	-0.14	-0.64	0.14	0.93	0.16	0.10
No. of monopodial branches per plant	0.72*	-0.05	0.49	-0.14	-0.52	-1.00	-0.51	-0.86	-0.03	-2.04	-0.05	-0.93
No. of sympodial branches per plant	-0.55	-0.31	-0.11	-0.03	0.35	-0.75	0.33	-0.08	0.15	-1.12	0.19	-0.34
No. of total bolls per plant	0.63*	0.47	0.66*	0.42	0.28	1.34	0.28	0.87	0.38	1.65	0.40	1.11
Boll weight (g)	0.01	0.22	0.11	0.42	0.02	0.25	0.02	0.71	0.03	-0.04	0.07	0.18
GOT (%)	-0.05	0.38	-0.01	-0.01	0.06	0.62	0.05	0.15	-0.02	0.20	0.01	0.11
Fibre length (mm)	-0.70*	-0.66	-0.61	-0.89	0.27	0.86	0.26	0.23	0.07	-0.53	0.07	-0.48
Fibre strength (g per tex)	-0.36	1.18	-0.33	0.62	-0.43	0.12	-0.40	0.25	0.01	0.69	0.01	0.50

*and ** P < 0.05 and 0.01, respectively

Table 3. Direct and indirect effects of various characters on seed cotton yield at genotypic (G) and phenotypic (P) levels in set 1.

Characters		Days to flowering	Plant height (cm)	No. of monopodial branches per plant	No. of sympodial branches per plant	No. of total bolls per plant	Boll weight (g)	GOT (%)	Fibre length (mm)	Fibre strength (g per tex)	Correlation with Seed cotton yield
Days to flowering	**G**	**-0.41**	0.52	-0.01	-0.18	0.15	0.05	0.11	0.09	-0.43	-0.11
	P	**-0.30**	0.07	-0.04	0.00	-0.09	0.10	-0.00	0.11	-0.19	-0.17
Plant height (cm)	**G**	-0.28	**0.77**	-0.04	0.06	0.28	0.07	0.08	0.33	-0.59	0.68
	P	-0.06	**0.35**	-0.07	0.00	0.22	0.03	0.00	0.27	-0.23	0.52
No. of monopodial branches per plant	**G**	-0.09	0.63	**-0.05**	0.09	0.36	0.02	0.08	0.50	-0.82	0.72
	P	-0.10	0.18	**-0.14**	0.01	0.27	0.09	0.00	0.53	-0.35	0.49
No. of sympodial branches per plant	**G**	-0.24	-0.16	0.02	**-0.31**	-0.00	-0.22	-0.07	-0.41	0.83	-0.55
	P	-0.04	0.02	0.05	**-0.03**	0.04	-0.08	0.01	-0.33	0.25	-0.11
No. of total bolls per plant	**G**	-0.13	0.46	-0.04	0.00	**0.47**	-0.12	0.05	0.46	-0.52	0.63
	P	-0.06	0.18	0.09	0.00	**0.42**	-0.07	0.00	0.52	-0.25	0.66
Boll weight (g)	**G**	-0.09	0.26	0.01	0.30	-0.25	**0.22**	-0.07	0.01	-0.37	0.00
	P	-0.07	0.03	-0.03	0.06	-0.07	**0.42**	0.00	-0.04	-0.13	0.11
GOT (%)	**G**	-0.12	0.16	-0.01	-0.05	0.06	-0.04	**0.38**	0.41	-0.95	-0.05
	P	-0.07	0.02	-0.01	0.00	0.04	-0.03	**0.00**	0.48	-0.42	0.00
Fibre length (mm)	**G**	0.06	-0.38	0.04	-0.19	-0.33	0.00	-0.23	**-0.66**	0.99	-0.70
	P	0.04	-0.11	0.08	-0.01	-0.25	0.02	0.00	**-0.89**	0.62	-0.61
Fibre strength (g per tex)	**G**	0.15	-0.39	0.04	-0.22	-0.21	-0.07	-0.30	-0.55	**1.18**	-0.21
	P	0.09	-0.13	0.08	-0.01	-0.17	-0.09	0.00	-0.73	**0.62**	-0.33

