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Original Research Article

Correlation and Path Analysis Study in F5 Generation of Cowpea

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A B S T R A C T

The present investigation entitled "Correlation and Path analysis study in F_5 Generation of Cowpea" was carried out during *kharif* season of the year 2015. The field experiment was carried out at Main Garden, Department of Horticulture, Dr. PDKV, Akola. The study was undertaken on twenty genotypes of cowpea using randomized block design with three replications. Cowpea seeds were dibbed at the spacing of 45 cm x 30 cm. In each treatment there were 30 plants of each genotype in a replication. Five competitive plants were randomly selected from each treatment to record observations on fifteen characters. A wide range of variation observed among the genotypes for all the character. Analysis of variance indicated significant differences among the genotypes for different morphological characters. In the present investigation, the results revealed comparatively higher degree of genotypic correlation coefficients than their phenotypic correlation coefficients in most of the characters. The characters like number of pods per plant, number of pods per cluster, primary branches per plant, number of cluster per plant, pod length, pod diameter, average pod weight, leaf area had highly significant positive correlation with pod yield per plot both genotypic and phenotypic levels, which indicating dependence of these characters on each other. Path coefficient analysis reveals that the characters number of pods per plant, 100 seed weight, primary branches per plant, plant height, pod length, number of seeds per pod positive direct effect on pod yield per plot. While trait like number of pods per cluster, number of cluster per plant, pod diameter, pod length, average, pod weight, primary branches per plant,100 seed weight, plant height and leaf area contributed indirect effect towards the yield. Therefore yield can be improved in cowpea by improving these traits.

Keywords

Genetic variability, correlation, genotypes, F5 generation, cowpea, Path analysis

Introduction

Cowpea (*Vigna unguiculata* (L) Walp) is an important leguminous vegetable crop mainly grown in both *kharif* and spring summer season in most parts of India. It is a self-pollinated crop with a chromosome no. 2n=2x= 22. Cowpea belongs to the family Leguminaceae genus *vigna*, subfamily fabaceae and tribe phaseoleae it comprises five subspecies (Verdcourt, 1970) viz., *unguiculata, cylindrical, sesquipedalis, dekindtiana and mensensis* in phaseolae. Out of these five subspecies first three are cultivated and later two are wild.

Vavilov (1951) recognized India and Africa as the primary center of origin, while china as the secondary center of origin. Faris (1965) assembled evidences to show that out of 170 species of cowpea, 120 species are cultivated in Africa, 22 in India and South

East Asia and some in America and Australia. The worldwide area under cowpea is 10.1 million hectares and annual global cowpea seed production is now approximately 4.99 million tones. (Anon., 2008).

Cowpea is now widely distributed throughout the tropics and subtropical area. Out of that total world production about 80% comes from Nigeria alone. Other major cowpea producers are Upper Volta, Uganda and USA. It is also grown on a limited scale in a Mediterranean region, South Africa and Australia. The cowpea has number of common names including crowder pea, black-eyed pea, lobia, chawali, kiffir pea, long yard bean, asparagus bean, snake bean, china bean, snake bean and china bean. Major cowpea producing states of India are Uttar Pradesh, Punjab, Delhi, Haryana, Bihar, Andhra Pradesh, It has realized the importance on account of Its tolerance to drought and adoptability to wide range of soils and in semi-arid areas of Maharashtra, Gujarat and Karnataka.

Cowpea has great nutritional importance grain contains 23.4 per cent protein, 1.8 per cent fat and 60.3 per cent carbohydrates and it is rich source of calcium and iron (Gupta, 1988). Cowpea is of major importance to livelihood of millions of relatively poor people in under developed countries of the tropics. In fresh forms the young leaves, succulent pods are used as vegetable, while several snacks and main meal dishes are prepared from grain. Being rich in protein and many other nutrients it is known as vegetable meat. (Singh *et al.,* 2000).

Cowpea is a warm season, annual herbaceous legume crop. Growth habit ranges from erect, determinate, non-branching type to prostrate or climbing, indeterminate and profusely branching types. It has strong tap root system. Stem may be green or pigmented. Leaves are alternate, trifoliate with one symmetrical terminal leaflet and two asymmetrical leaflets. Inflorescence is an unbranched auxiliary raceme bearing several flowers at the terminal and of peduncles. Calyx is longitudinal riffed, tubular with 2-15 mm long sub-equal lobes. The corolla is papilionaceous with an erect standard petal spreading at the time of flower opening. The wings are boat-shaped, enclosing the androecium and gynoecium. The stamens are diadelphous (9)+1. Anthers are bright yellow. Ovary is monocarpellary, unilocular with many ovules. Pods are vertically attached to the raceme axis, mostly linear.

