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Correlation and Path Analysis Studies for Yield and Yield Attributes in Recombinant Inbred Lines in Cotton (*Gossypium hirsutum* L.)

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ABSTRACT: The poor fibre quality and susceptibility of the cotton genotypes to the sucking pests serves as a major setback to the cotton growing community of the country. The present study consists 390 Recombinant inbred lines along with 6 checks which were evaluated in augmented design. The experiment was conducted in botanical garden, University of Agricultural Sciences, Dharwad during *kharif* 2021. The identification of the strength and kind of relationships between economically significant yield components that contribute to yield in order to increase cotton yield. The correlation study revealed that seed cotton yield was significantly and positively correlated with number of sympodial branches plants^{-1}, number of bolls plant^{-1}, boll weight and lint yield plant^{-1}. Whereas, it had negative association with ginning outturn, seed index and lint index. Path coefficient analysis revealed that plant height, total number of monopodial branches plant^{-1}, number of sympodial branches plant^{-1}, boll weight, seed index and lint yield plant^{-1} had a favourable direct effect on seed cotton output, indicating that selecting for these traits would be quite successful in enhancing seed cotton yield in cotton. The objective of this study is to improve the fibre quality and overall productivity through use the recombinant inbred lines.

Keywords: Correlation, recombinant inbred line, path coefficient, association, augmented design and seed cotton yield.

INTRODUCTION

Cotton is the world's most pertinent leading plant fibre and it is the king of appraisal fibres. It is important to India's economy in terms of its contribution to commercial output, industrial activity, employment, and foreign exchange profits. A total of 129.57 lakh hectares of seed cotton used to grow during 2020–21, yielding 371.00 lakh bales at a productivity rate of 487 kg per hectare (Anon., 2022). Among the major cotton exporting nations, India has emerged as the world's top producer of cotton, holding the top spot in terms of both production and total area. Hence, the main aim of cotton breeders to create cultivars with higher productivity and better fibre quality. Yield, however, is complicated, polygenically inherited feature that is the product of the epistatic interaction of its contributing characters. Since the environment has a significant impact on it, selection based just on yield may impede improvement. Through traditional breeding procedures also, it is difficult to improve the complex traits because of their long duration and low selective efficiency. To improve the yield component of cotton cultivars, an understanding the relationships between various plant features is more crucial for increasing the seed cotton yield component. Additionally, understanding the direct effects of various yield traits on seed cotton production would be crucial for developing a selection programme. But breeding for yield, for which direct selection is not particularly efficient the link between yield and plant characteristics is essential. Therefore, path coefficient analysis is an useful statistical method for evaluating the relationships between various components as well as their direct and indirect impacts on yield. Path coefficient analysis is a useful tool for dividing correlation coefficients into unidirectional and alternative paths, allowing for a more in-depth exploration of the precise causes of a given connection. Therefore, for the purpose of designing a successful selection programme a thorough understanding of the relationship between the yield and yield attribute is necessary. Thus, the goal of the current study is to evaluate the relationship between yield and yield attributes and to examine their path coefficients in order to make effective selections for breeding program.

Manonmani *et al.* (2019) conducted path analysis on cotton genotypes and showed direct and positive effect for days to first flowering, number of bolls per plant towards seed cotton yield. Negative direct effect on yield was stated by traits like plant height and fibre fineness. Monicashree and Balu (2018) evaluated 104 cotton genotypes made path analysis and found that traits like number of bolls per plant and lint index had very high positive direct effect on single plant yield and also plant height, ginning outturn and boll weight had positive effect. Days to 1^{st} flowering, fibre fineness and 2.5% span length had negative effect on yield.

Rehman *et al.* (2020) showed that seed cotton yield had a significant positive correlation with plant height, number of bolls per plant, number of sympodial branches per plant, staple length and fibre strength. Staple length and fibre strength were negatively associated with each other. Amanu *et al.* (2020) assessed correlation between various traits in cotton and showed that lint yield was positively correlated with seed cotton yield, number of bolls per plant, ginning percentage and micronaire value and plant height, while negatively associated with boll weight, days to emergence and fibre strength. Fibre quality trait micronaire showed positive relation with lint yield and negatively associated with fibre strength, while fibre strength was positively associated with uniformity ratio. Reddy *et al.* (2019) made association studies and reported significant positive association of seed cotton yield with lint yield per plant, number of bolls per plant, boll weight and negative correlation with ginning out turn and plant height.

Amamu *et al.* (2020) path analysis revealed that highest direct effect of lint yield, number of bolls per plant with seed cotton yield. Highest positive and indirect effect towards seed cotton yield was shown by ginning out turn. Reddy *et al.* (2019) reported high positive direct effects of lint yield, number of bolls per plant, boll weight on seed cotton yield per plant and the traits like plant height, ginning out turn and lint index had positive indirect effect towards seed cotton yield per plant. Deshmukh *et al.* (2019) made path coefficient analysis in cotton and showed that plant height, number of bolls per plan, boll weight, fibre strength, micronaire value, seed index, lint index, days to 50% flowering, fibre length had considerable direct positive effect with seed cotton yield.

