J. Farm Sci., 34(1) : (15-21) 2021

RESEARCH PAPER

Genetic variability, correlation and path coefficient analysis for yield, yield attributing and fibre quality traits in compact cotton (*Gossypium hirsutum* L.)

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(Received: July, 2020 ; Accepted: January, 2021)

Abstract : Genetic variability plays a key role in crop improvement programmes as success of selection process depends upon the initial genetic variability and heritability for the important traits and also on their heritability. Towards this, a study was conducted at Agricultural Research Station, Dharwad Farm in *kharif* 2019-20 with a set of 25 compact cotton genotypes. Traits *viz*.,plant height, number of monopodia, number of sympodia, days to first flowering, days to 50 per cent flowering, node number of first fruiting branch, height of node of first fruiting branch, sympodial length at 50 per cent plant height, sympodial angle at 50 per cent plant height, plant diameter, inter nodal distance, inter boll distance, number of bolls per plant, boll weight, boll harvest index, Bartlett's index, total biomass, root to shoot ratio, harvest index, ginning outturn, lint index, seed index, seed cotton yield per plant andfibre quality traits like fibre length, fibre strength and micronaire were studied. High PCV, GCV, genetic advance and GAM were noticed for number of monopodia, bolls per plant, total biomass, root to shoot ratio and seed cotton yield per plant indicating prevalence of additive gene action thus suggesting there would be response of these traits to direct selection. Seed cotton yield per plant had showed significant positive association with number of monopodia, number of bolls per plant, boll weight, total biomass and Bartlett's index and significant negative correlation was observed with days to first flowering, height of node of first fruiting branch, harvest index and fibre strength.The highest positive direct effect on yield was revealed by number of bolls per plant and boll weight indicating they can be used in indirect selection for yield. Results revealed that the material used in the experiment can be used for genetic improvement of the desirable traits.

Key words: Compact cotton, Correlation, Genetic variability, Path coefficient analysis

Introduction

Cotton crop often termed as “white gold” isa commercial fibre and cash crop of India exercises profound influence on our nation’s economy. It is the highest foreign exchange earner and is the major source of raw cotton for the textile industry. India stands first in cotton area and second in production. Breeders in cotton mainly focus on improving yield and fibre quality.In the present situation, due toincreased labour costmechanised harvesting is good option. Ideotypes that are suitable for high density plantingandmechanical harvesting would make cotton cultivation remunerative. Hence, breeder should aim for development ofan ideotype suited for this purpose. Over the past few years, the focus of breeding has been on the concept known as ‘Compact cotton’ which is having a shorter height with reduced canopy spread unlike the robust types being grown now. The variability found in the base population is very important as success of any crop improvement programme depends on the extent of initial genetic variability present in the population. A wider spectrum of variability will improve the chances of selecting elite genotypes Mahesh *et al.* (2020). By focusing mainly on yield and other agronomic traits, the variability for other traits has been lost in cotton. Hence there is a need to enrich the cotton germplasm for bringing about crop improvement, more specifically the compact plant type.

Yield is a complex polygenic trait governed by large number of independent component traits and by their interactions. yield is a complex polygenic trait which is affected by its components traits (Grafius1959). Thus, it is important to know the component characters involved in interaction and their correlation with the dependent character yield. Correlation studies provide information about degree and direction of relationship between an independent trait with the dependent trait. Hence it helps the breeders to practise selection (Robinson *et al*., 1951 and Johnson *et al*., 1955a). Path coefficient analysis (Wright,1921) gives an idea whether the relationship of an independent trait with dependent trait is due to its direct effect or due to indirect effect through other component traits. Dewey and Lu (1959) used this technique in plant breeding in crested wheat grass for plant selection. Both correlation and path coefficient analysis wave path for selection and could help in understanding the yield components which help in the improvement of yield.

