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PLANTING DENSITY DEPENDENT TRAIT ASSOCIATION AND THEIR IMPLICATIONS FOR IDEOTYPE BREEDING IN UPLAND COTTON (*Gossypium hirsutum* L.)

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ABSTRACT

The current study was performed at Main agricultural research station, Raichur, Karnataka in Kharif, 2021 to evaluate the inter relationship between traits at different planting densities and how selection of one trait effects another trait. The study was done using different planting geometries to analyze if spacing had any effect on how traits were influencing each other at different planting densities. It was observed that seed cotton yield showed high correlation with number of sympodia per plant, boll weight and number of reproductive nodes per plant in E1, with number of bolls per plant, boll weight in E2 and boll weight and lint yield per plant in E3. This study helped in selection of traits for development of plant type suitable for that particular planting density.

Key words: Ideotype, HDPS, Seed cotton yield.

Introduction

Cotton (*Gossypium hirsutum* L.) is the most widely cultivated natural fibre crop in the world, occupying an area of approximately 11.4 million hectares with a production of 29 million bales (Ministry of textiles, India). India ranks first globally in cotton acreage and production; however, its productivity remains considerably lower than the global average. Among the several factors limiting cotton productivity, sub-optimal planting density is recognized as one of the major constraints. Adoption of high-density planting systems (HDPS) has emerged as an effective strategy to enhance productivity per unit area by improving light interception, resource utilization and overall crop efficiency.

Successful adoption of HDPS, however, requires cotton cultivars with plant architectures suited to the target planting geometry. The concept of the ideotype, proposed by Donald C.M. (1968), has provided a scientific framework for designing crop plants with architectural characteristics tailored to specific production environments, management practices and breeding objectives. Since then, ideotypes have been developed

for diverse environments and production systems, and more recently, simulation-based approaches have been employed to design ideotypes for future climatic conditions. In cotton, Singh and Narayanan (1993) proposed an ideotype for rainfed cultivation, while subsequent studies have classified genotypes into compact, erect and spreading plant types based on their architectural characteristics. Nevertheless, the suitability of these plant types largely depends on the planting density under which they are cultivated.

Development of planting density-specific ideotypes requires a clear understanding of how architectural and yield component traits interact to determine seed cotton yield under different crop densities. Since seed cotton yield is a complex quantitative trait influenced by numerous interrelated characters, direct selection for yield alone is often inefficient. Correlation analysis provides information on the magnitude and direction of association among component traits, whereas path coefficient analysis partitions these associations into direct and indirect effects, thereby identifying traits with genuine causal influence on yield. The integration of these analyses enables

Table 1: Genotypic correlation between yield, yield attributing and fibre quality traits of cotton (*Gossypium hirsutum* L.) in E₁.

	PH	NSP	NBP	BW	NRNP	BR	SI	LYP	GOT	LI	UHML	SCYP
PH	1											
NSP	0.317											
NBP	-0.452**	0.564**										
BW	-0.380*	-0.177	0.015									
NRNP	0.326	0.737**	0.414*	-0.242								
BR	0.668**	0.077	-0.651**	-0.137	0.441**							
SI	-0.009	-0.573**	-0.588**	0.088	-0.524**	0.065						
LYP	0.262	0.129	-0.114	0.498**	0.100	0.203	-0.466**					
GOT	0.108	-0.253	-0.192	0.197	-0.392*	-0.054	-0.438**	0.641**				
LI	-0.050	-0.683**	-0.491**	0.333*	-0.816**	-0.157	0.225	0.292	0.773**			
UHML	0.425**	-0.216	-0.550**	-0.058	-0.306	0.256	0.677**	-0.197	-0.130	0.246		
SCYP	0.259	0.545**	0.089	0.418*	0.574**	0.350*	-0.197	0.576**	-0.251	-0.486**	-0.085	1

*, ** significant at 5% (P = 0.05) and 1% (P = 0.01) respectively
 PH- Plant height (cm), NSP-Number of sympodia/plant, NRNP-Number of reproductive nodes/plant,
 NBP-Number of bolls/plant, BR-Boll retention (%), BW-Boll weight (g), SCYP-Seed cotton yield/plant (g), LYP-Lint
 yield/plant(g), SI-Seed index(g), Ginning out turn-GOT (%), LI-Lint index, UHML-Upper half mean length (mm)

breeders to distinguish traits that contribute directly to productivity from those whose effects are mediated through other characters.

