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Multi-environment correlation and trait association analysis for seed cotton yield and its component traits in cotton (*Gossypium hirsutum* L.)

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Abstract

The objective of research was to extract information regarding correlation analysis for various traits in cotton. Experiment was carried out at three different locations of Gujarat, under the jurisdiction of Anand Agricultural University (AAU) during *kharif* 2023. Three different environments were made available by choosing three different locations of Gujarat *i.e.*, Regional Research Station, AAU, Anand; Agricultural Research Station, AAU, Jabugam and Agriculture Research Station for Irrigated Crops, AAU, Thasra. Correlation analysis demonstrated a significant and positive relationship of seed cotton yield per plant with bolls per plant, boll weight and lint yield per plant at both genotypic and phenotypic levels across all three environments. While lint index showed a significant negative correlation with seed cotton yield per plant at both levels in Thasra environment, this negative relationship was significant only at the phenotypic level in Anand and Jabugam environment. The breakdown of this tight negative association at the genotypic level in certain environments implies that simultaneous selection for both seed cotton yield and lint index is possible. Consequently, this provides breeders with flexibility in choosing breeding methodologies to improve overall cotton yield and its component traits.

Keywords: Cotton, correlation analysis, seed cotton yield, boll weight, lint yield, genotypic correlation

Introduction

Cotton is known for production of natural fiber in the world. It has wide genetic diversity with the genus *Gossypium* and includes more than 50 species. Among those, four are cultivated throughout the world: two of these species are diploids ($2n = 2x = 26$) and two are allotetraploids ($2n = 4x = 52$). Global cotton production is manifested from the two allotetraploid species *Gossypium hirsutum* (90%) and *Gossypium barbadense* (8%). Since the discovery of the Mohenjo-daro relics the history of cotton and cotton manufacture came to be treated as beginning from times of the ancient Indus valley civilization, which flourished in India about 5000 years ago. Cotton is one of the most important fiber and cash crop of India and plays a dominant role in the industrial and agricultural economy of the country.

Cotton is a woody perennial shrub typically exhibits perennial characteristics in the wild, but cultivated species are mostly annual in nature which grows in black soil. Cotton has deep root system with secondary roots and prominent upright stem. The leaves of cotton plants are petiolate and lobbed contains three, five or sometime seven lobes. Generally, branches are of two types which are monopodial and sympodial. Monopodial branches serve as vegetative (non-fruiting) structures that support structural growth. Conversely, sympodial branches act as fruiting branches, driven by specialized meristems that give rise to reproductive nodes and fruiting buds

Correlation could be used as an important tool to bring information about appropriate cause and effects relationship between yield and some yield components (Khan *et al.*, 2009) [5]. To assess the magnitude of correlations for various traits with yield would be immense help in the indirect selection for the improvement of yield.

The association between traits that can be directly observed by phenotypic correlation, whereas the real or true association could be known through genotypic correlations, which eliminates environmental influence.

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Genotypic correlation permits the prediction of correlated responses and evaluation of the relative influence of one trait on another. Genotypic correlation in particular is helpful in the construction of the selection indices or traits associated with each other as well as with yield.

Materials and Methods

The experimental material for present investigation was comprised of 42 genotypes (40 genotypes and two standard checks) of cotton (*Gossipium hirsutum* L.) procured from Regional Research Station, AAU, Anand. The 42 genotypes and two checks were evaluated in Randomized Complete Block Design (RCBD) with three replications. Each genotype is planted in 2 rows with a spacing of 120 × 45 cm between rows and plants respectively. The experiment was conducted during *kharif* 2023, at three different locations of Gujarat, under the jurisdiction of Anand Agricultural University (AAU). Three locations were Anand *kharif* 2023 (Regional Research Station, AAU, Anand), Jabugam *kharif* 2023 (Agricultural Research Station, AAU, Jabugam) and Thasara *kharif* 2023 (Agriculture Research Station for Irrigated Crops, AAU, Thasara). Observations on traits like seed cotton yield, its components and matriculate traits; whereas, the traits days to 50% flowering and days to 50% boll bursting were taken on plot basis. Fibre quality traits such as span length, fibre strength, fibre fineness and uniformity index.