Mahesh *et al.* (2020) found positive and direct effect of traits like plant height, number of bolls per plant, boll weight with seed cotton yield. Same way negative and direct effect was shown by ginning out turn, fibre strength, micronaire value with seed cotton yield. Gnanasekaran *et al.* (2020) estimated the direct and indirect effects of various characters on seed cotton yield in cotton and revealed that number of bolls per plant had positive and direct effect on seed cotton yield per plant and negative direct effect was shown by traits corresponding to lint index, 2.5% span length and uniformity ratio. Nawaz *et al.* (2019) assessed cotton genotypes for several parameters and reported that positive and direct effect of traits like plant height, number of bolls per plant, seed index, micronaire value, boll weight, lint index with seed cotton yield.

MATERIALS AND METHODS

The present study consists of 390 Recombinant Inbred Lines (RIL) and which were derived from intraspecific hybridization between cotton (*Gossypium hirsutum* L) genotypes *viz.*, RHAP 12 × RHAP 15, RHAP 24 × RHAP 15, and RHAP 12 × RHAP 7 which are different concerning fibre strength, fibre length and yield. The Recombinant Inbred Lines (RIL) population was produced using the Single Boll Descent technique from F_2 generation till stabilization. The RILs and check varieties (MCU 5, Sahana, DHH 263, Binds, RHAP 12 and HBS 144) were evaluated in augmented design at the University of Agricultural Sciences, Dharwad during *kharif* 2021. The spacing between and within the rows was maintained at 90 and 30 cm respectively. The randomly selected five plants from each line were used for observing the following parameters *viz.*, plant height (cm), number of sympodial branches plant^{-1}, number of monopodial branches plant^{-1}, number bolls plant^{-1}, seed cotton yield hectare^{-1} (kg/ha), seed index (g), boll weight (g), lint index (g), lint yield plant^{-1} (g) and ginning out turn (%). TNAUSTAT and R studio software were used for the analysis. Direct and indirect effects were worked out using procedure given by Wright (1921); Dewey and Lu (1959).

RESULTS AND DISCUSSION

Correlation studies reveal the nature, scope, and direction of relationships between various yield and yield components. Selection for yield will be successful when it is based on the factors that contribute to it rather than just yield (Grafius, 1960). The population being improved for a characteristic likewise improves in regard to all the other characters connected to it when selection pressure is applied for that trait. To choose the traits to be given significance in selection for high yield, it is helpful to have an understanding of the degree of correlation between yield and yield components. For the effective selection and to achieve the required combinations of various yield components, knowledge of the relationships among yield components is essential. With this view, association analysis was carried out between yield and yield components with seed cotton yield.

The correlation coefficient offered a trustworthy indicator of the relationships between the traits and aids in distinguishing between essential and non-vital partners for breeding. The phenotypic correlation coefficient between yield and yield components is shown in Table 1 of the current investigation. Seed cotton yield (kg/ha) was significantly and positively correlated with number of sympodial branches plant^{-1} (0.3072), number of bolls plant^{-1} (0.2900), boll weight (0.2586) and lint yield plant^{-1} (0.8908). It showed that an increase in one attribute will result in an increase in the other. Therefore, choosing genotypes with high yield will be aided by selection for these features. Similar results have been reported by Amanu *et al.* (2020); Hampannavar *et al.* (2020); Pooja *et al.* (2020), Rehman *et al.* (2020).

Seed index, lint index and ginning outturn recorded non-significant correlation with seed cotton yield. These results were in accordance with previous reports made by Reddy *et al.* (2019); Gnanasekaran *et al.* (2020). Among the yield contributing traits, number of sympodial branches plant^{-1} had positive significant correlation with number of bolls plant^{-1}, lint yield plant^{-1} and ginning outturn and number of bollsplant^{-1} had significant positive correlation with lint yield plant^{-1} and ginning outturn. While, lint yield plant^{-1} had significant positive correlation with lint index and ginning outturn. Seed index had positive significant correlation with lint index. Similar result is obtained by Monicashree and Balu (2018). Boll weight had positive significant correlation with lint yield plant^{-1}. Lint indexplant^{-1} had positive significant correlation with ginning outturn.