Residual = -0.01(G)
= 0.17(P)

significant in set 1 only at genotypic level (r = 0.68). A negative and non-significant correlation with yield of this trait was recorded for set 2. The corresponding direct effect of plant height on seed cotton yield was positive and high in sets 1 and 3 and negative in set 2, indicating that this difference was due to variation in genetic material in different sets. This indicated that the correlation explained the true relationship and a direct selection through this trait will be effective in all the 3 sets with difference in direction of selection in set 2 from sets 1 and 3 (Table 2). Plant height revealed a negative direct effect in the study by Kaushik et al. (2003).

3. Number of Monopodial Branches Per Plant

Both at genotypic and phenotypic levels a positive relationship between seed cotton yield per plant and number of monopodial branches per plant was obtained in set 1. However, it was significant at genotypic level (r = 0.72) as reported by Manimaran (1999) and Kaushik et al. (2003). In sets 2 and 3 the association was negative and non-significant. The negative direct effect of this trait was via fibre strength in set 1, plant height in set 2 and fibre length in set 3 (Tables 4 and 5). These results were contradictory to the findings published by Choudhary et al. (1998), Valarmathi (1996) and Kaushik et al. (2003),

Table 4. Direct and indirect effects of various characters on seed cotton yield at genotypic (G) and phenotypic (P) levels in set 2.

Characters		Days to flowering	Plant height (cm)	No. of monopodial branches per plant	No. of sympodial branches per plant	No. of total bolls per plant	Boll weight (g)	GOT (%)	Fibre length (mm)	Fibre strength (g per tex)	Correlation with Seed cotton yield
Days to flowering	**G**	**-0.26**	-0.18	-0.24	-0.04	0.42	-0.17	-0.10	0.62	0.01	0.06
	P	**0.46**	-0.17	-0.19	0.00	0.27	-0.43	-0.02	0.14	0.01	0.06
Plant height (cm)	**G**	-0.07	**-0.69**	-0.53	-0.38	0.95	0.05	-0.03	0.54	-0.02	-0.18
	P	0.12	**-0.64**	-0.39	-0.04	0.60	0.12	-0.01	0.13	-0.03	-0.14
No. of monopodial branches per plant	**G**	-0.06	-0.37	**-0.99**	0.25	0.39	0.07	0.13	0.02	0.04	-0.52
	P	0.10	-0.29	**-0.86**	0.03	0.23	0.19	0.02	0.00	0.08	-0.50
No. of sympodial branches per plant	**G**	-0.01	-0.35	0.33	**-0.75**	0.89	-0.03	-0.21	0.54	-0.06	0.35
	P	0.01	-0.31	0.26	**-0.08**	0.51	-0.08	-0.01	0.12	-0.10	0.33
No. of total bolls per plant	**G**	-0.08	-0.49	-0.29	-0.50	**1.34**	0.00	-0.24	0.58	-0.06	0.28
	P	0.14	-0.44	-0.23	-0.05	**0.87**	0.00	-0.05	0.15	-0.11	0.28
Boll weight (g)	**G**	0.18	-0.13	- 0.29	0.10	0.01	**0.25**	0.37	-0.46	-0.02	0.01
	P	-0.28	-0.11	-0.23	0.01	0.00	**0.71**	0.06	-0.11	-0.04	0.02
GOT (%)	**G**	0.04	0.03	-0.20	0.25	-0.51	0.15	**0.62**	-0.33	0.01	0.06
	P	-0.06	0.04	-0.10	0.01	-0.26	0.30	**0.15**	-0.06	0.03	0.05
Fibre length (mm)	**G**	-0.19	-0.43	-0.03	-0.47	0.91	-0.13	-0.24	**0.86**	-0.01	0.27
	P	0.29	-0.36	-0.01	-0.04	0.56	-0.35	-0.04	**0.23**	-0.02	0.26
Fibre strength (g per tex)	**G**	0.01	0.09	-0.33	0.36	-0.64	-0.05	0.07	-0.04	**0.12**	-0.43
	P	0.01	0.08	-0.27	0.03	-0.39	-0.11	0.02	-0.01	**0.25**	-0.40