Material and methods

The present study was carried out at Agricultural Research Station, Dharwad Farm during *kharif* 2019-20. A set of 22 compact cotton genotypes along with four released checks ARBH-813, Sahana, RAH-100 and a compact variety Suraj wereevaluated in the study. The genotypes were grown at a spacing of 60 cm × 15cm in four row each of 4.20 m length. The experiment was laid out in a randomized block design with three replications.

A special consideration apart from the compact plant type is also earliness. To evaluate the genotypes for early maturity

Bartlett's index was calculated by picking the seed cotton at regular intervals of 15 days starting from 140 DAS to 200 DAS. Four pickings were accomplished. The formula for Bartlett's index is given below,

$$BI = \frac{(P1)+(P1+P2)+(P1+P2+P3)+(P1+P2+P3+P4+\ldots\ldots+Pn)}{n(P1+P2+P3+P4+\ldots\ldots+Pn)}$$

where, $P_1, P_2, P_3 \ldots\ldots P_n$ are weight of seed cotton harvested during first, second, third and up to n^{th} pickings and n = number of pickings

Higher the value of Bartlett's index earlier is the maturity. Other observations like plant height, number of monopodia, number of sympodia, days to first flowering, days to 50 per cent flowering, node number of first fruiting branch, height of node of first fruiting branch, sympodial length at 50 per cent plant height, sympodial angle at 50 per cent plant height, plant diameter, inter nodal distance, inter boll distance, number of bolls per plant, average boll weight, boll harvest index, total biomass, root to shoot ratio, harvest index, ginning outturn, lint index, seed index and seed cotton yield per plant were taken from five representative plants from each replication. Fibre quality traits such as fibre length, fibre strength and micronaire were considered for the analysis. Replicated data obtained from the study was analysed using WINDOWSTAT software.

The analysis of variance was performed to know whether there is any significant difference among the genotypes for the characters considered in the study. The GCV, PCV and broad sense heritability was calculated according to formula given by Burton (1952) and Lush (1949), respectively. Phenotypic correlation showing the extent of association between the traits was estimated through procedure suggested by Johnson *et al.* (1955b).

Results and discussion

Considerable differences were seen in the mean values of different traits in the genotypes. Out of 23 traits, 19 traits showed significant treatment sum of squares indicating the possibility of improvement (Table 1). The mean, range, PCV, GCV, broad sense heritability, genetic advance and genetic advance as per cent mean for all the studied traits is given in Table 2. The results showed high genetic variability, GCV, PCV, heritability and genetic advance as per cent mean were high for number of monopodia per plant, number of bolls per plant, total biomass, root to shoot ratio and seed cotton yield per plant indicating the preponderance of additive genes controlling these traits. Similar results were reported by Eswari *et al.* (2017), Aarthi *et al.* (2018), Ramesh *et al.* (2018), Shruti *et al.* (2019), Praveen *et al.* (2019) and Mahesh *et al.* (2020). Correlation value gives an idea about the extent of relationship between the two variables. The seed cotton yield

Table 1. Mean performance of compact cotton (*G. hirsutum* L.) genotypes for yield and its component traits

