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Correlation and Path Coefficient Analysis of Yield with Yield Attributing Characters in Cotton (*Gossypium hirsutum* L.)

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Abstract The present study was carried out to determine direct and indirect effects of some characters (sympodial branches, number of leaves, total leaf area, number of boll, boll setting percentage, boll weight, boll size, total dry matter and seed per boll) on seed cotton yield. The experiment was conducted with two cotton (LH 1556 and hybrid LHH 144) of *hirsutum* cotton (*Gossypium hirsutum* L.) in randomized block design with six replications. Pearson correlation analysis revealed a positive correlation of seed cotton yield with sympodial branches, number of leaves, total leaves area, number of bolls, boll setting percentage, boll weight and seed per boll and had negative correlation with specific leaf area and total dry matter accumulation. Path coefficient analysis revealed a direct effect of number of sympodial branches, specific leaf area, number of bolls, boll weight and seed per boll on seed cotton yield. The result of present study revealed that evidently most of the traits exerted positive indirect effects through boll weight, boll number, seed per boll on cotton yield.

Keywords Yield, Path analysis, Correlation, Cotton.

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Introduction

Cotton is an important fiber yielding crop of global importance, which is grown in tropical and subtropical regions of more than 80 countries the world over. It provides livelihood to about sixty million people and is an important agricultural commodity providing remunerative income to million of farmers both in developed and developing countries. Inspite of severe competition from synthetic fibers in recent years, it is occupying the premiere position with 70% share in the textile industry. There many factors which directly and indirectly affect the cotton yield. For breeding purpose, it is important to identify traits which contribute to productivity and determination of direct and indirect relations among the traits is important plant selection. The yield of cotton crop depends on many factors, such as plant height, number of fruiting branches , number of bolls per plant, boll weight, seed index, G.O.T%. The extent of relationship between yield and its various components will facilitate the selection of plants with desirable characteristics. The knowledge of relationship among various yield components has been successfully exploited towards cotton improvement.

Path-coefficient analysis at genotypic level revealed that sympodia per plant, monopodia per plant and boll weight (g) had positive direct effect on seed cotton yield. Selection based on these characters may contribute considerably to improvement in seed yield [1]. Monopodial branches / plant, boll number and boll weight was positively and significantly correlated with yield. Similarly path coefficient analysis

revealed that node of first fruiting branch, monopodial branches/ plant, boll number and boll weight had maximum direct positive effect on seed cotton yield [2]. Monopodial branches / plant, boll / plant and boll weight were positively and significantly correlated with yield while no of bolls / plant and boll weight had maximum direct positive effect on yield of seed cotton [3].

Present study was conducted with *hirsutum* cotton hybrids to provide information on interrelationships of seed cotton yield with some characters viz. sympodial branches, number of leaves, total leaf area, number of bolls, boll setting percentage, boll weight, boll size, total dry matter and seed per boll and to partition the observed correlations into their direct and indirect effects. Path coefficients technique involves partitioning of the correlation coefficient to determine direct (unidirectional pathways 'P')and indirect influence through alternate pathways (pathway P × correlation coefficient r) of various variables over seed cotton yield per plant. Seed cotton yield was considered as the resultant variable and the others as casual variables.

Materials and Methods

Cotton (*Gossypium hirsutum* cv LH 1556 and hybrid LHH 144) crop was raised, using standard package of practices. The experiment was laid out in randomized block design with three replications. Five plants were selected randomly from each plot and observations were recorded, leaf number plant^{-1} were counted on five selected plants under control. To record specific leaf area (cm^2) the third fully expanded leaf from top was taken and leaf area was measured with the help of leaf area meter. All leaves from five tagged plants were harvested at 150 DAS and total leaf area of leaves was measured with leaf area meter and was expressed on per plant basis.

Number of bolls plant^{-1}

Bolls were counted on tagged plants of each plot under treatment and average value was represented as mean value.

Boll setting percent

It was calculated using following formula:

$$\text{BS percent} = \frac{\text{Total number of bolls plant}^{-1}}{\text{Total number of flowers plant}^{-1}}$$

Boll weight (*g*)

Five healthy well opened bolls were taken from selected plants to work out boll weight in grams.

Dry matter accumulation

The tagged plants were harvested at maturity and were placed in an oven at 70°C for three days. The dry matter accumulation in various treatments was recorded by taking dry weight (g).

Number of seeds boll^{-1}

Seed from bolls selected randomly from tagged plants were counted and mean was calculated.