Residual = -0.05(G)
= 0.26(P)

who reported a positive direct effect of this trait on seed cotton yield.

4. Number of Sympodial Branches Per Plant

Associations with seed cotton yield were non-significant positive in sets 2 and 3 and negative in set 1. Direct effect of this trait on yield was negative in all the sets. This suggested that, due to true correlation, direct selection will be effective for the trait in set 1, whereas in sets 2 and 3 simultaneous selection of other traits should be considered for improvement of this trait. In set 2 number of bolls per plant, number of monopodial branches per plant and fibre length and in set 3 number of bolls per plant, number of monopodial branches per plant and fibre strength should be considered for improvement of sympodial branches (Tables 4 and 5). These results were contradictory to the findings published by Choudhary et al. (1998), Valarmathi (1996) and Kaushik et al. (2003), as they reported a positive direct effect of this trait on seed cotton yield.

5. Number of Bolls Per Plant

There was a significant and positive association at genotypic level (r = 0.63) and phenotypic level (r = 0.66) in set 1 and a non-significant positive association in sets 2 and 3 with seed cotton yield per plant and

Table 5. Direct and indirect effects of various characters on seed cotton yield at genotypic (G) and phenotypic (P) levels in set 3.

Characters		Days to flowering	Plant height (cm)	No. of monopodial branches per plant	No. of sympodial branches per plant	No. of total bolls per plant	Boll weight (g)	GOT (%)	Fibre length (mm)	Fibre strength (g per tex)	Correlation with Seed cotton yield
Days to flowering	G	**-0.11**	0.33	-0.48	-0.23	0.52	0.01	0.02	-0.12	0.05	-0.01
	P	**0.00**	0.02	-0.25	-0.03	0.30	-0.03	0.01	-0.09	0.03	-0.04
Plant height (cm)	G	-0.04	**0.93**	-1.65	-0.45	1.33	-0.01	-0.02	-0.42	0.48	0.14
	P	0.00	**0.10**	-0.66	0.13	0.85	0.05	-0.01	-0.34	0.32	0.16
No. of monopodial branches per plant	G	-0.03	0.75	**-2.04**	0.08	1.09	-0.01	0.00	-0.32	0.45	-0.03
	P	0.00	0.07	**-0.93**	0.03	0.69	0.06	0.00	-0.27	0.31	-0.04
No. of sympodial branches	G	-0.02	0.38	0.15	**-1.12**	0.89	0.01	-0.06	-0.23	0.15	0.15
	P	0.00	0.04	0.09	**-0.34**	0.52	-0.01	-0.02	-0.17	0.09	0.19
No. of total bolls per plant	G	-0.03	0.74	-1.34	-0.60	**1.65**	-0.00	-0.05	-0.33	0.34	0.38
	P	0.00	0.08	-0.57	-0.15	**1.11**	0.01	-0.02	-0.29	0.24	0.40
Boll weight (g)	G	0.03	0.29	-0.68	0.24	0.07	**-0.04**	0.04	-0.05	0.13	0.03
	P	0.00	0.02	-0.31	0.02	0.09	**0.19**	0.02	-0.04	0.08	0.07
GOT (%)	G	-0.01	-0.12	0.03	0.31	-0.39	-0.01	**0.20**	0.19	-0.22	-0.02
	P	0.00	-0.01	0.03	0.05	-0.23	0.03	**0.11**	0.14	-0.12	0.01
Fibre length (mm)	G	-0.02	0.73	-1.22	-0.48	1.02	-0.00	-0.07	**-0.53**	0.64	0.07
	P	0.00	0.07	-0.52	-0.12	0.66	0.02	-0.03	**-0.48**	0.47	0.07
Fibre strength (g per tex)	G	-0.01	0.65	-1.33	-0.24	0.82	-0.01	-0.06	-0.50	**0.69**	0.01
	P	0.00	0.06	-0.58	-0.06	0.52	0.03	-0.03	-0.45	**0.50**	0.01

