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Character Association and Path Analysis in Cowpea
[*Vigna unguiculata* (L.) Walp] Germplasm Line

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A B S T R A C T

The present experiment was conducted using 60 genotypes of cowpea to study their correlation and path analysis during kharif-2015. It can be concluded from these experiment findings that main yield contributing traits are biological yield per plant, number of pods per plant, number of flowers per plant, test weight, number of pods per cluster, pod length, number of seeds per pod, number of clusters per plant, harvest index and plant height due to their direct high positive association with seed yield. The trait days to maturity had negative and non-significant correlation with seed yield per plant thereby indicating selection for early maturity would give drought tolerant and drought avoiding genotypes affecting the seed yield positively in cowpea. Path analysis revealed that, seed yield per plant can be improved practicing selection for biological yield per plant, harvest index, number of pods per plant, days to 50% flowering, number of flowers per cluster, number of primary branches per plant, number of seeds per pod, test weight and plant height as they contributed directly to the seed yield per plant as revealed from path analysis. It indicated the possibilities of simultaneous improvement of these traits by selection. This in turn, will improve the seed yield, since they are positively correlated with the seed yield.

Introduction

Cowpea (*Vigna unguiculata* L. Walp) is a diploid species with 2n=2x=22 chromosomes. It is a self-pollinated crop, with natural cross-pollination of up to one percent. Cowpea belongs to the class of Dicotyledonea, order Fabales, family Fabaceae, subfamily Faboideae, tribe Phaseoleae, subtribe Phaseolinae, and genus *Vigna* (Pasquet *et al.,* 2001). The primary gene-pool is composed of the domesticated cowpea (*V. unguiculata* subsp. *unguiculata* var. *unguiculata*) and its wild progenitor (*V. unguiculata* subsp. *unguiculata* var. *spontanea*. The secondary gene-pool of cowpea includes nine perennial subspecies (Mebeaselassie *et al.,* 2011). All cultivated cowpeas are grouped under the species *Vigna unguiculata*, which is subdivided into four cultivars group such as unguiculata (common cowpea used as food and fodder), sesquipedalis (the yard-long or asparagus bean used as vegetables), biflora (catjang) and textilis (used for fibers). The cultivar group of unguiculata is the most diverse of the four and is widely grown in Africa, Asia and Latin America. Arthur *et al.,* (2009) mentioned that cowpea is the second most important pulse crop after groundnut, cultivated in Africa. Correlation analysis is an

easy to use technique which provides information that selection for one character results in progress for other positively correlated characters. The importance of correlation studies in selection programmes is appreciable when highly heritable characters are associated with the important character like yield. Path coefficient is an excellent means of studying direct and indirect effects of interrelated components of a complex trait particularly if the high correlation between two traits is a consequence of the indirect effect of other traits (Bizeti *et al.,* 2004). Path-coefficient analysis measures the direct influence of one variable on another. By determining the inter-relationships among grain yield components, a better understanding of both the direct and indirect effects of the specific components can be attained (Chaudhary *et al.,* 2005).

Materials and Methods

Experimental site and materials

The present investigation was carried out during Kharif 2015-16 at the Research Farm of Plant Breeding and Genetics, Rajasthan college of Agriculture, MPUAT, Udaipur. This experiment material comprised of sixty diverse genotypes including three checks viz.,RC-101, RC-19 and RCV-7 of cowpea. The experimental material of cowpea were sown in randomized block design in three replications. Two rows of each genotype were sown in a plot of 4 m length. The row to row and plant to plant distance were kept at 30 cm and 10 cm, respectively. All the recommended package of practices were be followed to raise a healthy crop.

Data collection and analysis

The observations were recorded for 16 characters viz, Days to 50% flowering, Number of flowers per plant, Number of flowers per cluster, Days to maturity, Plant height, Number of primary branches per plant, Number of pods per plant, Number of clusters per plant, Number of pods per cluster, Pod length, Number of seeds per pod, Test weight, Seed yield per plant, Biological yield per plant, Harvest index and Seed protein content on five randomly selected plants from each genotypes in all the replications while days to 50% flowering and days to maturity which were recorded on plot basis. The phenotypic and genotypic correlation coefficients of all the characters were worked out as per the procedure suggested by Fisher (1954) and Al-Jibouri *et al.,* (1958) and the path coefficient analysis was carried out as per the method suggested by Dewey and Lu (1959) at both phenotypic and genotypic level.