The form of analysis used for estimating covariance components between different pairs of observation. The following estimates of covariances were worked out as reviewed by Singh and Choudhary (2014) [9]. The genotypic correlation is chiefly caused by pleiotropy and linkage action of genes and was estimated as suggested by Hazel (1943) [3]. The genotypic and phenotypic correlation coefficients were worked out for all possible pairs and were tested against standardized tabulated values of *r* with (g-2) and (rg-2) degree of freedom at 0.05 and 0.01 levels of probabilities for genotypic and phenotypic correlation, respectively (Fisher and Yates, 1963) [2].

Results and Discussion

The primary objective of a plant breeder is to introduce desirable changes into the genetic makeup of a crop to achieve higher yields. Yield is an important quantitative trait and is a multiplicative product of other quantitative traits. For selection of high yielder, a thorough understanding of yield attributing traits and their association with yield is very much essential. This understanding makes it easier to quickly identify high-yielding genotypes.

The phenotypic and genotypic correlation coefficients were estimated among 17 traits of 42 cotton genotypes to find out the association between seed cotton yield and other yield contributing traits. Correlation coefficients between seed cotton yield and its 16 component traits and among components themselves were estimated at genotypic and phenotypic levels from the data collected at, and are presented in tables 1 to 3.

In all three environments, seed cotton yield per plant exhibited a significant positive association at both genotypic and phenotypic levels with bolls per plant (= 0.7737, = 0.7868), (= 0.7825, = 0.7899), (= 0.7750, = 0.7828), boll weight (= 0.427, = 0.4237), (= 0.4039, = 0.406), (= 0.3832, = 0.3941) and lint yield per plant (= 0.8255, = 0.8268), (= 0.8603, = 0.8419), (= 0.8561, = 0.8441). In plant height was

found to be positive association with seed cotton yield per plant (= 0.3268, = 0.3053) at both genotypic and phenotypic levels. Among all traits boll weight, bolls per plant, lint yield per plant and plant height are directly correlated with yield. A significant and positive association was found between seed cotton yield per plant with bolls per plant and plant height were reported earlier by Patel *et al.* (2013) [6]. Patel *et al.* (2023) [7] recorded a significant correlation of seed cotton yield per plant with bolls per plant and lint yield per plant.

Days to 50% flowering exhibited significant and negative association with plant height (= -0.1877) and positive association with days to 50% boll bursting (= 0.2438) at phenotypic level in Patel *et al.* (2023) [4] also found a positive and significant correlation at phenotypic level for days to 50% flowering with days to 50% boll bursting.

In days to 50% boll bursting was found significant and positive association with days to 50% flowering (= 0.2438) at phenotypic level and positive association in and at both level. On contrary, uniformity index exhibited a significant and negative correlation with days to 50% boll bursting in (= -0.5228, = -0.4903) and in (= -0.3321, = -0.2891) at both genotypic and phenotypic level. Patel *et al.* (2023) [7] also recorded similar trend for days to 50% boll bursting with days to 50% flowering and uniformity index.

Plant height was significant and positive association with sympodia per plant in (= 0.2108) and (= 0.1888) at phenotypic level while, in (= 0.3245, = 0.2979) at both genotypic and phenotypic levels. Significant and positive association between plant height with bolls per plant was found in (= 0.3304, = 0.3134) at genotypic and phenotypic level whereas, in (= 0.2905) and in (= 0.3413) at phenotypic level. Seed cotton yield per plant was significant and positive correlation with plant height in (= 0.2793) and in (= 0.2502) at phenotypic level while, in (= 0.3268, = 0.3053) at both genotypic and phenotypic levels. Lint yield per plant was significant and positive association with plant height in (= 0.2781) and in (= 0.2643) at phenotypic level while, in (= 0.324, = 0.3014) at both genotypic and phenotypic levels. Similar results were recorded by Patel *et al.* (2013) [6] for plant height with sympodia per plant, bolls per plant, seed cotton yield per plant and lint yield per plant. Kadam *et al.* (2024) [4] also recorded same results with seed cotton yield per plant.