Residual = -0.38(G)
= 0.57(P)

corresponding direct effects were also positive, indicating that this trait had similar information in all the sets and therefore does not change with the nature of the material. However, values in set 3 were higher than corresponding values in sets 1 and 2 (Table 2). Boll number per plant has been reported to have a positive association with and a positive direct effect on seed cotton yield (Amudha et al., 1996; Altaher and Singh, 2003).

6. Boll Weight (g)

Like boll number per plant, this trait exhibited a positive association at both genotypic and phenotypic levels in all the sets. Direct effects on yield were also positive in all the sets except the low value negative direct effect at genotypic level in set 3. This is in conformity with the findings published by Rajarathinam et al. (1993), Dedaniya and Pethania (1994), Amudha et al. (1996), Altaher and Singh (2003) and Gururajan and Sunder (2004), who reported a positive direct effect of this trait on seed cotton yield.

7. Ginning Out Turn (GOT %)

Phenotypic and genotypic correlation coefficients of this trait with the seed cotton yield were negative and non-significant in set 1 and positive and non-significant in sets 2 and 3. The direct effect of this trait on yield was also positive in sets 2 and 3 but was positive only at genotypic level in set 1. The correlation coefficients being of low value or negligible and the direct effect being positive and high indicated that restrictions should be imposed to nullify the undesirable indirect effects in order to make use of the direct effect (Singh and Kakar, 1977). Restrictions should be imposed to nullify the undesirable indirect effects of fibre strength in set 1, number of bolls per plant and fibre length in set 2, and number of bolls per plant and fibre strength in set 3. A negative correlation of this trait with seed cotton yield was also obtained by Amudha et al. (1996) and Gururajan and Sunder (2004).

8. Fibre Length

A significant negative association with seed cotton yield at genotypic level ($r = -0.70$) was obtained for this trait in set 1. Associations with seed cotton yield were non-significant and positive in sets 2 and 3. Corresponding direct effects on yield were negative in sets 1 and 3 and positive in set 2. This suggested that a true relationship existed in all the sets and direct selection will be effective for the trait. A negative direct effect and association of this trait were also reported by Amudha et al. (1996) and Gururajan and Sunder (2004).

9. Fibre Strength

This trait gave a negative correlation at both genotypic and phenotypic levels with yield in sets 1 and 2 and a positive correlation in set 3, although these were non-significant. Direct effects of the trait on seed cotton yield were positive in all 3 sets. Under these circumstances, restrictions should be imposed to nullify the undesirable indirect effects in order to make use of the direct effect (Singh and Kakar, 1977). Restrictions should be imposed to nullify the undesirable indirect effects of fibre length in set 1, number of total bolls per plant and number of monopodial branches per plant in set 2, and number of monopodial branches per plant and fibre length in set 3 (Tables 3-5). These results were contradictory to the reports by Amudha et al. (1996) and Gururajan and Sunder (2004), as they obtained a negative direct effect of this trait with yield.

Conclusions

The results discussed above indicate that correlation and direct and indirect effect estimates vary for different traits with variation in genetic material based on fibre properties. Hence, correlations and direct and indirect effect estimation would provide useful information for planning a successful breeding programme if the genetic material is grouped for fibre length and fibre strength.

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