Results and Discussion

Correlation coefficient

Estimates of correlation coefficient at phenotypic and genotypic level are given in table 1. seed yield per plant exhibited significant positive correlation with biological yield (0.739**), number of pods per plant (0.453**), number of flowers per plant (0.429**), test weight (0.421**), number of pods per cluster (0.373**), pod length (0.351**), number of seeds per pod (0.343**), number of clusters per plant (0.318**), harvest index (0.307**) and plant height (0.252**), respectively at genotypic level. Biological yield per plant (0.718**) followed by number of pods per plant (0.419**), test weight (0.410**), number of flowers per plant (0.383**), harvest index (0.340**), number of seeds per pod (0.325**), pod length (0.319**), number of clusters per plant (0.272**), plant height (0.248**) and number of pods per cluster (0.189*) showed positive highly significant correlation with seed yield per plant, respectively at phenotypic level. The present findings are in accordance with the findings

of Leeliji *et al.,* (1981), Padi *et al.,* (2003), Fana *et al.,* (2004), Kaveris *et al.,* (2007) and Manggoel *et al.,* (2012).

Seed protein content showed negative significant correlation with days to maturity (rg -0.198** and rp -0.187*). However, harvest index also showed highly significant and negative correlation with biological yield per plant (rg -0.396** and rp -0.375**) and days to maturity also showed significant and negative correlation with harvest index (rg -0.232** and rp -0.191*). The present results are also finds out by Fikru *et al.,* (2004) and Kaveris *et al.,* (2007). Biological yield per plant exhibited highly significant and positive correlation with test weight (rg 0.398** and rp 0.397**), number of seeds per pod (rg 0.386** and rp 0.369**), pod length (rg 0.353** and rp 0.314**), and biological yield per plant showed negative significant correlation with days to 50% flowering (rg -0.189*) by Leleji (1981), Uguru (1996) and Manggoel *et al.,* (2012). Test weight exhibited significant and positive correlation with pod length (rg 0.602** and rp 0.527**), number of primary branches per plant (rg 0.259** and rp 0.255**) However, test weight also showed significant and negative correlation with number of pods per plant (rg -0.165* and - rp 0.149*) by Fana *et al.,* (2004), Fikru (2004) and Kaveris *et al.,* (2007). Number of seeds per pod showed significant and positive correlation with pod length (rg 0.366** and rp 0.401**), number of primary branches per plant (rg 0.217** and rp 0.206**) and plant height (rg 0.160* and rp 0.153*) However, number of seeds per pod also showed significant and negative correlation with days to 50% flowering (rg -0.496** and rp -0.272**) and days to maturity (rg -0.273** and rp -0.231**) by Padi (2003) and Diriba Shanko *et al.,* (2014). Pod length showed significant positive correlation with number of flowers per cluster (rg 0.245**), number of pods per cluster (rg 0.219**) and number of primary branches per

plant (rg 0.189* and rp 0.157*) Pod length also showed significant and negative correlation with days to 50% flowering (rg -0.426* and rp -0.150*) and days to maturity (rg -0.236* and rp -0.167*) by Manggoel *et al.,* (2012) and Diriba Shanko *et al.,* (2014). Pods per cluster was exhibited highly significant and positive correlation with number of flowers per clusters (rg 0.823** and rp 0.637**), number of flowers per plant (rg 0.494** and rp 0.250**) However, it was exhibited significant and negative correlation with number of clusters per plant (rp -0.374**) and days to 50% flowering (rg -0.178*) by Veeraswamy *et al.,* (1973) and Vange *et al.,* (2009). Pods per plant was exhibited highly significant and positive correlation with number of flowers per plant (rg 0.933** and rp 0.822**). However, it was also exhibited significant and negative correlation with number of flowers per cluster (rg -0.245**) by Venkatesan *et al.,* (2003) and Diriba Shanko *et al.,* (2014). It can be concluded from these experiment findings that main yield contributing traits are biological yield per plant, number of pods per plant, number of flowers per plant, test weight, number of pods per cluster, pod length, number of seeds per pod, number of clusters per plant, harvest index and plant height due to their direct high positive association with seed yield. It indicated the possibilities of simultaneous improvement of these traits by selection. This in turn, will improve the seed yield, since they are positively correlated with the seed yield.