Planting density alters crop competition, canopy architecture, light interception and assimilate partitioning, thereby modifying the relationships among plant architectural and reproductive traits. Consequently, the relative importance of individual yield components may vary across planting geometries, indicating that selection criteria effective under one planting density may not necessarily remain effective under another. Understanding these density-dependent changes in trait associations is therefore essential for developing spacing-specific breeding strategies and designing ideotypes optimized for high-density planting systems.

In view of these considerations, the present investigation was undertaken to elucidate the relationships among architectural, yield component and fibre quality traits under contrasting planting densities using correlation and path coefficient analyses, with the objective of identifying spacing-specific selection criteria for ideotype development aimed at improving seed cotton yield.

Material and methods

The experiment was carried out at Main Agricultural Research Station, Raichur during *Kharif*, 2021-22. Raichur comes under North-Eastern Dry Zone (Zone-2) of Karnataka. It is located between 16° 15' N latitude and 77° 21' E longitude with an altitude of 389 m above mean sea level. Twelve cotton genotypes were planted under three different planting densities i.e., E1: 90 × 15cm, E2 75 × 15cm and E3: 60 × 15cm.

Data on morphological, yield, and fibre quality traits

were recorded from five randomly selected competitive plants in each genotype of every replication. Plant height (cm) was measured from the ground level to the apical tip at 90 DAS and subsequently at 15-day intervals until maturity. The number of sympodia per plant was recorded by counting all fruiting branches at maturity, while the total number of harvested bolls per plant was recorded at picking. Boll weight (g) was estimated as the average weight of ten well-opened bolls. The total number of reproductive nodes was counted at maturity, and boll retention (%) was calculated as the percentage of retained bolls over the total number of reproductive nodes. Seed cotton yield per plant (g) was determined by weighing the seed cotton harvested from the selected plants, while lint yield per plant (g) was recorded after ginning. Ginning outturn (GOT, %) was calculated as the ratio of lint weight to seed cotton weight multiplied by 100.

$$\text{GOT (\%)} = \frac{\text{Weight of lint yield (g)}}{\text{Weight of seed cotton yield (g)}} \times 100$$

Seed index (g) was determined by weighing 100 randomly selected, well-filled seeds. Lint index was computed using the formula:

$$\text{Lint index} = \frac{\text{Seed index} \times \text{GOT (\%)}}{100 - \text{GOT (\%)}}$$

Fibre quality was assessed by measuring upper half mean length (UHML, mm) using a High Volume Instrument (HVI), which estimates the average length of the longest 50% of fibres by weight through optical scanning of a fibre beard. Correlation analysis and path coefficient analysis was performed using 'r' software.

'r' value was calculated using formula given by Singh and Narayan (1993).

Table 2: Genotypic correlation between yield, yield attributing and fibre quality traits of cotton (*Gossypium hirsutum* L.) in E₂.

	PH	NSP	NBP	BW	NRNP	BR	SI	LYP	GOT	LI	UHML	SCYP
PH	1											
NSP	0.761**	1										
NBP	-0.220	0.253	1									
BW	-0.006	0.097	-0.254	1								
NRNP	0.625**	0.704**	0.370*	-0.668**	1							
BR	0.281	-0.217	-0.657**	-0.309	0.197	1						
SI	0.170	0.099	-0.341*	0.873**	-0.449**	0.073	1					
LYP	-0.430**	-0.308	0.190	0.633**	-0.430**	-0.455**	-0.035	1				
GOT	-0.402*	-0.325	-0.089	0.959**	-0.556**	-0.304	0.339*	0.819**	1			
LI	-0.329	-0.279	-0.183	1.020**	-0.596**	-0.237	0.518**	0.718**	0.980**	1		
UHML	0.362*	0.146	0.016	-0.332*	0.171	0.347*	0.563**	-0.610**	-0.525**	-0.375*	1	
SCYP	-0.059	-0.002	0.419*	0.502**	0.200	-0.239	-0.621**	0.377*	-0.219	-0.348*	-0.254	1