In all environments monopodia per plant appears to be significant and positive correlation with bolls per plant viz., (= 0.3226, = 0.2989), (= 0.3166, = 0.2869), (= 0.3311, = 0.3103) and ginning outturn viz., (= 0.3823, = 0.3414), (= 0.3274, = 0.3053), (= 0.4305, = 0.3794). The significant and positive correlation found at genotypic and phenotypic levels for monopodia per plant with bolls per plant and ginning outturn was earlier reported by Sanmugapriya *et al.* (2023) [8].

Sympodia per plant seems to be strongly and positive relation to plant height in (= 0.2108) at phenotypic level, in (= 0.3245, = 0.2979) at both genotypic and phenotypic levels and in (= 0.1888) at phenotypic level. Monopodia per plant in (= 0.2288) was significant and positive association with sympodia per plant. While it demonstrated positive and significant association with bolls per plant, seed cotton yield per plant and lint yield per plant at phenotypic level in (= 0.2587), (= 0.2775) and (= 0.2009) respectively. Patel *et al.* (2013) [6] found a positive and significant correlation at both levels of sympodia per plant with plant height. For

sympodia per plant with bolls per plant was earlier reported by Patel *et al.* (2023)^[7], Sanmugapriya *et al.* (2023)^[8] and Kadam *et al.* (2024)^[4].

In two environments, bolls per plant exhibited significant and positive correlation with plant height at both levels in ($= 0.3304, = 0.3139$) and in ($= 0.358, = 0.3413$) whereas; in ($= 0.2905$) at phenotypic level. In all environments, bolls per plant exhibited significant and positive correlation with monopodia branches per plant at both levels in ($= 0.3226, = 0.2989$), in ($= 0.3166, = 0.2869$) and in ($= 0.3311, = 0.3103$).

While, seed cotton yield per plant ($= 0.7737, = 0.7868$), ($= 0.7825, = 0.7899$) and ($= 0.775, = 0.7828$) were significant and positive correlation with bolls per plant at both genotypic and phenotypic levels. Lint yield per plant was found genotypically and phenotypically significant and positive correlation with bolls per plant in ($= 0.7783, = 0.7797$), in ($= 0.8902, = 0.8755$) and in ($= 0.8848, = 0.8727$). A highly significant and positive correlation of bolls per plant with seed cotton yield per plant was reported by Patel *et al.* (2013)^[6] and Sanmugapriya *et al.* (2023)^[8]. For bolls per plant with lint yield per plant was reported by Patel *et al.* (2023)^[7].

At the genotypic and phenotypic levels, boll weight appears to be significant and positive association with seed cotton yield per plant in ($= 0.427, = 0.4237$), in ($= 0.4039, = 0.406$) and in ($= 0.3832, = 0.3491$) at both level. Bolls weight exhibited significant and positive linkage with seed index in ($= 0.2813$) and in ($= 0.2724$) at phenotypic level whereas; in ($= 0.3203, = 0.3108$) at both genotypic and phenotypic level. Boll weight show positive correlation with seed index and negative with lint index and indicate that higher seed cotton yield is due to bold seeds rather than lint. A significant correlation of boll weight with seed cotton yield per plant was reported by Sanmugapriya *et al.* (2023)^[8]. A significant correlation of boll weight with seed index was reported by Patel *et al.* (2023)^[7].

Ginning outturn exhibited a positive and significant correlation at genotypic and phenotypic levels with lint yield per plant in all environments. The genotypic and phenotypic correlation coefficients for lint yield per plant were found to be positive across all instances. Specifically, the values were ($= 0.3827, = 0.329$), ($= 0.4925, = 0.4149$) and ($= 0.3313, = 0.3402$). While, lint index in ($= 0.456, = 0.5924$), in ($= 0.5454, = 0.6095$) and in ($= 0.48, = 0.5678$) were significant and positive correlation with ginning outturn at both genotypic and phenotypic levels. While, monopodia per plant in ($= 0.3823, = 0.3414$), in ($= 0.3274, = 0.3053$) and in ($= 0.4305, = 0.3794$) were significant and positive correlation with ginning outturn at both genotypic and phenotypic levels. A significant and positive correlation of ginning outturn with monopodia per plant was reported by Sanmugapriya *et al.* (2023)^[8].