Sl. No.	Genotypes	PH	MP	SP	DF	DFL	NF	HNF	SL50	SA50	PD	IND	IBD	NBP	BW
1.	ESS-20	79.20	0.60	15.13	71.00	81.67	5.80	13.27	18.60	79.80	36.28	3.79	3.33	8.00	4.25
2.	N-30	76.00	0.22	13.33	74.33	89.00	5.67	15.73	19.07	75.03	36.59	4.03	3.26	5.06	3.74
3.	ESS-11	83.20	1.32	13.47	74.00	84.00	5.13	14.50	16.87	79.03	32.65	4.33	3.85	4.61	4.71
4.	ESS-8	92.40	0.52	15.07	78.33	80.33	4.47	12.73	24.13	77.67	46.70	4.59	3.55	7.00	4.34
5.	FLT-17	92.67	0.12	15.00	72.67	88.33	5.60	16.07	20.60	80.00	40.44	4.54	4.09	5.52	3.79
6.	FLT-21	90.73	0.37	14.93	79.33	80.67	5.53	16.00	18.93	81.67	37.11	4.36	3.40	4.79	4.09
7.	FLT-22	84.20	0.43	14.13	77.67	83.33	5.13	16.27	17.33	77.33	33.54	4.27	4.24	6.15	3.43
8.	FLT-25	102.47	0.56	15.27	72.67	90.33	5.53	17.27	24.80	80.00	48.51	4.84	3.85	4.82	4.18
9.	FLT-31	86.73	0.89	14.67	79.00	88.67	5.67	17.40	20.20	79.67	39.24	4.09	4.18	5.36	4.24
10.	ESS-18	86.60	0.75	16.33	75.00	88.33	5.13	14.07	18.00	81.33	35.25	3.90	3.93	8.61	3.80
11.	URT-21	81.33	0.12	13.53	77.00	86.33	6.73	17.93	18.07	76.03	34.77	4.02	4.00	4.42	4.74
12.	S-32	83.60	0.35	14.53	70.33	81.33	5.93	19.20	19.13	78.67	37.33	4.07	3.55	6.39	3.54
13.	S-34	99.73	0.40	15.93	71.33	87.00	5.60	19.53	20.47	78.00	38.29	4.56	3.52	4.88	4.33
14.	A-2	80.80	0.07	13.87	76.67	86.00	5.33	15.27	20.07	80.00	39.27	4.10	3.63	5.64	4.24
15.	A-11	86.40	0.47	13.47	76.67	93.67	5.67	17.33	19.27	80.67	37.77	4.42	4.12	4.85	4.30
16.	A-16	85.67	0.23	13.07	77.00	95.00	5.27	18.07	21.07	77.33	40.88	4.65	3.93	4.82	4.53
17.	A-31	84.20	0.39	15.20	79.67	83.33	5.07	13.73	17.27	77.00	33.51	4.19	3.13	4.85	4.61
18.	BRCC-1601	72.20	0.46	13.60	77.00	96.67	4.60	15.53	21.73	77.00	41.99	3.73	4.26	6.12	3.43
19.	BRCC-1602	69.73	0.14	12.40	79.67	98.33	4.80	15.73	19.27	73.67	36.83	3.89	3.83	5.09	3.56
20.	SCS-1206	79.67	0.03	14.20	78.67	95.33	5.13	15.73	20.00	74.00	38.24	4.06	3.99	5.61	3.84
21.	ARBC-64	80.07	0.40	13.33	73.33	79.33	5.20	14.73	18.67	75.60	35.64	4.23	3.63	4.76	3.89
	Checks														
22.	ARBH-813	91.93	0.17	14.73	75.33	88.33	5.93	17.93	20.93	82.33	40.95	4.53	4.05	5.67	4.10
23.	SAHANA	94.33	0.41	16.13	75.00	88.33	5.53	18.67	20.93	80.00	40.72	4.28	4.09	5.24	4.00
24.	RAH-100	96.13	0.85	15.27	81.00	90.67	5.80	16.33	21.13	74.67	40.24	4.41	3.16	4.85	4.04
25.	SURAJ	89.40	0.44	14.87	76.67	93.33	5.80	15.53	19.20	78.67	37.27	4.26	4.16	3.76	4.18
	Mean	85.97	0.43	14.45	75.92	87.90	5.44	16.18	19.82	78.20	38.39	4.24	3.79	5.47	4.07
	CV	9.73	19.17	10.11	4.55	10.48	11.19	13.16	16.21	5.00	16.33	7.16	4.69	18.53	5.55
	C.D. at 5%	13.74	0.13	2.40	5.68	15.14	1.00	3.49	5.28	6.42	10.29	0.49	0.29	1.66	0.37