Path coefficient analysis

The direct and indirect effects of fifteen dependent characters on seed yield per plant as independent character was obtained in path coefficient analysis using genotypic correlation coefficient are presented in table 2. The highest positive direct effect on seed yield per plant was exhibited by biological

Table.1 Genotypic and phenotypic correlation (*and ** significance levels of 5% and 1% respectively)

No	Character		Days to 50% flowering	Number of flowers/ plant	Number of flowers/ cluster	Days to maturity	Plant height (cm)	Number of primary branches/ plant	Number of pods/ plant	Number of clusters/ plant	Number of pods/ cluster	Pod length (cm)	Number of seeds/ pod	Test weight (g)	Biological yield/ plant (g)	Harvest index %	Seed protein content %	Seed yield/ plant (g.)
1	Days to 50% flowering	P	1.000	-0.026	-0.203**	0.578**	0.066	-0.060	0.066	0.133	-0.088	-0.150*	-0.272**	-0.081	-0.130	0.045	-0.070	**-0.094**
		G	1.000	-0.076	-0.238**	0.790**	0.080	-0.100	0.046	0.136	-0.178*	-0.426**	-0.496**	-0.106	-0.189*	0.017	-0.090	**-0.180***
2	Number of flowers/ plant	P		1.000	0.136	-0.084	0.121	-0.030	0.822**	0.641**	0.250**	-0.068	0.051	-0.118	0.285**	0.121	0.033	**0.383****
		G		1.000	0.089	-0.112	0.137	-0.065	0.933**	0.791**	0.494**	-0.0881	0.049	-0.133	0.321**	0.114	0.031	**0.429****
3	Number of flowers/cluster	P			1.000	-0.042	-0.007	0.132	-0.123	-0.568**	0.637**	0.054	-0.004	0.023	0.044	-0.029	-0.006	**0.012**
		G			1.000	-0.071	-0.005	0.199**	-0.245**	-0.603**	0.823**	0.245**	0.061	0.039	0.108	-0.124	-0.028	**0.019**
4	Days to maturity	P				1.000	0.135	0.137	-0.054	-0.008	-0.063	-0.167*	-0.231**	0.062	0.101	-0.191*	-0.187*	**-0.061**
		G				1.000	0.140	0.144*	-0.062	-0.030	-0.089	-0.236**	-0.273**	0.065	0.104	-0.232**	-0.198**	**-0.074**
5	Plant height (cm)	P					1.000	0.058	0.128	0.089	0.018	-0.101	0.153*	0.012	0.300**	-0.105	-0.059	**0.248****
		G					1.000	0.061	0.139	0.101	0.036	-0.118	0.160*	0.012	0.301**	-0.114	-0.060	**0.252****
6	Number of primary branches/ plant	P						1.000	-0.100	-0.132	0.070	0.157*	0.206**	0.255**	0.221**	-0.127	-0.029	**0.133**
		G						1.000	-0.129	-0.153*	0.095	0.189*	0.217**	0.259**	0.226**	-0.141	-0.032	**0.135**
7	Number of pods/ plant	P							1.000	0.722**	0.352**	-0.064	0.012	-0.149*	0.254**	0.190*	0.059	**0.419****
		G							1.000	0.906**	0.359**	-0.101	0.007	-0.165*	0.278**	0.201**	0.063	**0.453****
8	Number of clusters/ plant	P								1.000	-0.374**	-0.136	-0.000	-0.105	0.169*	0.122	0.010	**0.272****
		G								1.000	-0.068	-0.211**	-0.020	-0.125	0.190*	0.158*	0.017	**0.318****
9	Number of pods/ cluster	P									1.000	0.086	-0.001	-0.041	0.108	0.096	0.058	**0.189***
		G									1.000	0.219**	0.030	-0.084	0.237**	0.132	0.100	**0.373****
10	Pod length (cm)	P										1.000	0.401**	0.527**	0.314**	0.020	0.109	**0.319****
		G										1.000	0.366**	0.602**	0.353**	-0.005	0.127	**0.351****
11	Number of Seeds/ pod	P											1.000	0.158*	0.369**	-0.070	0.038	**0.325****
		G											1.000	0.167*	0.386**	-0.091	0.040	**0.343****
12	Test weight (g)	P												1.000	0.397**	0.049	-0.045	**0.410****
		G												1.000	0.398**	0.052	-0.045	**0.421****
13	Biological yield/ plant (g)	P													1.000	-0.375**	-0.045	**0.718****
		G													1.000	-0.396**	-0.045	**0.739****
14	Harvest index %	P														1.000	0.074	**0.340****
		G														1.000	0.077	**0.307****
15	Seed protein content %	G															1.000	0.006
		P															1.000	0.005