*, ** significant at 5% (P = 0.05) and 1% (P = 0.01) respectively

PH- Plant height (cm), NSP-Number of sympodia/plant, NRNP-Number of reproductive nodes/plant, NBP-Number of bolls/plant, BR-Boll retention (%), BW-Boll weight (g), SCYP-Seed cotton yield/plant (g), LYP-Lint yield/plant(g), SI-Seed index(g), Ginning out turn-GOT (%), LI-Lint index, UHML-Upper half mean length (mm)

$$r = \frac{\text{Cov}(XY)}{\sqrt{\text{Var}(X) \times \text{Var}(Y)}}$$

Results and Discussion

Seed cotton yield is a complex quantitative trait resulting from the cumulative contribution of several architectural and yield component traits. Since planting geometry alters crop competition, canopy architecture and assimilate partitioning, the magnitude and direction of associations among component traits are expected to vary with spacing. Correlation analysis (Table 1-3) revealed that the traits associated with seed cotton yield differed across planting geometries, while path coefficient analysis (Table 4-6) further partitioned these associations into direct and indirect effects, thereby identifying the most reliable selection criteria for each environment.

Under the widest spacing (E1), seed cotton yield exhibited positive associations with the strongest correlations for number of reproductive nodes, number of sympodia and lint yield. These results indicate that when inter-plant competition is minimal, plants capable of producing a larger reproductive framework contribute more effectively towards yield improvement. Similar associations of seed cotton yield with plant height, sympodial branches, boll weight and lint yield have been reported by Alkuddsi *et al.*, (2013), Parmar *et al.*, (2016), Raza *et al.*, (2016), Bhailume *et al.*, (2016), Rathinavel *et al.*, (2017), Nawaz *et al.*, (2019), Rahman *et al.*, (2020), Shruti *et al.*, (2020), Sahar *et al.*, (2021), Parre and Patil (2021) and Hampannavar *et al.*, (2021)

However, correlation alone does not distinguish whether these relationships arise from true causal effects or through indirect associations. Path coefficient analysis

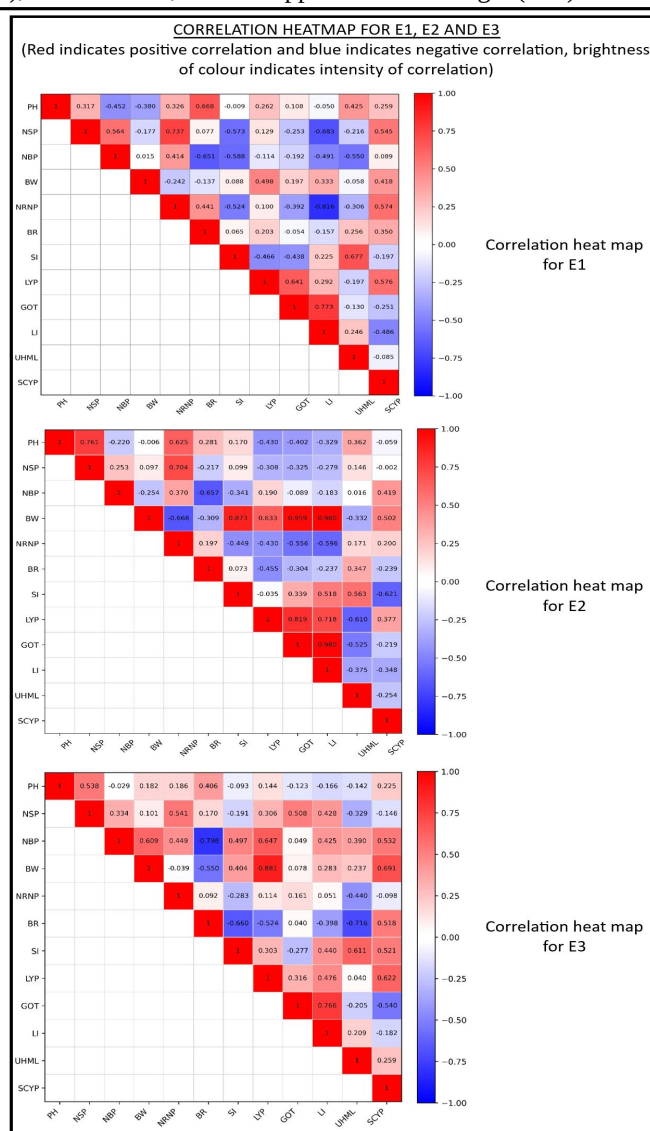
**Fig. 1:** Correlation Heat Map for E₁, E₂ and E₃.