Sl. No.	Genotypes	BHI	BI	TB	RS	HI	GOT	LI	SI	FL	FS	MIC	UI	MR	EL	SCYP
1.	ESS-20	74.39	0.71	31.67	0.27	55.48	40.27	6.82	9.83	24.80	23.40	4.43	82.40	0.74	5.40	26.41
2.	N-30	76.98	0.58	25.78	0.35	58.30	42.28	6.17	8.67	25.20	26.40	4.36	90.90	0.72	5.20	14.55
3.	ESS-11	77.62	0.57	29.78	0.22	62.33	39.27	7.44	11.50	27.60	25.50	4.62	80.30	0.77	5.80	17.94
4.	ESS-8	74.40	0.55	50.78	0.24	44.85	40.18	6.28	9.50	27.00	26.20	4.17	86.90	0.69	5.70	23.14
5.	FLT-17	75.70	0.63	23.56	0.29	61.86	39.83	5.58	8.83	25.40	23.90	4.08	82.40	0.68	5.40	15.20
6.	FLT-21	75.76	0.58	35.00	0.28	55.00	39.92	6.86	10.33	27.40	25.10	4.37	82.90	0.73	5.60	15.24
7.	FLT-22	74.59	0.59	29.56	0.29	55.12	41.22	5.94	9.50	25.00	23.60	4.53	80.80	0.75	5.50	14.27
8.	FLT-25	74.27	0.54	29.22	0.43	56.52	39.25	6.25	10.50	27.30	26.60	4.06	87.90	0.67	5.70	14.47
9.	FLT-31	72.66	0.56	42.33	0.29	48.02	39.67	6.98	11.17	27.30	25.40	4.26	84.00	0.71	5.70	15.65
10.	ESS-18	72.49	0.61	40.22	0.20	46.69	41.02	6.00	8.83	25.90	23.40	4.29	79.30	0.71	5.60	22.64
11.	URT-21	75.10	0.54	18.22	0.31	70.59	41.00	7.88	11.17	25.60	24.60	4.48	84.60	0.74	5.50	16.24
12.	S-32	73.52	0.67	18.11	0.34	66.40	39.15	5.97	9.33	27.70	25.90	4.25	82.60	0.71	5.80	17.41
13.	S-34	73.75	0.56	26.33	0.33	62.61	40.00	7.04	10.67	25.80	25.50	4.21	85.20	0.70	5.60	16.03
14.	A-2	75.82	0.62	24.44	0.26	63.47	41.03	6.66	9.83	24.80	24.60	4.54	85.90	0.75	5.20	18.44
15.	A-11	73.91	0.55	32.44	0.28	56.50	39.37	6.21	9.83	25.80	25.10	4.32	85.20	0.72	5.60	19.42
16.	A-16	73.05	0.57	34.00	0.33	53.14	38.05	6.18	10.33	28.80	25.70	4.53	77.80	0.75	5.90	14.98
17.	A-31	75.01	0.57	25.89	0.29	60.56	40.50	6.92	10.33	24.40	24.60	4.80	86.10	0.80	5.40	15.39
18.	BRCC-1601	72.39	0.61	34.67	0.24	48.55	40.10	5.07	8.17	24.90	23.50	4.38	84.80	0.73	5.50	15.50
19.	BRCC-1602	73.27	0.58	19.33	0.30	63.67	40.33	5.33	8.67	25.50	24.40	4.36	79.60	0.72	5.50	13.22
20.	SCS-1206	72.32	0.58	31.22	0.38	52.21	40.50	6.12	8.67	28.10	26.30	4.23	81.50	0.70	5.80	15.78
21.	ARBC-64	76.03	0.63	24.00	0.31	61.43	40.52	6.88	10.33	26.70	25.60	4.46	86.50	0.74	5.60	14.52
	Checks															
22.	ARBH-813	75.44	0.56	36.56	0.23	52.55	40.75	6.96	10.33	26.90	24.70	4.42	81.30	0.73	5.70	15.88
23.	SAHANA	74.58	0.63	32.11	0.25	52.97	41.33	6.55	9.50	25.20	24.70	4.37	86.00	0.73	5.50	15.73
24.	RAH-100	74.66	0.55	28.67	0.37	56.23	40.67	6.64	10.17	26.10	24.50	4.29	84.30	0.71	5.60	15.02
25.	SURAJ	73.32	0.56	30.00	0.21	59.50	38.55	6.27	10.00	27.80	27.80	4.24	86.50	0.70	5.80	11.24
	Mean	74.44	0.58	30.15	0.29	56.98	40.17	6.44	9.84	26.28	25.08	4.36	83.83	0.72	5.58	16.57
	CV	2.22	8.67	17.21	17.99	7.61	2.30	3.74	5.91			SE				17.03
	C.D. at 5 %	2.71	0.08	8.52	0.08	7.12	1.52	0.39	0.95	0.29	0.23	0.005	1.79	0.0001	0.006	4.63