For the study of genetic variability and correlation of characters, cowpea offers a good scope because of its extravert nature of pistil comparatively easier handling, wider adaptability and presence of maximum variability. Study of genetic variability particularly important in yield and yield contributing characters is basic to plan out future improvement programme in any crop. The correlation co-efficient gives, an idea of the nature and intensity of association between two or more quantitative characters between yield and yield contributing characters. Correlation simply measures that mutual relationship between yield and yield contributing characters. Thus, correlation helps in the selection of superior genotype from diverse genetic populations.

As there are number of factors involved in correlation studies, their indirect associations become more complex and confusing but path analysis helps to avoid this complication by measuring the direct influence of one characters on other as well as permits the partitioning of given correlation coefficients into its components of direct and indirect effects. The path

coefficient analysis is an effective means of analyzing direct and causes of association and permits the critical examination of the specific that produce a given correlation. The path analysis provides information about magnitude and direction of direct and indirect effect of the yield components, which cannot provide by correlation.

The correlation studies between yield and its component characters have been immense help in selecting suitable plant type. The need for studying the magnitude of interrelationship between different characters is important in many cases. The phenotypic correlations do not given an accurate idea about inherent association between different variables because they are susceptible to environmental fluctuations. Hence it is very necessary to estimate genotypic correlation coefficients for designing to reliable and efficient breeding programme.

Path coefficient analysis helps to avoid complications by measuring direct influence of one character upon other as well as permits the partitioning of a given correlation coefficients into its components of direct and indirect effects.

Materials and Methods

The present investigation "Correlation and Path analysis study in F_5 Generation of Cowpea " was carried out at Main Garden, University Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during *kharif* season of the year 2015.The plot was selected on the basis of suitability of the land for cultivation of cowpea.

The study was undertaken on twenty genotypes of cowpea using randomized block design with three replications. Cowpea seeds were dibbed at the spacing of 45 cm x 30 cm. In each treatment there were 30 plants of each genotype in a replication. Five competitive plants were randomly selected from each treatment to record observations on fifteen characters.

Source of plant materials

The material under study was constituted of 20 genotypes of cowpea (*vigna unguiculata* (L.) Walp) with check which were developed from the segregating progenies. At department of horticulture Dr. PDKV, Akola.

Results and Discussion

Correlation studies

In order to find out the association between yield and yield contributing characters, the genotypic and phenotypic correlation coefficients were estimated and presented in Table 1.

Genotypic and Phenotypic correlation coefficient

In Pod yield per plot genotypic correlation coefficient revealed that pod yield per plot was significantly and positively correlated with number of pods per plant (0.832), number of pods per cluster (0.632), primary branches per plant(0.556), number of cluster per plant (0.533), pod length (0.523), pod diameter (0.501), average pod weight (0.409), leaf area (0.355). However, days to first flower (-0.513), days to 50 % flowering (-0.387), fiber content (-0.644) showed significant negative correlation with pod yield per plot. Other characters viz. number of cluster per plant (0.533), plant height (0.190), number of seeds per pod (0.179) showed positive non-significant correlation with pod yield per plot 100 seed weight (-

0.102) showed negative non-significant correlation with pod yield per plot. The result on phenotypic correlation coefficient revealed that pod yield per plot had strong significant and positive phenotypic correlation with number of pods per plant (0.837), number of pods per cluster (0.637), primary branches per plant (0.529), number of cluster per plant (0.512), pod length (cm) (0.507), pod diameter(cm) (0.483), average pod weight (g) (0.391), leaf area (cm^2) (0.339).

However, fiber content (-0.623), days for first flowering (-0.461), days to 50 % flowering (-0.368) showed significant and negative phenotypic correlation with pod yield per plot. Other characters viz., plant height (0.186), number of seeds per pod (0.163) showed positive non-significant phenotypic correlation with pod yield per plot while 100 seed weight (-0.102) showed negative non-significant phenotypic correlation with pod yield per plot. Similar findings were reported by Vidya C. and S. K. Oommen (2002).