Table 3: Genotypic correlation between yield, yield attributing and fibre quality traits of cotton (*Gossypium hirsutum* L.) in E₃.

	PH	NSP	NBP	BW	NRNP	BR	SI	LYP	GOT	LI	UHML	SCYP
PH	1											
NSP	0.538**											
NBP	-0.029	0.334*										
BW	0.182	0.101	0.609**									
NRNP	0.186	0.541**	0.449**	-0.039								
BR	0.406*	0.170	-0.798**	-0.550**	0.092							
SI	-0.093	-0.191	0.497**	0.404*	-0.283	-0.660**						
LYP	0.144	0.306	0.647**	0.881**	0.114	-0.524**	0.303					
GOT	-0.123	0.508**	0.049	0.078	0.161	0.040	-0.277	0.316				
LI	-0.166	0.428**	0.425**	0.283	0.051	-0.398*	0.440**	0.476**	0.766**			
UHML	-0.142	-0.329*	0.398*	0.237	-0.440**	-0.716**	0.611**	0.040	-0.205	0.209		
SCYP	0.225	-0.146	0.532**	0.691**	-0.098	0.518**	0.521**	0.622**	-0.540**	-0.182	0.259	1

*, ** significant at 5% (P = 0.05) and 1% (P = 0.01) respectively
 PH- Plant height (cm), NSP-Number of sympodia/plant, NRNP-Number of reproductive nodes/plant,
 NBP-Number of bolls/plant, BR-Boll retention (%), BW-Boll weight (g), SCYP-Seed cotton yield/plant (g), LYP-Lint
 yield/plant(g), SI-Seed index(g), Ginning out turn-GOT (%), LI-Lint index, UHML-Upper half mean length (mm)

Table 4: Genotypic path component analysis for yield, yield component and fibre quality traits in cotton (*Gossypium hirsutum* L.) in E₁. (Residual : -0.01497)

	PH	NSP	NBP	BW	NRNP	BR	SI	LYP	GOT	LI	UHML	SCYP
PH	0.09896	0.14174	0.00198	-0.0427	0.03961	0.03892	-0.0021	0.23717	-0.0944	-0.0176	-0.063	-0.564**
NSP	0.03139	0.4469	-0.0025	-0.0199	0.08957	0.00451	-0.1304	0.11672	0.22113	-0.2386	0.03203	0.495*
NBP	-0.0447	0.25218	0.00439	0.00168	0.0504	-0.0379	-0.1338	-0.1031	0.16765	-0.1714	0.0815	0.1988
BW	-0.0377	-0.0792	-7E-05	0.11235	-0.0294	-0.008	0.02008	0.45048	-0.1724	0.11624	0.00858	0.632**
NRNP	0.03223	0.32918	-0.0018	-0.0272	0.1216	0.02567	-0.1194	0.0903	0.34273	-0.2851	0.04535	0.551**
BR	0.06614	0.03459	0.00286	-0.0154	0.05361	0.05823	0.01469	0.18395	0.04726	-0.0547	-0.038	0.2210
SI	-0.0009	-0.256	0.00258	0.00991	-0.0638	0.00376	0.22761	-0.4214	0.38283	0.0787	-0.1004	0.2587
LYP	0.02593	0.05762	0.0005	0.05591	0.01213	0.01183	-0.106	0.90523	-0.5605	0.10198	0.02918	0.1899
GOT	0.01068	-0.113	0.00084	0.02215	-0.0477	-0.0032	-0.0996	0.58008	-0.8747	0.27011	0.0193	0.452*
LI	-0.005	-0.3053	0.00216	0.03739	-0.0993	-0.0091	0.05128	0.26429	-0.6764	0.3493	-0.0365	0.712**
UHML	0.04208	-0.0966	0.00241	-0.0065	-0.0372	0.01493	0.15412	-0.1782	0.11392	0.08608	-0.1482	0.2150
SCYP	-0.564**	0.495*	0.1988	0.632**	0.551**	0.2210	0.2587	0.1899	0.452*	0.712**	0.2150	1.0000