Table 2. Analysis of variance for various quantitative traits in compact cotton (*G. hirsutum* L.) genotypes

Source of variation	df	Characters											
		PH	MP	SP	DF	DFL	NF	HNF	SL50	SA50	PD	IND	IBD
Replication	2	280.53*	0.01	2.28	6.77	5.29	5.68**	21.80*	59.46**	22.41	241.22**	0.38*	0.03
Treatment	24	191.63**	0.26**	3.09	26.14*	87.37	0.68*	9.79*	10.94	17.58	42.12	0.24**	0.36**
Error	48	70.09	0.006	2.13	11.98	85.01	0.37	4.54	10.33	15.30	39.32	0.09	0.03

Source of variation	df	Characters										
		NBP	BW	BHI	BI	TB	RS	HI	GOT	LI	SI	SCYP
Replication	2	0.07	0.36**	3.07	0.0005	74.73	0.0004	21.18	176.68**	2.36**	11.47**	0.35
Treatment	24	3.61**	0.43**	5.99*	0.005*	170.14**	0.009**	121.75**	2.60**	1.22**	2.28**	32.83**
Error	48	1.03	0.05	2.73	0.002	26.96	0.002	18.82	0.86	0.05	0.34	7.97

PH: Plant height; MP: Monopodia; SP: Sympodia; DF: Days to first flowering; DFL: Days to fifty per cent flowering

NF: Node number of first fruiting branch; HNF: Height of node of first fruiting branch; SL50: Sympodial length at 50 per cent plant height; SA50: Sympodial angle at 50 per cent plant height; PD: Plant diameter

BW: Boll weight; IND: Inter nodal distance; IBD: Inter boll distance; NBP: No. of bolls per plant; BHI: Boll harvest index

BI: Bartlett's index; TB: Total biomass; RS: Root to shoot ratio; HI: Harvest index; GOT: Ginning outturn

LI: Lint index; SI: Seed index; SCYP: Seed cotton yield per plant

in cotton isa dependent and low heritable trait hence direct selection is less rewarding. Therefore, selection of genotypes by considering the independent traits which had high heritability and significant association with yield will relatively simplify the breeder's work. It is necessary to know the component traits involved in interaction and direction and extent of their association with yield parameter. Association study provides the better understanding of yield attributes which assists the plant breeder during the selection (Mahesh *et al*., 2020).The results revealed significant positive correlation of seed cotton yield with number of monopodia per plant, number of bolls per plant, boll weight, total

Table 3. Genetic parameters of various characters in compact cotton (*Gossypium hirsutum* L.) genotypes