Table.2 Genotypic path matrix for seed yield

No	Character	Days to 50% flowering	Number of Flowers / plant	Number of flowers / cluster	Days to maturity	Plant height (cm)	Number of primary branches / plant	Number of pods/ plant	Number of clusters / plant	Number of pods/ cluster	Pod length (cm)	Number of seeds/ pod	Test weight (g)	Biological yield/ plant (g)	Harvest index %	Seed protein content %	Seed yield/ plant (g.)
1	**Days to 50% flowering**	**0.078**	-0.006	-0.019	0.061	0.006	-0.008	0.004	0.011	-0.014	-0.033	-0.039	-0.008	-0.015	0.001	-0.007	**-0.180***
2	**Number of flowers/ plant**	0.010	**-0.129**	-0.011	0.014	-0.018	0.008	-0.120	-0.102	-0.064	0.011	-0.006	0.017	-0.041	-0.015	-0.004	**0.429****
3	**Number of flowers/ cluster**	-0.012	0.004	**0.048**	-0.003	0.000	0.010	-0.012	-0.029	0.040	0.012	0.003	0.002	0.005	-0.006	-0.001	**0.019**
4	**Days to maturity**	-0.073	0.010	0.007	**-0.093**	-0.013	-0.013	0.006	0.003	0.008	0.022	0.025	-0.006	-0.010	0.022	0.018	**-0.074**
5	**Plant height (cm)**	0.000	0.001	0.000	0.001	**0.005**	0.000	0.001	0.001	0.000	-0.001	0.001	0.000	0.001	-0.001	0.000	**0.252****
6	**Number of primary branches/ plant**	-0.003	-0.002	0.006	0.005	0.002	**0.032**	-0.004	-0.005	0.003	0.006	0.007	0.008	0.007	-0.005	-0.001	**0.135**
7	**Number of pods/ plant**	0.031	0.620	-0.163	-0.041	0.092	-0.086	**0.665**	0.602	0.239	-0.067	0.005	-0.110	0.185	0.134	0.042	**0.453****
8	**Number of clusters/ plant**	-0.064	-0.373	0.284	0.014	-0.048	0.072	-0.428	**-0.472**	0.032	0.100	0.010	0.059	-0.090	-0.075	-0.008	**0.318****
9	**Number of pods/ cluster**	0.033	-0.093	-0.154	0.017	-0.007	-0.018	-0.067	0.013	**-0.188**	-0.041	-0.006	0.016	-0.045	-0.025	-0.019	**0.373****
10	**Pod length (cm)**	0.012	0.002	-0.007	0.007	0.003	-0.005	0.003	0.006	-0.006	**-0.028**	-0.010	-0.017	-0.010	0.000	-0.004	**0.351****
11	**Number of seeds/ pod**	-0.014	0.001	0.002	-0.008	0.004	0.006	0.000	-0.001	0.001	0.010	**0.028**	0.005	0.011	-0.003	0.001	**0.343****
12	**Test weight (g)**	-0.003	-0.003	0.001	0.002	0.000	0.006	-0.004	-0.003	-0.002	0.014	0.004	**0.023**	0.009	0.001	-0.001	**0.421****
13	**Biological yield/ plant (g)**	-0.188	0.320	0.107	0.103	0.210	0.225	0.276	0.189	0.236	0.352	0.384	0.396	**0.995**	-0.394	-0.045	**0.739****
14	**Harvest index %**	0.011	0.077	-0.083	-0.156	-0.077	-0.095	0.135	0.106	0.089	-0.004	-0.061	0.035	-0.266	**0.672**	0.052	**0.307****
15	**Seed protein content %**	0.002	-0.001	0.001	0.004	0.001	0.001	-0.001	0.000	-0.002	-0.002	-0.001	0.001	0.001	-0.001	**-0.018**	**0.005**

(R square= 0.9761 and Residual effect = 0.1547)