Lint yield per plant exhibited significant and positive association with bolls per plant in ($= 0.7783, = 0.7797$), in ($= 0.8902, = 0.8755$) and in ($= 0.8848, = 0.8727$) at both genotypic and phenotypic level. The genotypic and phenotypic correlation coefficients for seed cotton yield per plant were significant and positive association with lint yield per plant at both levels. Specifically, these strong associations were observed across the environments with values of ($= 0.8255, = 0.8268$), ($= 0.8603, = 0.8419$), ($= 0.8561, = 0.8441$). While, lint yield per plant in ($= 0.3827, = 0.329$), in ($= 0.4925, = 0.4149$) and ($= 0.3313, = 0.3402$)

were significant and positive correlation with ginning outturn at both genotypic and phenotypic levels. Patel *et al.* (2023)^[7] recorded significant correlation of lint yield per plant with bolls per plant and seed cotton yield per plant.

In all environments, lint index exhibited significant and positive correlation with ginning outturn at both levels viz., in ($= 0.456, = 0.5924$), in ($= 0.5454, = 0.6095$) and in ($= 0.48, = 0.5678$). A similar type of relationship was observed for seed index, in ($= 0.4001, = 0.3253$) and in ($= 0.4059, = 0.3733$) at genotypic and phenotypic level, while, in ($= 0.2687$) at phenotypic level. Significant and positive association between lint index and seed index was reported earlier by Patel *et al.* (2013)^[6] and Kadam *et al.* (2024)^[4]. While positive interaction with ginning outturn was reported by Sanmugapriya *et al.* (2023)^[8].

The seed index exhibited significant and positive correlation with lint index in ($= 0.4001, = 0.3253$), in ($= 0.4059, = 0.3733$) at genotypic and phenotypic level while in ($= 0.2687$) at phenotypic level. In all environments, boll weight established significant and positive correlation notably in ($= 0.2813$), in ($= 0.2724$) at phenotypic level and in ($= 0.3203, = 0.3108$) at genotypic and phenotypic levels. It was exhibited significant and negative association with ginning outturn in ($= -0.6302, = -0.5646$), in ($= -0.6451, = -0.5968$) and in ($= -0.6045, = -0.5484$) at both genotypic and phenotypic levels. Positive and significant association between seed index and lint index was also observed by Patel *et al.* (2013)^[6], Sanmugapriya *et al.* (2023)^[8] and Kadam *et al.* (2024)^[4]. Positive and significant association between seed index and boll weight was observed by Patel *et al.* (2023)^[7]. While, significant and negative association with ginning outturn was observed by Patel *et al.* (2013)^[6].

The oil content exhibited significant and positive correlation with days to 50% flowering in ($= 0.208$) at phenotypic level. Plant height established significant and positive correlation notably in ($= 0.2024$) and in ($= 0.2231$) at phenotypic level. Oil content exhibited significant and negative association with days to 50% boll bursting in ($= -0.2893$) at phenotypic level. Oil content showed non-significant and positive correlation with seed cotton yield per plant in ($= 0.0199$) at phenotypic level. A similar result was reported by and Patel *et al.* (2023)^[7].

The span length exhibited significant and positive correlation with fibre strength in ($= 0.1938$) and in ($= 0.2824$) at phenotypic level. Monopodia per plant established significant and positive correlation in ($= 0.19$) at phenotypic level. Span length exhibited significant and positive association with uniformity index in ($= 0.3268, = 0.3216$) at both genotypic and phenotypic level. Span length exhibited significant and positive correlation with fibre fineness in ($= 0.1767$) at phenotypic level. Chaudhary *et al.* (2017) reported totally opposite findings; span length was significant and positive association with fibre fineness.

Fibre strength exhibited a positive and significant correlation at phenotypic levels with span length in ($= 0.1938$) and in ($= 0.2844$). Whereas, it was found significant and negative association with lint index in ($= -0.209$) at phenotypic level and in ($= -0.3053, = -0.2966$) at both genotypic and phenotypic level. Fibre strength appears to be significantly and negatively linked with seed index in ($= -0.2267$) and in ($= -0.263$). A significant and positive correlation of fiber strength with lint index and seed index at phenotypic level was reported by Patel *et al.* (2023)^[7].