Character	Mean	Range		Standardized range	Variance		Coefficient of variation (%)		h^2_{bs}	GA	GAM (%)
		Min	Max		Genotypic	Phenotypic	Genotypic	Phenotypic			
Plant height (cm)	85.97	69.73	102.46	0.38	40.51	110.60	7.40	12.23	36.63	10.17	11.82
Number of monopodia	0.43	0.03	1.32	3.00	0.08	0.09	67.89	70.54	92.61	0.74	172.4
Number of sympodia	14.45	12.40	16.30	0.27	0.32	2.45	3.90	10.84	13.0	0.53	3.72
Days to first flowering	75.92	70.33	81.00	0.14	4.72	16.70	2.86	5.38	28.30	3.05	4.01
Days to 50 per cent flowering	87.90	79.33	98.33	0.22	0.79	85.80	1.00	10.54	0.90	0.22	0.25
Node number of first fruiting branch	5.44	4.46	6.73	0.42	0.10	0.47	5.92	12.66	21.80	0.40	7.29
Height of node of first fruiting branch (cm)	16.18	12.73	19.53	0.42	1.75	6.29	8.18	15.50	27.82	1.84	11.38
Sympodial length at 50 per cent plant height (cm)	19.82	16.86	24.80	0.40	0.20	10.53	2.27	16.37	1.93	0.16	0.83
Sympodial angle at 50 per cent plant height	78.20	73.66	82.33	0.11	0.76	16.06	1.11	5.13	4.70	0.50	0.63
Plant diameter (cm)	38.39	32.65	48.51	0.41	0.93	40.25	2.52	16.52	2.30	0.39	1.01
Inter nodal distance (cm)	4.24	3.73	4.84	0.26	0.05	0.14	5.19	8.84	34.50	0.34	8.05
Inter boll distance (cm)	3.79	3.13	4.26	0.30	0.11	0.14	8.79	9.97	77.79	0.77	20.47
Number of bolls per plant	5.47	3.75	8.60	0.89	0.86	1.89	16.95	25.12	45.55	1.65	30.20
Boll weight (g)	4.07	3.43	4.74	0.32	0.12	0.17	8.60	10.24	70.62	0.78	19.09
Boll harvest index	74.44	72. 32	77.61	0.07	1.08	3.82	1.40	2.63	28.50	1.47	1.97
Bartlett's index	0.58	0.54	0.71	0.25	0.001	0.004	5.03	10.03	25.17	0.04	6.66
Total biomass (g)	30.15	18.11	50.77	1.08	47.72	74.69	22.91	28.66	63.90	14.57	48.34
Root to shoot ratio	0.29	0.20	0.43	0.79	0.002	0.005	16.39	24.34	45.33	0.08	29.13
Harvest index (%)	56.98	44.84	70.59	1.19	34.31	53.13	10.28	12.79	64.58	12.42	21.81
Ginning outturn (%)	40.17	38.05	42.28	0.11	0.58	1.44	1.90	2.98	40.50	1.28	3.19
Lint index	6.44	5.06	7.88	0.44	0.39	0.44	9.65	10.35	86.95	1.53	23.76
Seed index	9.84	8.16	11.50	0.34	0.65	0.98	8.19	10.10	65.79	1.73	17.54
Seed cotton yield per plant (g)	16.57	11.24	26.41	0.94	8.29	16.26	17.37	24.33	50.98	5.42	32.74

Table 4. Phenotypic correlation of yield and fibre quality traits in compact cotton (*G. hirsutum* L.) genotypes