Table.3 Phenotypic path matrix for seed yield

No	Character	Days to 50% flowering	Number of flowers/ plant	Number of flowers/ cluster	Days to maturity	Plant height (cm)	Number of primary branches/ plant	Number of pods/ plant	Number of clusters/ plant	Number of pods/ cluster	Pod length (cm)	Number of seeds/ pod	Test weight (g)	Biological yield/ plant (g)	Harvest index %	Seed protein content %	Seed yield/ plant (g.)
1	**Days to 50% flowering**	**0.021**	-0.001	-0.004	0.012	0.00	-0.001	0.001	0.003	-0.002	-0.003	-0.006	-0.002	-0.003	0.001	-0.002	**-0.094**
2	**Number of flowers/ plant**	0.001	**-0.038**	-0.005	0.003	-0.005	0.001	-0.032	-0.025	-0.010	0.003	-0.002	0.005	-0.011	``````-0.005	-0.001	**0.383****
3	**Number of flowers/ cluster**	-0.001	0.001	**0.007**	-0.000	0.000	0.001	-0.001	-0.004	0.004	0.000	0.000	0.000	0.000	-0.000	0.000	**0.012**
4	**Days to maturity**	-0.025	0.004	0.002	**-0.044**	-0.006	-0.006	0.002	0.000	0.003	0.007	0.010	-0.003	-0.004	0.008	0.008	**-0.061**
5	**Plant height (cm)**	0.002	0.003	-0.000	0.004	**0.026**	0.002	0.003	0.002	0.001	-0.003	0.004	0.000	0.008	-0.003	-0.002	**0.248****
6	**Number of primary branches/ plant**	-0.001	-0.001	0.003	0.003	0.001	**0.019**	-0.002	-0.003	0.001	0.003	0.004	0.005	0.004	-0.002	-0.001	**0.133**
7	**Number of pods/ plant**	0.010	0.129	-0.019	-0.009	0.020	-0.016	**0.157**	0.114	0.055	-0.010	0.002	-0.023	0.040	0.030	0.009	**0.419****
8	**Number of clusters/ plant**	-0.012	-0.056	0.050	0.001	-0.008	0.012	-0.063	**-0.088**	0.032	0.012	0.000	0.009	-0.015	-0.011	-0.001	**0.272****
9	**Number of pods/ cluster**	0.006	-0.017	-0.042	0.004	-0.001	-0.005	-0.023	0.025	**-0.066**	-0.006	0.000	0.003	-0.007	-0.006	-0.004	**0.189***
10	**Pod length (cm)**	0.000	0.000	-0.000	0.000	0.000	-0.000	0.000	0.000	-0.000	**-0.002**	-0.001	-0.001	-0.001	0.000	-0.000	**0.319****
11	**Number of seeds/ pod**	-0.002	0.000	0.000	-0.002	0.001	0.001	0.000	0.000	0.000	0.003	**0.007**	0.001	0.003	-0.001	0.000	**0.325****
12	**Test weight (g)**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	**0.410****
13	**Biological yield/ plant (g)**	-0.125	0.274	0.043	0.097	0.289	0.213	0.244	0.163	0.104	0.302	0.356	0.382	**0.963**	-0.361	-0.043	**0.718****
14	**Harvest index %**	0.031	0.084	-0.020	-0.132	-0.072	-0.088	0.131	0.084	0.066	0.014	-0.048	0.034	-0.259	**0.690**	0.051	**0.340****
15	**Seed protein content %**	0.001	-0.000	0.000	0.002	0.001	0.000	-0.001	-0.000	-0.001	-0.001	-0.000	0.001	0.001	-0.001	**-0.010**	**0.006**

(R square= 0.9518 and Residual effect = 0.2196

Yield (0.995) followed by harvest index (0.672), number of pods per plant (0.665), whereas number of flowers per plant (-0.129), days to maturity (-0.093), pod length (-0.028), seed protein content (-0.018) were contributed negative direct effect on seed yield. The present findings are also with the similar trends of result reported by Singh *et al.,* (1990), Kutty *et al.,* (2003) and Diriba Shanko *et al.,* (2014).