*, ** significant at 5% (P = 0.05) and 1% (P = 0.01) respectively
 PH- Plant height (cm), NSP-Number of sympodia/plant, NRNP-Number of reproductive nodes/plant,
 NBP-Number of bolls/plant, BR-Boll retention (%), BW-Boll weight (g), SCYP-Seed cotton yield/plant (g), LYP-Lint
 yield/plant(g), SI-Seed index(g), Ginning out turn-GOT (%), LI-Lint index, UHML-Upper half mean length (mm)

Table 5: Genotypic path component analysis for yield, yield component and fibre quality traits in cotton (*Gossypium hirsutum* L.) in E₂. (Residual : -0.03417)

	PH	NSP	NBP	BW	NRNP	BR	SI	LYP	GOT	LI	UHML	SCYP
PH	0.22376	-0.0215	0.16209	0.00147	0.20189	-0.2114	-0.0107	-0.683	0.78645	-0.1879	-0.0798	-0.610**
NSP	0.17023	-0.0283	-0.1867	-0.0236	0.22735	0.16295	-0.0062	-0.4892	0.63659	-0.1595	-0.0321	0.2932
NBP	-0.0492	-0.0072	0.73784	0.06209	0.11955	0.49365	0.02141	0.302	0.17375	-0.1046	-0.0035	0.2242
BW	-0.0014	-0.0027	0.18772	0.24404	-0.2158	0.2322	-0.0547	1.00513	-1.8769	0.58249	0.07312	0.551**
NRNP	0.1398	-0.0199	-0.273	0.16296	0.32314	-0.1479	0.02815	-0.683	1.08868	-0.3402	-0.0377	0.588**
BR	0.06295	0.00613	0.4848	0.07542	0.0636	0.75131	-0.0046	-0.7228	0.59411	-0.1356	-0.0766	0.1584
SI	0.03813	-0.0028	0.25195	-0.213	-0.1451	-0.0551	0.0627	-0.0548	-0.6643	0.29606	-0.1242	0.0260
LYP	-0.0962	0.0087	-0.1403	-0.1545	-0.139	0.34193	0.00217	1.58814	-1.6035	0.40995	0.13451	0.683**
GOT	-0.0899	0.00919	0.06551	-0.2341	-0.1798	0.2281	-0.0213	1.30134	-1.9569	0.56	0.11586	0.488*
LI	-0.0736	0.00789	0.13507	-0.2489	-0.1925	0.17841	-0.0325	1.13982	-1.9185	0.57119	0.08262	0.455*
UHML	0.08098	-0.0041	-0.0119	0.08093	0.05532	-0.261	-0.0353	-0.9689	1.02827	-0.214	-0.2205	0.378*
SCYP	-0.610**	0.2932	0.2242	0.551**	0.588**	0.1584	0.0260	0.683**	0.488*	0.455*	0.378*	1.0000

*, ** significant at 5% (P = 0.05) and 1% (P = 0.01) respectively
 PH- Plant height (cm), NSP-Number of sympodia/plant, NRNP-Number of reproductive nodes/plant,
 NBP-Number of bolls/plant, BR-Boll retention (%), BW-Boll weight (g), SCYP-Seed cotton yield/plant (g), LYP-Lint
 yield/plant(g), SI-Seed index(g), Ginning out turn-GOT (%), LI-Lint index, UHML-Upper half mean length (mm)

Table 6: Genotypic path component analysis for yield, yield component and fibre quality traits in cotton (*Gossypium hirsutum* L.) in E₃. (Residual : -0.00719)