Yield of seed cotton plant^{-1}

Seed cotton yield of each picking was weighed separately and added to get the total seed cotton yield per plant.

Results and Discussion

The phenotypic correlation among all the characters related to seed cotton yield per plant were estimated and result is depicted in Table 1. Seed cotton yield per plant had significant and positively phenotypic correlation with sympodial branches ($r = 0.6780$), number of leaves ($r = 0.3970$), total leaf area ($r = 0.9034$), number of boll ($r = 0.9934$), boll weight ($r = 0.7508$), boll size ($r = 0.2608$) and seed per boll ($r = 0.5248$) (Table 1). This was in conformity with reports [4]. A significantly negative correlation was observed between specific leaf area ($r = –0.0876$) and total dry

Table 1. Pearson correlation analysis between seed cotton yield and different traits in cotton. ** Significant at 5% level. *Significant at 1% level.

	Characters	1	2	3	4	5	6
1.	Sympodial branches	1.000					
2.	Number of leaves	0.5881	1.000				
3.	Specific leaf area	–0.4348	– 0.1352	1.000			
4.	Total leaf area	–0.6235	– 0.2956	0.6782	1.000		
5.	Number of boll	0.6799	0.4000	–0.7267	–0.9152	1.000	
6.	Boll setting percentage	0.6770	0.2771	–0.0325	–0.8767	0.9204	1.000
7.	Boll weight	0.4167	0.2470	–0.2149	–0.6381	0.6735	0.6993
8.	Boll size	0.3767	0.2652	–0.0131	–0.3990	0.2695	0.0436
9.	Total dry matter	– 0.1918	0.1078	0.7833	0.3599	– 0.3580	–0.2321
10.	Seed per boll	0.1437	0.1260	–0.5483	–0.5199	0.5333	0.4857
11.	Seed cotton yield	0.6780	0.3970	–0.6876	0.9088	0.9934	0.9238

Table 1. Continued.

	Characters	7	8	9	10	11
1.	Sympodial branches					
2.	Number of leaves					
3.	Specific leaf area					
4.	Total leaf area					
5.	Number of boll					
6.	Boll setting percentage					
7.	Boll weight	1.000				
8.	Boll size	0.1884	1.000			
9.	Total dry matter	0.0734	–0.1291	1.000		
10.	Seed per boll	0.3449	0.0367	– 0.3526	1.000	
11.	Seed cotton yield	0.7506	0.2608	– 0.3183	0.5248	1.000

matter (r = –0.3186). The analysis revealed that seed cotton yield per plant had highly significant and positive phenotypic correlation with bolls per plants (r = 0.6210). A significant and positive phenotypic correlation was recorded between seed cotton yield and boll weight (r = 0.3270) (Table 1). Highly positive and phenotypic significantly association was recorded between boll setting percentage and number of boll (r = 0.9204), total dry matter and specific leaf area (r = 0.7833) and boll setting percentage and boll weight whereas, seed per boll exhibited negative and significant correlation with specific leaf area.

Path analysis of seed cotton yield showed that the boll weight at maturity had significant positive direct effect on (p_{711} = 0.1584) on the seed cotton yield. The weight of boll had significant positive correlation with the number of boll ($r_{75}p$ =0.7333) and it contributed more indirectly through the total leaf area ($r_{74}p_{74}$ = -0.0100) (Table 2). The direct effect of boll setting percentage was lower (p_{611} =-0.3336) while its correlation in analysis was due to indirect effect through number of bolls ($r_{511}p_{511}$ = 0.0100). Total leaf area had negative direct effect on seed cotton yield (p_{411} = -0.1170). Its lower correlation in analysis was due to its indirect contribution through number of leaves ($r_{24}p_{24}$ =-0.0045) (Tables 1 and 2). The correlation coefficient of boll size showed the positive correlation (Fig. 1). Number of sympodial branches contributed directly (p_{111} = 0.1270) but its direct effect on seed cotton yield was masked by indirect effect through number of bolls (r_{15} = 0.6799, p_{15} = 0.0865) (Tables 1 and 2) and boll setting percentage (r_{16} =0.6770) (p_{16} =0.0861). In earlier studies boll setting percentage was reported to be negatively correlated with seed cotton yield [5]. Path-coefficient analysis at genotypic level revealed that sympodia per plant, monopodia per plant and boll weight (g) had positive direct effect on seed cotton yield. Seed per boll had direct effect on seed cotton yield (p_{1011}=0.0765) and correlation coefficient from analysis showed positive correlation (r_{1011} =0.5248). Boll setting percentage