Fibre fineness exhibited a positive and significant correlation at phenotypic levels with lint index in ($= 0.195$), with days to 50% boll bursting in ($= 0.2886$), with plant height in ($= 0.2133$) and with seed index in ($= 0.1767$). Whereas; it was found significant and negative association with monopodia per plant in ($= -0.3492$, $= -0.3355$), in ($= -0.345$, $= -0.3338$) and in ($= -0.3918$, $= -0.3751$) at both genotypic and phenotypic level. In contrast to these findings, Patel *et al.* (2023) [7] observed a significant and positive relationship between fiber fineness and the number of monopodia per plant.

In monopodia per plant appears to be significant and positive correlation with uniformity index at both genotypic and phenotypic level ($= 0.3087$, $= 0.2449$) whereas; in ($= 0.2125$) at phenotypic level. Bolls per plant was significant and positive association with uniformity index at phenotypic level in ($= 0.2575$). Span length was found genotypically and phenotypically significant and positive correlation with

uniformity index in ($= 0.3268$, $= 0.3216$). Kadam *et al.* (2024) [4] recorded significant and positive correlation of uniformity index with span length at both genotypic and phenotypic level.

Overall results of correlation studies revealed that seed cotton yield per plant had positive and significant correlation with bolls per plant, boll weight and lint yield per plant in all three environments. While lint index showed a significant negative correlation with seed cotton yield per plant at both levels in Thasra environment, this negative relationship was significant only at the phenotypic level in Anand and Jabugam environment. The breakdown of this tight negative association at the genotypic level in certain environments implies that simultaneous selection for both seed cotton yield and lint index is possible. Consequently, this provides breeders with flexibility in choosing breeding methodologies to improve overall cotton yield and its component traits.

Table 1: Genotypic () and phenotypic () correlation coefficients among different characters in forty two genotypes of cotton at Anand during Kharif (2023) ()