	PH	NSP	NBP	BW	NRNP	BR	SI	LYP	GOT	LI	UHML	SCYP
PH	-0.0546	0.1064	0.00734	-0.01602	0.04439	-0.19043	0.00045	0.14697	0.11473	0.00835	0.02449	-0.738**
NSP	-0.02937	0.19776	-0.08383	-0.00885	0.12922	-0.07987	0.00092	0.3114	-0.47369	-0.02146	0.05667	0.2224
NBP	0.0016	0.06606	0.25098	-0.0536	0.10731	0.37385	-0.00238	0.65871	-0.04529	-0.02132	-0.0684	0.369*
BW	-0.00994	0.01989	-0.15285	0.088	-0.00941	0.25783	-0.00194	0.8964	-0.07236	-0.01421	-0.04078	0.1916
NRNP	-0.01014	0.10691	-0.11267	0.00347	0.23903	-0.04329	0.00136	0.11573	-0.15025	-0.00254	0.07567	0.444*
BR	-0.02218	0.0337	0.20017	0.04841	0.02207	0.46874	0.00317	-0.53266	-0.03714	0.01995	0.12315	0.682**
SI	0.00509	-0.03784	-0.12476	-0.03553	-0.06762	0.30945	-0.0048	0.30791	0.25899	-0.02205	-0.10511	0.475*
LYP	-0.00789	0.06053	-0.1625	-0.07754	0.02719	0.24542	-0.00145	1.01738	-0.29535	-0.02388	-0.00697	0.2697
GOT	0.00671	0.10036	-0.01218	-0.00682	0.03848	-0.01865	0.00133	0.32194	-0.93336	-0.03842	0.03528	0.1571
LI	0.00909	0.08461	-0.10671	-0.02493	0.01213	0.18648	-0.00211	0.4844	-0.71504	-0.05015	-0.03599	0.440*
UHML	0.00777	-0.06513	-0.09978	-0.02086	-0.10513	0.3355	-0.00293	0.04119	0.19141	-0.01049	-0.17206	0.402*
SCYP	-0.738**	0.2224	0.369*	0.1916	0.444*	0.682**	0.475*	0.2697	0.1571	0.440*	0.402*	1.0000

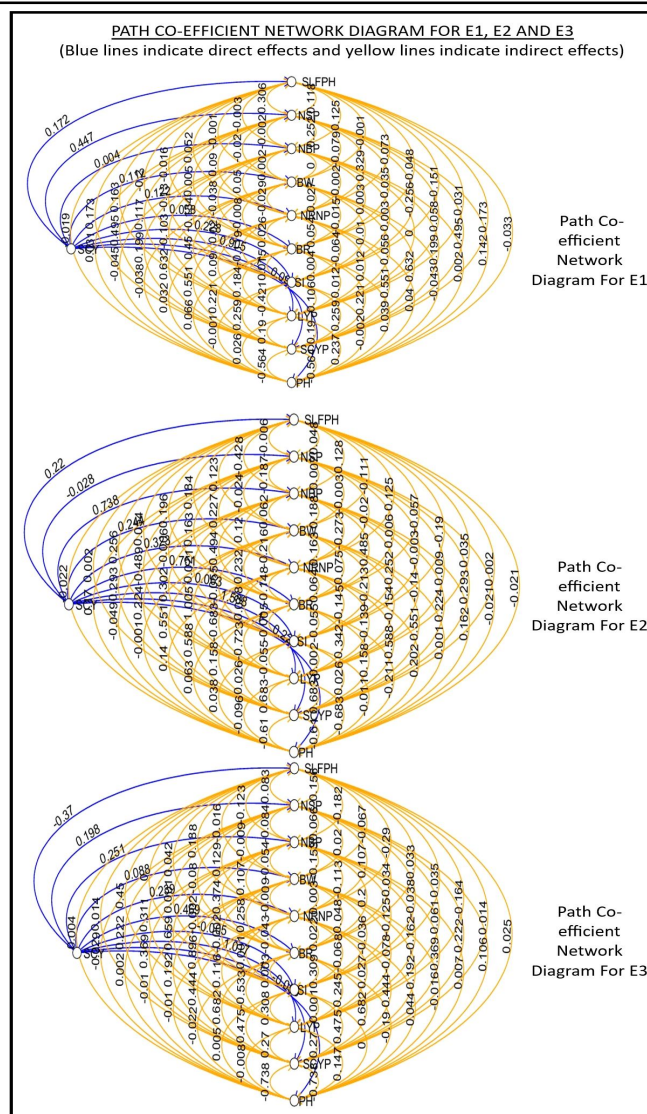
*, ** significant at 5% (P = 0.05) and 1% (P = 0.01) respectively