Number of cluster per plant had strong significant and positive genotypic correlation with number of pods per plant (0.560), pod diameter (cm) (0.394) while it showed positive non-significant genotypic correlation with number of seeds per pod (0.138), pod length (cm) (0.128). It also showed negative non-significant genotypic correlation with fiber content (%) (-0.190), 100 seed weight (-0.123), average pod weight (-0.068), number of pods per cluster (-0.059). The result on phenotypic correlation coefficient revealed that number of cluster per plant had strong positive and significant phenotypic correlation with number of pods per plant (0.534), pod diameter (cm) (0.386) while it showed positive non-significant phenotypic correlation with number of seeds per pod (0.123), pod length (cm) (0.126). It also showed negative non-significant phenotypic correlation with fiber content (%) (-0.185), 100 seed weight (-0.121), average pod weight (-0.084), number of pods per cluster (-0.038). These results are in consonance with the finding of Venkatesan *et al.*, (2003).

Number of pods per plant had positive and significant phenotypic correlation with, pod diameter (cm) (0.352), while significant and negative correlation with fiber content (%) (-0.554).It also showed positive non-significant phenotypic correlation with number of seeds per pod (0.167), pod length (cm) (0.136) and negative non-significant phenotypic correlation with 100 seed weight (-0.183), average pod weight (-0.004).

The result on phenotypic correlation coefficient revealed that number of pods per plant showed high positive indirect effect on yield through number of pods per cluster (1.2017), number of cluster per plant (0.8556), pod diameter (cm) (0.5742) and highest negative indirect effect due to fiber content (%) (-0.8943), days to first flower (-0.4583), days to 50 % flowering (-0.288). Similar findings were reported by Nigude *et al.*, (2004).

Number of seeds per pod had negative and non-significant genotypic correlation with fiber content (-0.112), average pod weight (-0.006). The result on phenotypic correlation coefficient revealed that number of seeds per pod showed negative and non-significant phenotypic correlation with Fiber content (-0.109), average pod weight (-0.001). Similar findings were reported by Venkatesan *et al.*, (2003)

Average pod weight showed negative and significant genotypic as well as phenotypic correlation with fiber content (%) (-0.349).

Table.1 Estimation of genotypic and phenotypic correlation coefficient for different characters of cowpea

Characters		Plant height (cm)	Primary branches per plant	Leaf area (cm^2)	Days to first flower	Days to 50 % flowering	Number of clusters per plant	Number of pods per cluster	Number of pods per plant	Pod diameter (cm)	Pod length (cm)	100 seed weight (g)	Number of seeds per pod	Average pod weight (g)	Fiber content (%)	Pod yield per plot (Kg)
Plant height (cm)	**G**	**1**	0.4008**	0.1602	0.2800	0.0879	0.1690	0.0003	0.0897	0.1266	0.2815*	-0.1799	0.6645**	-0.0133	-0.0961	0.1906
	P	1	0.3906 **	0.1583	0.2526*	0.0797	0.1730	0.0094	0.0915	0.1232	0.2813 *	-0.1783	0.6390**	-0.0188	-0.0968	0.1867
Primary branches per plant	**G**		**1**	0.2837	-0.4670**	-0.4610**	0.1566	0.1579	0.2526	0.1167	0.7750**	-0.1210	0.2374	0.3577**	-0.5355	0.5568**
	P		1	0.2778 *	-0.4383**	-0.4531 **	0.1501	0.1465	0.2277	0.1107	0.7647**	-0.1256	0.2231	0.3506**	-0.5225**	0.5292**
Leaf area (cm^2)	**G**			**1**	-0.3120	-0.3118	0.1514	-0.0179	0.0224	0.4115**	0.4844**	0.2378	0.2058	0.3796**	-0.3404**	0.3556**
	P			1	-0.2905*	-0.3047 *	0.1491	-0.0188	0.0171	0.4089 **	0.4822 **	0.2344	0.2032	0.3751**	-0.3372**	0.3394**
Days to first flower	**G**				**1**	0.8374**	-0.0511	-0.3871**	-0.3004	-0.2176	-0.3389**	-0.1416	0.3406**	-0.6069	0.6670**	-0.5139**
	P				1	0.7820 **	-0.0523	-0.3108 *	-0.2626 *	-0.2035	-0.3197*	-0.0994	0.3053*	-0.5482**	0.6231**	-0.4611**
Days to 50 % flowering	**G**					**1**	0.1437	-0.3824**	-0.1888	-0.3043	-0.2709*	-0.2173	0.2254	-0.4373**	0.6712**	-0.3871**
	P					1	0.1275	-0.3424 **	-0.1786	-0.2971 *	-0.2667*	-0.1977	0.2218	-0.4170**	0.6568**	-0.3689**
Number of cluster per plant	**G**						**1**	-0.0597	0.5608**	0.3949**	0.1287	-0.1234	0.1388	-0.0689	-0.1902	0.5334**
	P						1	-0.0384	0.5340 **	0.3865 **	0.1266	-0.1214	0.1233	-0.0843	-0.1859	0.5121**
Number of pods per cluster	**G**							**1**	0.7877**	0.1989	0.0861	-0.0588	0.1512	0.1346	-0.5819**	0.6325**
	P							1	0.7952 **	0.1820	0.0860	-0.0483	0.1069	0.1026	-0.5351**	0.6375**
Number of pods per plant	**G**								**1**	0.3764	0.1442	-0.1838	0.2006	0.0117	-0.5862**	0.8327**
	P								1	0.3522**	0.1369	-0.1738	0.1679	-0.0042	-0.5540**	0.8376 **
Pod diameter (cm)	**G**									**1**	0.1118	-0.1229	-0.1343	0.1340	-0.1518	0.5016**
	P									1	0.1110	-0.1188	-0.1283	0.1295	-0.1503	0.4831**
Pod length (cm)	**G**										**1**	0.1401	0.2606*	0.6165**	-0.4898**	0.5236**
	P										1	0.1367	0.2545 *	0.6071**	-0.4877 **	0.5072**
100 seed weight (g)	**G**											**1**	0.2642*	0.3961**	-0.1831	-0.1022
	P											1	0.2582*	0.3904**	-0.1825	-0.1021
Number of seeds per pod	**G**												**1**	-0.0068	-0.1129	0.1795
	P												1	-0.0010	-0.1098	0.1634
Average pod weight (g)	**G**													**1**	-0.3495**	0.4099**
	P													1	-0.3433 **	0.3914**
Fiber content (%)	**G**														**1**	-0.6449**
	P														1	-0.6269 **
Pod yield per plot (Kg)	**G**															**1**
	P															1