Characters	DFB	DFBB	PH	MPP	SPP	BPP	BW	SCYP	GOT	LYPP	LI	SI	OC	SL	FS	FFN	UI
DFB	1	0.2661	-0.2096	0.0751	0.0555	0.0909	-0.1232	0.0174	0.1643	0.0938	0.0847	-0.088	0.0311	-0.0296	0.1432	0.0561	-0.0957
	1	0.2438**	-0.1877*	0.0632	0.0458	0.0673	-0.0911	0.0133	0.1027	0.0753	0.0384	-0.0766	0.0278	-0.0238	0.1291	0.0501	-0.0845
DFBB		1	-0.0351	0.0521	-0.178	-0.0103	-0.1644	-0.1128	0.2479	-0.0286	0.142	-0.1584	-0.1793	0.0227	0.0691	0.1549	-0.5228**
		1	-0.0347	0.0538	-0.1622	-0.015	-0.157	-0.1091	0.2*	-0.0388	0.1067	-0.1514	-0.1726	0.0202	0.07	0.149	-0.4903**
PH			1	-0.0164	0.2258	0.3304*	-0.0355	0.2936	0.0817	0.2919	0.0589	-0.0134	0.1676	-0.0377	-0.1258	0.1392	0.0608
			1	-0.0209	0.2108*	0.3139**	-0.033	0.2793**	0.0635	0.2781**	0.0413	-0.0127	0.166	-0.0389	-0.1248	0.1388	0.0617
MPP				1	0.2514	0.3226*	-0.1682	0.1812	0.3823*	0.2744	0.103	-0.3188*	-0.0584	0.159	-0.1684	-0.3492*	0.053
				1	0.2288**	0.2989**	-0.1584	0.1692	0.3414**	0.2484**	0.1132	-0.2971**	-0.0549	0.1569	-0.1631	-0.3355**	0.0457
SPP					1	0.0686	-0.0249	0.069	-0.1316	0.0017	-0.0719	0.0867	-0.0795	-0.0407	-0.0136	-0.1871	-0.0653
					1	0.0676	-0.02	0.0693	-0.1077	0.0123	-0.0564	0.0778	-0.0748	-0.0368	-0.0112	-0.1729	-0.065
BPP						1	-0.2355	0.7737**	0.2355	0.7783**	-0.0808	-0.3127*	-0.0632	-0.1783	0.0471	-0.2284	0.27
						1	-0.2181*	0.7868**	0.203*	0.7797**	-0.0492	-0.2875**	-0.0591	-0.1694	0.0457	-0.2133*	0.2575**
BW							1	0.427**	-0.5371**	0.1613	-0.3165*	0.2826	-0.0092	0.0154	0.0454	0.0215	-0.1946
							1	0.4237**	-0.4891**	0.1673	-0.2886**	0.2813**	-0.0115	0.0157	0.0447	0.0234	-0.1901*
SCYP								1	-0.147	0.8255**	-0.2805	-0.0893	-0.0877	-0.1514	0.0616	-0.2233	0.13
								1	-0.1344	0.8268**	-0.228*	-0.073	-0.0838	-0.1434	0.0596	-0.2067*	0.1244
GOT									1	0.3827*	0.456**	-0.6302**	-0.0496	-0.0093	0.0392	0.0659	-0.0538
									1	0.329**	0.5924**	-0.5646**	-0.0386	-0.0131	0.0278	0.0582	-0.0467
LYPP										1	0.0598	-0.3286*	-0.1064	-0.0864	0.0651	-0.155	0.1167
										1	0.0626	-0.3078**	-0.1016	-0.0818	0.0643	-0.1438	0.1118
LI											1	0.4001**	-0.0021	-0.1223	-0.2469	0.2317	0.0561
											1	0.3253**	0.0033	-0.1051	-0.209*	0.195*	0.0462
SI												1	0.0628	-0.1007	-0.2349	0.1338	0.1117
												1	0.0613	-0.0958	-0.2267*	0.1324	0.1095
OC													1	0.0211	-0.0494	-0.0102	0.0863
													1	0.0193	-0.049	-0.0099	0.0852
SL														1	0.1093	-0.2465	-0.0257
														1	0.1092	-0.2454**	-0.0291
FS															1	0.0214	-0.0525
															1	0.022	-0.0511
FFN																1	-0.2009
																1	-0.1987*
UI																	1
																	1