Estimates of the correlation coefficient often showed relationships between various features but did not provide information on cause and effect. In these circumstances, path analysis aids the breeder in determining the index of selection. The direct and indirect impacts of each component character on the dependent variable, yield were examined using path coefficient analysis. Breeders can concentrate on the variable that has a strong direct impact on yield by studying path coefficients. The findings of further dividing the phenotypic correlation coefficients of yield with other yield components into direct and indirect effects are shown in Table 2. The component of residual effect of path analysis in yield and yield contributing character was 0.283. Path coefficient analysis revealed that plant height, number of monopodial branches plant^{-1}, number of sympodial branches plant^{-1}, boll weight, seed index and lint yield plant^{-1} exerted positive direct effect on seed cotton yield (kg/ha). Similar results have been reported by Gnanasekaran *et al.* (2020); Mahesh *et al.* (2020); Nawaz *et al.* (2019). Indirect effects of number of bollsplant^{-1}influenced the seed cotton yield (kg/ha) through number of monopodial branches plant^{-1}, number of sympodial branches plant^{-1}, ginning outturn, seed index and lint yield plant^{-1}. The indirect effect of number of sympodial branches plant^{-1} was positive through number of monopodial branches plant^{-1}, seed index, ginning outturn and lint yield plant^{-1}. Indirect effects of boll weight influenced the seed cotton yield (kg/ha) through number of bollsplant^{-1}, seed index and lint index. Similar results are recorded by Amanu *et al.* (2020); Reddy *et al.* (2019).

Table 1: Phenotypic correlation coefficient among yield and yield attributing traits in RIL population of cotton.

	PH	NMP	NSP	NBP	BW	SI	LYP	LI	GOT
PH	1								
NMP	0.0306	1							
NSP	-0.0746	0.0455	1						
NBP	-0.0552	0.0356	0.5211**	1					
BW	-0.0694	-0.0681	-0.266**	-0.6042**	1				
SI	0.0377	0.0960	-0.0973	-0.0736	0.0398	1			
LYP	-0.0136	-0.0349	0.3498**	0.4221**	0.1185*	-0.0590	1		
LI	0.0044	0.0356	0.0570	0.0206	-0.0587	0.1909**	0.1069**	1	
GOT	-0.0365	0.0019	0.1462**	0.2728**	-0.2320**	-0.0549	0.3432**	0.5411**	1
SCY	0.0097	0.0198	0.3072**	0.2900**	0.2586**	-0.0366	0.8908**	-0.0572	-0.0168

PH-Plant Height in cm, **NMP**- Number of Monopodia Plant^{-1}, **NSP**- Number of Sympodia Plant^{-1}, **NBP**- Number of Bolls Plant^{-1}, **BW**- Boll Weight, **GOT**- Ginning Outturn (%), **SI**- Seed Index, **LI**- Lint Index, **LYP**- lint yield plant^{-1},**SCYP**- Seed Cotton Yield (kg/ha).

Table 2: Phenotypic path coefficient among yield and yield attributing traits in RIL population of cotton.

	PH	NMP	NSP	NBP	BW	GOT	SI	LYP	LI	SCY
PH	**0.0140**	0.0018	-0.0022	0.0008	-0.0042	-0.0004	-0.0137	0.0002	0.0134	0.0097
NMP	0.0004	**0.0582**	0.0013	-0.0005	-0.0042	-0.0011	-0.0350	0.0013	-0.0007	0.0198
NSP	-0.0010	0.0026	**0.0288**	-0.0074	-0.0163	0.0011	0.3509	0.0021	-0.0537	0.3072
NBP	-0.0008	0.0021	0.0150	**-0.0142**	-0.0369	0.0008	0.4234	0.0008	-0.1002	0.2900
BW	-0.0010	-0.0040	-0.0077	0.0086	**0.0611**	-0.0005	0.1189	-0.0021	0.0852	0.2586
GOT	0.0005	0.0056	-0.0028	0.0010	0.0024	**-0.0114**	-0.0592	0.0070	0.0201	-0.0366
SI	-0.0002	-0.0020	0.0101	-0.0060	0.0072	0.0007	**1.0031**	0.0039	-0.1261	0.8908
LYP	0.0001	0.0021	0.0016	-0.0003	-0.0036	-0.0022	0.1072	**0.0366**	-0.1988	-0.0572
LI	-0.0005	0.0001	0.0042	-0.0039	-0.0142	0.0006	0.3443	0.0198	**-0.3673**	-0.0168

RESIDUE= 0.2831

PH-Plant Height in cm, **NMP**- Number of Monopodia Plant^{-1}, **NSP**- Number of Sympodia Plant^{-1}, **NBP**- Number of Bolls Plant^{-1}, **BW**- Boll Weight, **GOT**- Ginning Outturn (%), **SI**- Seed Index, **LI**- Lint Index, **LYP**- lint yield plant^{-1}, **SCYP**- Seed Cotton Yield (kg/ha).

CONCLUSION

The present investigation revealed that seed index, number of monopodial branches plant^{-1}, lint yield plant^{-1}, number of bolls plant^{-1}, number of sympodial branches plant^{-1}, ginning outturn and boll weight played a major role in cotton yield and fibre improvement of cotton. These characteristics should be considered as significant selection criteria for seed cotton yield improvement in cotton.

FUTURE SCOPE

By considering indirectly yield-related characteristics, correlation and path studies are helpful for improving yield. The relationship between yield and its parts reveals the ideal cotton improvement criterion. The recombinant inbred lines reciprocating higher magnitudes in these specific characteristics can be used as the parents or can be subjected to more strict screening.

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Conflict of Interest. None.

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