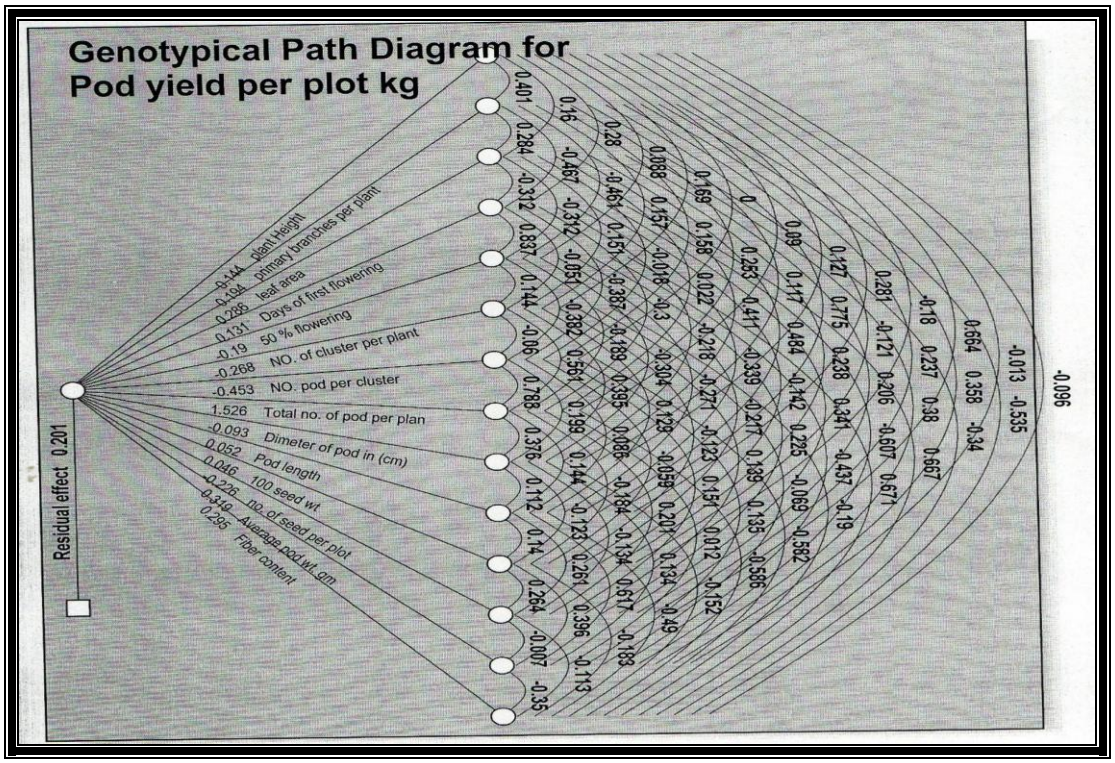
** Significant at 1% level (0.325) * Significant at 5% level (0.250) G-Genotypic P- Phenotypic