	PH	MP	SP	DF	DFL	NF	HNF	SL50	SA50	PD	BW	IND	IBD	NBP	BHI	BI	TB	RS	HI	GOT	LI	SI	FL	FS	MIC	SCYP
PH	1	0.18	0.67**	-0.07	-0.11	0.19	0.33**	0.39**	0.31**	0.38**	0.22*	0.67**	0.03	-0.10	0.08	-0.26*	0.21	0.22*	-0.13	-0.19	0.19	0.26*	0.19	0.19	-0.34**	-0.0.4
MP		1	0.20	-0.03	-0.09	-0.09	-0.14	-0.03	0.09	-0.03	0.23*	0.003	-0.04	0.11	0.05	-0.07	0.33**	-0.18	-0.24*	-0.14	0.24*	0.36**	0.15	-0.02	0.06	0.25*
SP			1	-0.08	-0.17	0.04	0.13	0.34**	0.32**	0.34**	0.04	0.003	-0.04	0.21	0.02	0.04	0.21	-0.04	-0.19	-0.001	0.08	0.003	-0.06	-0.06	-0.22*	0.13
DF				1	-0.003	-0.06	-0.07	0.002	-0.19	-0.01	0.077	-0.025	0.076	-0.22*	-0.06	-0.36**	0.19	-0.16	-0.18	0.09	0.0002	0.007	0.007	-0.037	0.18	-0.26*
DFL					1	-0.04	0.15	0.04	-0.18	0.024	-0.07	-0.07	0.25*	-0.16	-0.33**	-0.17	-0.06	0.06	-0.04	-0.02	-0.32**	-0.18	0.05	0.04	-0.13	0.17
NF						1	0.52**	-0.11	0.13	-0.10	0.18	-0.02	0.01	-0.18	0.13	-0.18	-0.24*	0.13	0.29**	-0.099	0.31**	0.31**	0.032	0.068	-0.06	-0.08
HNF							1	0.12	0.19	0.12	0.04	0.12	0.26*	-0.24*	0.02	-0.21	-0.18	0.29**	0.18	-0.05	0.06	0.12	0.16	0.11	-0.17	-0.29**
SL50								1	0.04	0.99**	0.05	0.27*	0.13	0.16	-0.02	0.03	0.21	0.22*	-0.23*	-0.08	-0.12	-0.03	0.14	0.16	-0.37**	0.03
SA50									1	0.13	0.08	0.08	0.16	0.05	0.17	0.03	0.16	-0.24*	-0.06	-0.08	0.12	0.20	0.03	-0.09	-0.06	0.068
PD										1	0.05	0.26*	0.15	0.17	-0.007	0.05	0.22*	0.19	-0.24*	-0.09	-0.12	-0.02	0.13	0.15	-0.36**	0.05
BW											1	0.25*	-0.11	-018	0.25*	-0.25*	0.13	-0.02	0.15	-0.18	0.69**	0.68**	0.17	0.21	0.29**	0.23*
IND												1	0.02	-0.24*	0.08	-0.28*	0.09	0.27*	-0.02	-0.24*	0.14	0.24*	0.31**	0.30**	-0.21	-0.11
IBD													1	-0.03	-0.22*	-0.11	0.11	-0.21	-0.14	-0.11	-0.23*	-0.03	0.16	-0.05	-0.18	-0.16
NBP														1	-0.19	0.35**	0.29**	-0.12	-0.39**	0.17	-0.22*	-0.27*	-0.19	-0.41**	-0.09	0.75**
BHI															1	-0.02	-0.17	-0.10	0.33**	0.14	0.35**	0.27*	-0.14	0.01	0.25*	-0.02
BI																1	-0.13	-0.05	0.04	0.03	-0.14	-0.19	-0.22*	-0.29**	0.07	0.24*
TB																	1	-0.29**	-0.89**	-0.04	-0.03	0.002	0.22*	0.03	-0.16	0.30**
RS																		1	0.19	0.01	-0.01	0.06	0.13	0.23*	-0.22*	-0.19
HI																			1	-0.03	0.26*	0.23*	0.13	0.08	0.19	-0.28*
GOT																				1	0.13	-0.25*	-0.48**	-0.30**	0.10	0.05
LI																					1	0.75**	0.09	0.12	0.35**	0.11
SI																						1	0.27*	0.20	0.25*	0.034
FL																							1	0.66**	-0.28*	-0.15
FS																								1	-0.31**	-0.29**
Mic																									1	0.01