PH- Plant height (cm), NSP-Number of sympodia/plant, NRNP-Number of reproductive nodes/plant, NBP-Number of bolls/plant, BR-Boll retention (%), BW-Boll weight (g), SCYP-Seed cotton yield/plant (g), LYP-Lint yield/plant(g), SI-Seed index(g), Ginning out turn-GOT (%), LI-Lint index, UHML-Upper half mean length (mm)

demonstrated that number of sympodia exerted the highest positive direct effect on seed cotton yield, followed by number of reproductive nodes, seed index and lint yield per plant. Although plant height and boll weight were positively correlated with yield, much of their contribution was mediated indirectly through reproductive traits and lint yield rather than through large direct effects. These findings suggest that under wider spacing, improvement in yield is primarily achieved by enhancing reproductive capacity rather than merely increasing vegetative growth. Consequently, selection for genotypes possessing a well-developed fruiting framework with higher reproductive node production and efficient assimilate partitioning would be more effective than selection based solely on plant size.

Under the intermediate spacing (E2), the pattern of association shifted considerably. Seed cotton yield showed stronger positive associations with number of bolls per plant, boll weight and lint yield per plant, whereas associations with vegetative architectural traits became comparatively weaker. Moderate plant density appears to maintain a balance between vegetative growth and reproductive development, enabling both boll production and boll filling to contribute substantially towards yield. Similar positive associations between seed cotton yield, boll number and boll weight have been reported by Srinivas *et al.*, (2015), Rathinavel *et al.*, (2017), Nawaz *et al.*, (2019), Salem *et al.*, (2021) and Hampannavar *et al.*, (2021).

The path analysis further substantiated these relationships by revealing substantial positive direct effects of boll number, boll weight, number of reproductive nodes,

**Fig. 2:** Path Co-Efficient Network Diagram for E₁, E₂ and E₃.

boll retention and lint yield on seed cotton yield. The coincidence of strong positive correlation with high direct effects indicates that these characters contribute independently to yield and therefore represent reliable targets for direct selection. Compared with E1, the relative importance of vegetative architecture declined, while sink-related traits assumed greater significance. This transition suggests that under moderate plant density, efficient fruit production and retention become the major determinants of productivity, reflecting a more balanced source-sink relationship.

A further change in trait relationships was observed under the closest spacing (E3), where increased plant competition substantially modified yield formation. Seed cotton yield exhibited strong positive associations with boll weight, number of bolls per plant and lint yield per plant, whereas the contribution of several architectural traits was reduced. Although competition restricted vegetative expansion, productive genotypes were those capable of maintaining fruit production and boll development despite limited resources. Path coefficient analysis demonstrated that number of sympodia, number of bolls per plant, number of reproductive nodes, boll retention and lint yield exerted positive direct effects on seed cotton yield, confirming that reproductive efficiency rather than vegetative vigour becomes the principal determinant of productivity under high-density conditions. The indirect effects further indicated that several architectural traits influenced yield primarily through their effects on reproductive development, emphasizing the importance of assimilate partitioning towards economically productive organs.

The combined interpretation of correlation and path analyses clearly demonstrates that planting geometry modifies the functional relationships among architectural and yield component traits. The principal determinants of seed cotton yield were not identical across environments, indicating that the biological basis of yield formation changes with spacing. Under wider spacing, yield improvement depended largely on the development of an extensive reproductive framework through increased sympodia and reproductive nodes. Under intermediate spacing, both sink size and sink number contributed simultaneously, making boll weight and boll number the principal selection criteria. Under closer spacing, reproductive efficiency, fruit retention and maintenance of boll production under competitive conditions became increasingly important.

Conclusion

These findings have important implications for cotton

improvement under high-density planting systems. The variability in trait associations across planting geometries demonstrates that a common selection criterion cannot be universally applied across environments. Such environment-specific selection strategies would facilitate the development of ideotypes possessing architectural features best suited for the target planting geometry. Ideotypes intended for high-density systems should emphasize reproductive efficiency, fruit retention and efficient partitioning of assimilates into boll production.