*, ** Significant at 5% and 1% levels, respectively

Characters	DFF	DFBB	PH	MPP	SPP	BPP	BW	SCYPP	GOT	LYPP	LI	SI	OC	SL	FS	FFN	UI
DFF	1	0.1024	-0.0359	-0.074	0.0265	-0.1089	0.0013	-0.0785	0.0226	-0.0978	-0.1197	-0.1223	0.2348	-0.2635	-0.0665	0.1121	-0.0922
	1	0.1021	-0.0348**	-0.0611	0.0011	-0.1065	0.0184	-0.0707	0.0092	-0.0851	-0.1268	-0.1277	0.208*	-0.232**	-0.0565	0.0952	-0.0432
DFBB		1	-0.108	0.0235	0.1251	0.0135	-0.1064	-0.043	0.3741*	0.1021	0.2644	-0.2018	-0.1308	-0.1213	0.0503	0.044	-0.3321*
		1	-0.0967	0.0131	0.1286	0.015	-0.0905	-0.0308	0.3087**	0.0975	0.195*	-0.1887*	-0.1278	-0.1174	0.0493	0.0427	-0.2891**
PH			1	0.0819	0.3245*	0.2972	-0.0376	0.2592	0.0931	0.2736	-0.0201	-0.1081	0.2069	-0.0705	-0.2465	0.0223	0.0925
			1	0.0753	0.2979**	0.2905**	-0.0396	0.2502**	0.0943	0.2643**	-0.0028	-0.1016	0.2024*	-0.0679	-0.243**	0.0218	0.0776
MPP				1	0.193	0.3166*	-0.1305	0.2024	0.3274*	0.2714	0.2022	-0.1918	-0.0525	0.2022	-0.2994	-0.345*	0.3087*
				1	0.1683	0.2869**	-0.1208	0.1805*	0.3053**	0.2464**	0.1873*	-0.18*	-0.0479	0.19*	-0.2838**	-0.3338**	0.2449**
SPP					1	0.266	0.0591	0.2854	-0.0216	0.2135	0.0394	0.0751	-0.1075	-0.0317	0.0762	-0.0773	0.002
					1	0.2587**	0.0589	0.2775**	-0.0188	0.2009*	0.0408	0.0755	-0.1012	-0.0265	0.0806	-0.0726	0.0048
BPP						1	-0.2445	0.7825**	0.3793*	0.8902**	0.0526	-0.3833*	-0.0634	-0.0408	0.0976	-0.2977	0.0026
						1	-0.2304**	0.7899**	0.3213**	0.8755**	0.0224	-0.3657**	-0.0607	-0.0344	0.0943	-0.2855**	-0.0141
BW							1	0.4039**	-0.5056**	0.0436	-0.3273*	0.2766	0.0143	0.0133	-0.0441	0.0811	-0.0677
							1	0.406**	-0.4822**	0.0436	-0.3052**	0.2724**	0.015	0.0123	-0.0429	0.0775	-0.0625
SCYPP								1	-0.198	0.8603**	-0.1669	-0.1741	-0.0695	-0.0416	0.0511	-0.2515	-0.0304
								1	-0.0144	0.8419**	-0.1763*	-0.1617	-0.0657	-0.0356	0.0488	-0.2401**	-0.0411
GOT									1	0.4925**	0.5454**	-0.6451**	-0.0526	0.0749	0.023	-0.1264	-0.1833
									1	0.4149**	0.6095**	-0.5968**	-0.0491	0.0607	0.0222	-0.117	-0.1641
LYPP										1	0.0831	-0.4859*	-0.1383	0.0186	0.0368	-0.2806	-0.0943
										1	0.0436	-0.4578**	-0.133	0.0212	0.0342	-0.2649**	-0.1003
LI											1	0.2855	-0.0478	-0.031	-0.1395	0.0361	-0.04
											1	0.2687**	-0.0423	-0.0396	-0.1216	0.0328	-0.0561
SI												1	0.0252	-0.137	-0.1432	0.1612	0.183
												1	0.0248	-0.1365	-0.1405	0.1589	0.1482
OC													1	-0.0267	-0.0696	0.0198	0.1646
													1	-0.0258	-0.0688	0.02	0.1512
SL														1	0.1943	-0.0373	-0.0786
														1	0.1938*	-0.037	-0.0748
FS															1	0.0452	-0.164
															1	0.0459	-0.1464
FFN																1	-0.1626
																1	-0.1485
UI																	1
																	1