Table.2 Direct and indirect effect of different characters on yield

Characters	Plant height (cm)	Primary branches per plant	Leaf area (cm^2)	Days to first flower	Days to 50 % flowering	Number of clusters per plant	Number of pods per cluster	Number of pods per plant	Pod diameter (cm)	Pod length (cm)	100 seed weight (g)	Number of seeds per pod	Average pod weight (g)	Fibre content (%)	Pod yield per plot (kg)
Plant height (cm)	**0.1441**	0.0577	0.0231	0.0403	0.0127	0.0244	0.0001	0.0129	0.0182	0.0406	-0.0259	0.0957	-0.0019	-0.0139	0.1906
Primary branches per plant	0.0777	**0.1938**	0.055	-0.0905	-0.0893	0.0303	0.0306	0.049	0.0226	0.1502	-0.0235	0.046	0.0693	-0.1038	0.5568
Leaf area (cm^2)	0.0458	0.0811	**0.2857**	-0.0892	-0.0891	0.0433	-0.0051	0.0064	0.1176	0.1384	0.0679	0.0588	0.1085	-0.0973	0.3556
Days to first flower	0.0367	-0.0613	-0.0409	**0.1312**	0.1098	-0.0067	-0.0508	-0.0394	-0.0285	-0.0445	-0.0186	0.0447	-0.0796	0.0875	-0.5139
Days to 50 % flowering	-0.0167	0.0874	0.0591	-0.1587	**-0.1896**	-0.0272	0.0725	0.0358	0.0577	0.0514	0.0412	-0.0427	0.0829	-0.1273	-0.3871
Number of clusters per plant	-0.0453	-0.042	-0.0406	0.0137	-0.0385	**-0.268**	0.016	-0.1503	-0.1058	-0.0345	0.0331	-0.0372	0.0185	0.051	0.5334
Number of pods per cluster	-0.0002	-0.0715	0.0081	0.1752	0.1731	0.027	**-0.4526**	-0.3565	-0.09	-0.039	0.0266	-0.0684	-0.0609	0.2634	0.6325
Number of pods per plant	0.1368	0.3854	0.0341	-0.4583	-0.288	0.8556	1.2017	**1.5256**	0.5742	0.2199	-0.2805	0.3061	0.0178	-0.8943	0.8327
Pod diameter (cm)	-0.0117	-0.0108	-0.0382	0.0202	0.0282	-0.0366	-0.0185	-0.0349	**-0.0928**	-0.0104	0.0114	0.0125	-0.0124	0.0141	0.5016
Pod length (cm)	0.0146	0.0401	0.0251	-0.0175	-0.014	0.0067	0.0045	0.0075	0.0058	**0.0517**	0.0072	0.0135	0.0319	-0.0253	0.5236
100 seed weight (g)	-0.0083	-0.0056	0.011	-0.0065	-0.01	-0.0057	-0.0027	-0.0085	-0.0057	0.0065	**0.0461**	0.0122	0.0182	-0.0084	-0.1022
Number of seeds per pod	-0.1502	-0.0537	-0.0465	-0.077	-0.051	-0.0314	-0.0342	-0.0454	0.0304	-0.0589	-0.0597	**-0.2261**	0.0015	0.0255	0.1795
Average pod weight (g)	-0.0043	0.1143	0.1213	-0.1939	-0.1397	-0.022	0.043	0.0037	0.0428	0.1969	0.1265	-0.0022	**0.3194**	-0.1116	0.4099
Fibre content (%)	-0.0284	-0.1582	-0.1006	0.1971	0.1983	-0.0562	-0.1719	-0.1732	-0.0448	-0.1447	-0.0541	-0.0334	-0.1033	**0.2955**	-0.6449