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References

- Alkuddsi, Y., Rao M.G., Patil S.S., Joshi M. and Gowda T.H. (2013). Correlation and path coefficient analysis between seed cotton yield and its attributing characters in intra hirsutum cotton hybrids. *Molecular Plant Breeding*, **4**(26), 214-216.
- Bhailume, M.S., Borole D.N. and Magar N.M. (2016). Correlation and path analysis between seed cotton yield and its attributing characters in deshi cotton. *Journal of Cotton Research and Development*, **30**(1), 29-31.
- Donald, C.M. (1968). The breeding of crop ideotypes. *Euphytica*, **17**(3), 385-403.
- Hampannavar, M.R., Patil B.R., Katageri I.S., Kumar B.A. and Janagoudar B.S. (2020). Genetic variability and correlation analysis for agronomic and fibre quality traits in intra-specific cotton (*Gossypium hirsutum* × *Gossypium hirsutum*) recombinant inbred lines (RILs). *International Journal of Current Microbiology and Applied Sciences*, **9**(1), 493-503.
- Ministry of Textiles (2025). Available from: <https://www.texmin.gov.in/static/uploads/2025/07/db767d1d1501e27672906cd8c320c5f4.pdf>
- Nawaz, B., Sattar S. and Malik T.A. (2019). Genetic analysis of yield components and fiber quality parameters in upland cotton. *International Multidisciplinary Research Journal*, **9**, 13-19.
- Parmar, M.B., Kapadia V.N., Patel B.C. and Patel A.D. (2016). Genetic analysis for variability and relationship studies for seed cotton yield and its yield attributing traits in Bt cotton hybrids (*Gossypium hirsutum*). *Advances in Life Sciences*, **5**(1), 194-196.
- Parre, S. and Patil R.S. (2021). Correlation studies and path coefficient analysis of yield attributing traits among selected F₂ populations of intra-hirsutum cotton hybrids under rain-fed situation. *Journal of Pharmacognosy and Phytochemistry*, **10**(3), 942-950.

- Rathinavel, K., Kavitha H. and Priyadharshini C. (2017). Assessment of genetic variability and correlation analysis of seed and seed cotton yield attributing traits of tetraploid cotton genotypes (*Gossypium hirsutum* L.). *Electronic Journal of Plant Breeding*, **8(4)**, 1275-1283.
- Raza, H., Khan N.U., Khan S.A., Gul S., Latif A., Hussain I., Khan J., Raza S. and Baloch M. (2016). Genetic variability and correlation studies in F₂ populations of upland cotton. *Journal of Animal and Plant Sciences*, **26(4)**, 1048-1055.
- Rehman, A., Mustafa N., Du X. and Azhar M.T. (2020). Heritability and correlation analysis of morphological and yield traits in genetically modified cotton. *Journal of Cotton Research*, **3(1)**, 1-9.
- Sahar, A., Zafar M.M., Razzaq A., Mannan A., Haroon M., Sajib S. and Rehman A. (2021). Genetic variability for yield and fiber related traits in genetically modified cotton. *Journal of Cotton Research*, **4(1)**, 1-10.
- Salem, T.S., Rabie H.A., Mowafy S.A.E., Eissa A.E.M. and Mansour E. (2021). Genetic variability and interrelationships among earliness characters, yield-related traits and fiber quality parameters in certain cotton genotypes. *Zagazig Journal of Agricultural Research*, **48(4)**, 967-974.
- Shruti, Sowmya H.C., Nidagundi J.M., Lokesha R., Arunkumar B. and Shankar M. (2020). Correlation and path coefficient analysis for seed cotton yield, yield attributing and fibre quality traits in cotton (*Gossypium hirsutum* L.). *International Journal of Current Microbiology and Applied Sciences*, **9(2)**, 200-207.
- Singh, P. and Narayan S.S. (1993). *Biometrical Techniques in Plant Breeding*. Kalyani Publishers, New Delhi.
- Singh, P. and Narayanan S.S. (1993). A brief review on breeding aspects of plant type in cotton. *Journal of the Indian Society for Cotton Improvement*, **18**, 1-14.
- Srinivas, B., Bhadru D. and Brahmeswara Rao M.V. (2015). Correlation and path coefficient analysis for seed cotton yield and its components in American cotton (*Gossypium hirsutum* L.). *Agricultural Science Digest*, **35**, 13-18.