*, ** Significant at 5% and 1% levels, respectively

Characters	DFF	DFBB	PH	MPP	SPP	BPP	BW	SCYPP	GOT	LYPP	LI	SI	OC	SL	FS	FFN	UI
DFF	1	0.2974	0.0454	-0.0785	0.2279	0.1671	0.1588	0.2906	-0.152	0.1961	-0.2616	-0.0708	-0.0032	-0.1511	0.1167	0.0832	-0.1055
	1	0.1716	0.0314	-0.0705	0.1502	0.0836	0.104	0.1649	-0.1403	0.0705	-0.222*	-0.0595	-0.0072	-0.1048	0.081	0.0623	-0.0649
DFBB		1	-0.0894	0.1162	0.0686	0.0674	-0.1127	0.0091	0.1957	0.0853	0.2631	0.0176	-0.3022	0.0126	-0.0877	0.3039	-0.1535
		1	-0.0885	0.0945	0.0684	0.0632	-0.1098	0.0066	0.1801*	0.0799	0.2348**	0.0209	-0.2893**	0.0124	-0.0811	0.2886**	-0.1461
PH			1	0.0037	0.1903	0.358*	-0.0445	0.3268*	-0.0094	0.324*	-0.0438	-0.0185	0.2238	-0.0633	-0.2949	0.2139	-0.029
			1	0.0095	0.1888*	0.3413**	-0.045	0.3053**	-0.0094	0.3014**	-0.0398	-0.0199	0.2231*	-0.0624	-0.2875**	0.2133*	-0.0348
MPP				1	0.1366	0.3311*	-0.3032	0.101	0.4305**	0.3177	0.2591	-0.2234	-0.0565	0.18	-0.0402	-0.3918*	0.235
				1	0.1271	0.3103**	-0.275**	0.1001	0.3794**	0.2964**	0.2285*	-0.206*	-0.0522	0.1726	-0.0501	-0.3751**	0.2125*
SPP					1	0.1382	-0.1044	0.0719	-0.0456	0.0561	-0.0041	0.0442	-0.0603	-0.0016	-0.0651	-0.0906	0.0298
					1	0.1264	-0.0965	0.0643	-0.0314	0.055	0.0051	0.0407	-0.0598	-0.0022	-0.0675	-0.0912	0.0213
BPP						1	-0.2803	0.775**	0.2616	0.8848**	-0.0355	-0.3045*	0.0367	-0.09	0.0053	-0.2615	0.1305
						1	-0.2561**	0.7828**	0.2212*	0.8727**	-0.0401	-0.2876**	0.0359	-0.0818	-0.002	-0.2504**	0.1262
BW							1	0.3832*	-0.6785**	0.0114	-0.4325**	0.3203*	-0.0018	-0.0354	0.0576	0.0792	-0.1691
							1	0.3941**	-0.6432**	0.0299	-0.4122**	0.3108**	-0.0014	-0.035	0.0673	0.0767	-0.1517
SCYPP								1	-0.1986	0.8561**	-0.3138*	-0.0739	0.0199	-0.1164	0.0239	-0.213	0.0044
								1	-0.2105*	0.8441**	-0.3026**	-0.0645	0.02	-0.1056	0.0234	-0.2008*	0.0145
GOT									1	0.3313*	0.48**	-0.6045**	-0.1602	0.0705	-0.0026	-0.1078	-0.0762
									1	0.3402**	0.5678**	-0.5484**	-0.1459	0.0639	-0.0293	-0.1027	-0.0855
LYPP										1	-0.0652	-0.3984**	-0.0485	-0.0754	0.0062	-0.2528	-0.0463
										1	0.0056	-0.3702**	-0.0454	-0.0676	-0.0072	-0.2404**	-0.0424
LI											1	0.4059**	-0.1305	-0.1445	-0.3053*	0.0783	-0.1227
											1	0.3733**	-0.1139	-0.1221	-0.2966**	0.0629	-0.1249
SI												1	0.0521	-0.2159	-0.2734	0.1803	-0.0483
												1	0.0517	-0.2062*	-0.263**	0.1767*	-0.0457
OC													1	0.0431	-0.016	0.0954	0.1207
													1	0.0424	-0.0162	0.0949	0.1174
SL														1	0.2911	-0.1103	0.3268*
														1	0.2824**	-0.1092	0.3216**
FS															1	-0.0126	0.0724
															1	-0.0105	0.0761
FFN																1	-0.3412*
																1	-0.3346**
UI																	1
																	1

*, ** Significant at 5% and 1% levels, respectively

Conclusion

Overall results of correlation studies revealed that seed cotton yield per plant had positive and significant correlation with bolls per plant, boll weight and lint yield per plant in all three environments. While lint index showed a significant negative correlation with seed cotton yield per plant at both levels in Thasra environment, this negative relationship was significant only at the phenotypic level in

Anand and Jabugam environment. The breakdown of this tight negative association at the genotypic level in certain environments implies that simultaneous selection for both seed cotton yield and lint index is possible. Consequently, this provides breeders with flexibility in choosing breeding methodologies to improve overall cotton yield and its component traits.

In many cases, the presence of a significant and negative correlation at the phenotypic level, but not at the genotypic level, indicates that simultaneous improvement of yield and quality traits is achievable through the implementation of appropriate breeding methodologies. Generally, the nature of inter-trait correlations may enhance or retard the selection progress. A positive association between component traits indicates that the selection for improvement in one of the yield component would result in a concomitant increase in the other.

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