Residual Effect = 0.201

Fig.1 Genotypic path digram and coefficient of factors influencing yield



List of genotypes /varieties

Sr. No.	Genotype
1.	AKCP – 13 – 1 – 2
2.	AKCP – 13 – 1 – 4
3.	AKCP – 13 - 2 – 2
4.	AKCP – 13 – 2 - 3
5.	AKCP – 13 – 2 – 4
6.	AKCP – 13 – 2 – 5
7.	AKCP – 13 – 4 – 4
8.	AKCP – 13 – 5 – 1
9.	AKCP – 13 – 5 – 4
10.	AKCP – 13 – 5 – 5
11.	AKCP – 13 – 5 – 7
12.	AKCP – 13 – 5 – 10
13.	AKCP – 13 – 7 – 5
14.	AKCP – 13 – 7 – 15
15.	AKCP – 13 – 10 – 2
16.	AKCP – 13 – 10 – 9
17.	AKCP – 13 – 5 – 6
18.	AKCP – 13 – 9 – 10
19.	Pusa Komal
20.	Pusa Barsathi

Path co-efficient analysis

The genotypic correlation coefficient of all the characters with yield was further partitioned into direct and indirect effect utilizing path coefficient analysis. The result on path analysis of various causes influencing yield per plant have been presented in Table 2 and Fig. 1.

Direct effect

The direct effect of different characters on yield estimated from the path coefficient analysis reveals that the characters number of pods per plant (1.525),100 seed weight(0.319), fiber content (0.295), leaf area (0.285), primary branches per plant (0.193), plant height (0.144), days to first flower (0.131), pod length (0.051), number of seeds per pod (0.046) positive direct effect while number of pods per cluster (-0.452), number of cluster per plant (-0.268), average pod weight (-0.226) days to 50% flowering (-0.189), had negative direct effect on yield. Similar findings were reported Vidya and Oommen (2002).

Indirect effect

Number of pods per cluster showed high positive indirect effect on yield through days to first flowering (0.1752), days to 50 % flowering (0.1731), number of cluster per plant(0.027) and highest negative indirect effect due to number of pods per plant (-0.3565), pod diameter (cm) (-0.09), primary branches per plant (-0.0715).

Number of cluster per plant showed high positive indirect effect on yield through fiber content (%) (0.051), 100 seed weight (0.0331), average pod weight (0.0185) and highest negative indirect effect due to number of pods per plant (-0.1503), pod diameter (cm) (-0.1058), plant height (-0.0453). Pod diameter (cm) showed high positive indirect effect on yield through days to 50 % flowering (0.0282), days to first flower (0.0202), fiber content (%) (0.0141) and highest negative indirect effect due to leaf area (cm^2) (-0.0382), number of cluster per plant (-0.0366), number of pods per plant (-0.0349).

Pod length (cm) showed high positive indirect effect on yield through primary branches per plant (0.0401), average pod weight (0.0319), leaf area (cm^2) (0.0251) and highest negative indirect effect due to fiber content (%) (-0.0253), days to first flower (-0.0175), days to 50 % flowering (-0.014).

Average pod weight showed high positive indirect effect on yield through number of pods per cluster (0.043), pod diameter (cm) (0.0428), pod length (cm) (0.1969) and highest negative indirect effect due to days to first flower (-0.01939), days to 50 % flowering (-0.1397), fiber content (%) (-0.1116).

The positive indirect effect of primary branches per plant on yield through pod length (0.01502), plant height (0.0777), average pod weight (0.0693) and highest negative indirect effect due to days to first flower (-0.0905), days to 50 % flowering (-0.0893),fiber content (%) (-0.1038).

100 seed weight showed high positive indirect effect on yield through average pod weight (0.0182), number of seeds per pod (0.0122), leaf area (cm^2) (0.011) and highest negative indirect effect due to number of pods per plant (-0.0085), fiber content (%) (-0.0084), plant height (-0.0083).

Plant height showed moderate positive indirect effect on yield through number of seeds per pod (0.0957), primary branches

per plant (0.0577), pod length (0.0406) and highest negative indirect effect due to fiber content (%) (-0.0139), average pod weight (-0.0019).

The indirect effect of leaf area on yield was positive through pod length (0.1384), pod diameter (cm) (0.1176), and average pod weight (0.1085) and highest negative indirect effect due to fiber content (%) (-0.0973), days to first flower (-0.0892), days to 50 % flowering (-0.0891).

These results are in consonance with the finding of Kapor *et al.*, (2000), Tyagi *et al.*, (1998), singh *et al.*, (2004).

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