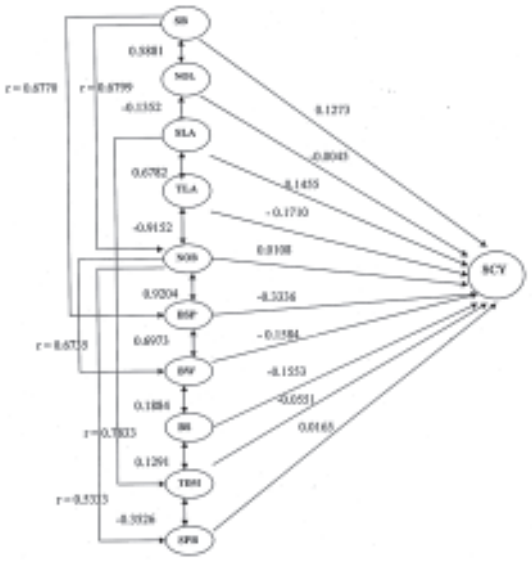

Fig. 1. Diagrammatic representation of direct and indirect effects and correlation coefficient of variable on dependent variable, SB=Sympodial branches, NOL = No, of leaves, SLA = Specific leaf area, TLA = Total leaf area, NOB = Number of boll, BSP = Boll setting percentage, BS=Boll size, BW = Boll weight, TDM = Total dry matter, SPB = Seed per boll.

had indirect effect on seed per boll (p_{610} = -0.1620) (Table 2) while the correlation showed positive relationship (r_{610} = 0.4587) (Table 1) which was due to indirect effect of boll setting on the seed per boll on the seed cotton yield. Increase seed cotton yield in the studies of breeding program and selection the highness of leaf SPAD value, number of sympodial branches, single boll weight, number of monopodial branches and number of bolls characters should be considered important [6].

The cotton plants have the most complex structures of any major field crops. Its indetermine growth habit and sympodial fruiting caused it to develop a four dimensional occupation of space and time, which often defies analysis. Correlation and factor analysis would provide useful information for planning a successful breeding program. The true picture of correlation of seed cotton yield with other traits is reflected some direct traits which have direct effect. It will help in identifying the traits that contribute directly to improve seed cotton yield. A great yield response is obtained when the character for which indirect selection is practiced has a high heritability and a positive

Table 2. Path coefficient analysis of seed cotton yield with different traits. (Bold values show direct effect).

	Characters	1	2	3	4	5	6	7	8	9	10
1.	Sympodial branches (SB)	**0.1273**	**-** 0.0126	-0.0633	0.1060	0.7402	-0.2258	0.0660	-0.0585	0.0105	0.0023
2.	Number of leaves (NOL)	0.0748	-**0.0456**	**-**0.0196	0.0502	0.4355	-0.0924	0.0391	-0.0411	-0.0059	0.0020
3.	Specific leaf area (SLA)	-0.0553	0.0061	**0.1455**	**-** 0.1155	-0.7912	0.2111	-0.0340	-0.0020	-0.0403	-0.0019
4.	Total leaf area (TLA)	-0.0793	0.0134	0.0987	-**0.1701**	**-** 0.9964	0.2925	-0.1010	0.0619	-0.0198	-0.0086
5.	Number of boll (NOB)	0.0865	-0.0182	-0.1057	0.1557	**0.0108**	**-**0.3071	0.1066	-0.0418	0.1973	0.0088
6.	Boll setting percentage (BSP)	0.0861	-0.0126	-0.0920	0.1491	0.0100	-**0.3336**	0.1104	-0.0067	0.0127	0.0080
7.	Boll weight (BW)	0.0530	-0.0112	-0.0312	0.1085	0.7333	-0.2326	**0.1584**	**-**0.0292	-0.0046	0.0057
8.	Boll size (BS)	0.0479	-0.0120	0.0019	0.0678	0.2933	-0.0145	0.0298	**-0.1553**	0.0071	0.0006
9.	Total dry matter (TDM)	-0.0224	-0.0049	0.1139	-0.0612	-0.3898	0.0774	0.0116	0.0200	-**0.0551**	**-**0.0058
10.	Seed per boll (SPB)	0.0183	-0.0057	-0.0798	0.0884	0.5807	-0.1620	0.0546	-0.0056	0.0194	**0.0765**

correlation with yield. The result of present study revealed that most of the traits exerted positive indirect effects through boll weight, boll number and seed per boll on seed cotton yield and confirmed that correlation coefficient and path analysis are complementary for seed cotton yield improvement.

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