PH: Plant height, MP: Monopodia per plant, SP: Sympodia per plant, DF: Days to first flowering, DFL: Days to 50 per cent flowering, NF: Node number of first fruiting branch, HNF: Height of node of first fruiting branch, SL50: Sympodial length at 50 per cent plant height, SA50: Sympodial angle at 50 per cent plant height, PD: Plant diameter, BW: Boll weight, IND: Inter nodal distance, IBD: Inter boll distance, NBP: Number of bolls per plant, BHI: Boll harvest index, BI: Bartlett's index, TB: Total biomass, RS: Root to shoot ratio, HI: Harvest index, GOT: Ginning outturn, LI: Lint index, SI: Seed index, FL: Fibre length, FS: Fibre strength, Mic:Micronaire value, SCYP: Seed cotton yield per plant

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Table 5. Direct and indirecteffects of different characters on seed cotton yield at phenotypic level in compact cotton (*G. hirsutum* L.) genotypes

Characters	MP	DF	HNF	BW	NBP	BI	TB	HI	FS	SCYP
MP	0.0357	-0.0012	-0.0051	0.0084	0.0040	-0.0026	0.0119	-0.0086	-0.0011	0.25*
DF	0.0050	-0.1488	0.0107	-0.0116	0.0334	0.0543	-0.0284	0.0268	0.0056	-0.26*
HNF	0.0178	0.0089	-0.1235	-0.0051	0.0301	0.0269	0.0229	-0.0223	-0.0143	-0.29**
BW	0.0953	0.0316	0.0168	0.4060	-0.0767	-0.1029	0.0529	0.0625	0.0877	0.23*
NBP	0.0807	-0.1608	-0.1748	-0.1353	0.7160	0.2503	0.2092	-0.2843	-0.2989	0.75**
BI	0.0008	0.0039	0.0023	0.0027	-0.0037	-0.0106	0.0013	-0.0005	0.0032	0.24*
TB	-0.0112	-0.0064	0.0062	-0.0044	-0.0098	0.0042	-0.0335	0.0301	-0.0009	0.30**
HI	0.0194	0.0145	-0.0145	-0.0124	0.0319	-0.0039	0.0721	-0.0802	-0.0065	-0.28*
FS	0.0021	0.0027	-0.0081	-0.0151	0.0293	0.0210	-0.0018	-0.0057	-0.0701	-0.29**

Residual effect: 0.502

biomassand Bartlett's index. While significant negative correlation was shown by days to first flowering, height of node of first fruiting branch, harvest index and fibre strength indicating they can be used in negative selection (Table 3). Similar results were reported by Nikhil *et al*. (2018), Khalid *et al*. (2018), Chapepa *et al*. (2020), Mahesh *et al*. (2020) and Mahdi *et al*. (2020). However, harvest index in the study showed significant negative correlation with yield and this could be because of heavy rainfall during the cropping period leading to higher vegetative growth.

Traits showing significant association with yield were considered further to know the direct and indirect effect they had on the end dependent character *i.e.* seed cotton yield (Table 4). Among the nine traits, three traits *viz.,* number of monopodia, boll weight and number of bolls per plant showed positive direct effect on yield and the remaining six traits*viz.,*days to first flowering, height of node of first fruiting branch, Bartlett's index, total biomass, harvest index and fibre strength had negative direct effect on yield. The traits having positive direct effects can be effectively used in indirect selection. Similar results on path analysis in cotton were obtained by Gulhane and Wadikar (2017), Deshmukh *et al*. (2019) and Shruti *et al*. (2020).

Conclusion

From the results, it can be concluded that phenotypic selection in the set of material for number of monopodia, number of bolls per plant, total biomass, root to shoot ratio and seed cotton yield can be relied upon for crop improvement as these traits had high heritability and high GAM suggesting the preponderance of additive gene effects. Correlation analysis revealed significant correlation of number of monopodia, boll weight, number of bolls per plant and total biomass which can be banked upon for indirect selection for higher yield. The highest positive direct effect on yield was showed by boll weight and number of bolls per plant indicating the scope of using these two traits for effective indirect selection.

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