Number of pods per plant (0.620) followed by biological yield (0.320) and harvest index (0.077) exhibited considerable positive indirect effect on seed yield per plant via number of flowers per plant. Such similar results were also reported by Uguru, (1995) and Nakawuka and Adipala (1999). Number of pods per plant (0.602) followed by biological yield (0.189) and harvest index (0.106) exhibited considerable positive indirect effect on seed yield per plant via number of cluster per plant by Tyagi and Koranne (1988), Patil *et al.,* (1989) and Altinbas and Sepetogly (1993). Biological yield per plant (0.396) followed by number of cluster per plant (0.059), harvest index (0.035) and number of flowers per plant (0.017) exhibited considerable positive indirect effect on seed yield per plant via test weight by Kalaiyarasi and Palanisamy (2001) and Anbumalarmathi *et al.,* (2005). Biological yield per plant (0.352) followed by number of clusters per plant (0.100) and days to maturity (0.022) exhibited considerable positive indirect effect on seed yield per plant via pod length by Uguru (1995), Nakawuka and Adipala (1999) and Driba Shanko *et al.,* (2014). Biological yield per plant (0.210) followed by number of pods per plant (0.092), days to 50% flowering (0.006) and number of seeds per pod (0.004) exhibited considerable positive indirect effect on seed yield per plant via plant height by Kutty *et al.,* (2003), Venkatesan *et al.,* (2003) and Anbumalarmathi *et al.,* (2005). Number of

clusters per plant (0.284) followed by biological yield per plant (0.107), days to maturity (0.007) and number of primary branches per plant (0.006) exhibited considerable positive indirect effect on seed yield per plant via number of flowers per cluster by Tyagi and Koranne (1988), Patil *et al.,* (1989) and Altinbas and Sepetogly (1993). Biological yield per plant (0.276) followed by harvest index (0.135) and days to maturity (0.006) exhibited considerable positive indirect effect on seed yield per plant via number of pods per plant by Tyagi and Koranne (1988) and Altinbas and Sepetogly (1993). Number of pods per plant (0.239) followed by biological yield per plant (0.236) and harvest index (0.089) exhibited considerable positive indirect effect on seed yield per plant via number of pods per cluster by Kutty *et al.,* (2003) and Driba Shanko *et al.,* (2014). Biological yield per plant (0.225) followed by number of cluster per plant (0.072), number of flowers per cluster (0.010), number of flowers per plant (0.008) and test weight (0.006) exhibited considerable positive indirect effect on seed yield per plant via number of primary branches per plant by Tyagi and Koranne (1988) and Altinbas and Sepetogly (1993) and Meena *et al.,* (2015). Number of pods per plant (0.185) followed by number of seeds per pod (0.011) and test weight (0.009) exhibited considerable positive indirect effect on seed yield per plant via biological yield by Uguru (1995) and Kutty *et al.,* (2003). The component of residual effect of path analysis was 0.1547 low residual effect indicated that character for path analysis were adequate and appropriate.

The direct and indirect effect of fifteen dependent characters on seed yield per plant as independent character was obtained in path coefficient analysis using phenotypic correlation coefficient are presented in table 3. Path coefficient analysis revealed that the maximum positive direct effect was observed

for biological yield (0.963) followed by harvest index (0.690), number of pods per plant (0.157), plant height (0.026), days to 50% flowering (0.021), number of primary branches per plant (0.019), number of flowers per cluster (0.007), number of seeds per pod (0.007) on seed yield per plant by Singh *et al.,* (1990) and Kutty *et al.,* (2003). Biological yield per plant (0.382) followed by harvest index (0.034) and number of cluster per plant (0.009) had considerable positive indirect effect on seed yield per plant via test weight by Kalaiyarasi and Palanisamy (2001) and Anbumalarmathi *et al.,* (2005). Biological yield per plant (0.356) followed by days to maturity (0.010) and number of primary branches per plant (0.004) had considerable positive indirect effect on seed yield per plant via number of seeds per pod by Tyagi and Koranne (1988) and Altinbas and Sepetogly (1993). Biological yield per plant (0.302) followed by harvest index (0.014) and number of clusters per plant (0.012) had considerable positive indirect effect on seed yield per plant via pod length by Uguru (1995), Nakawuka and Adipala (1999) and Driba Shanko *et al.,* (2014). Biological yield per plant (0.289) and number of pods per plant (0.020) had considerable positive indirect effect on seed yield per plant via plant height. These results are in accordance with the findings of Kutty *et al.,* (2003), Venkatesan *et al.,* (2003) and Anbumalarmathi *et al.,* (2005). Biological yield per plant (0.274) and number of pods per plant (0.129) had considerable positive indirect effect on seed yield per plant via number of flowers per plant. Such similar results were also reported by Uguru (1995) and Nakawuka and Adipala (1999). Biological yield per plant (0.244) and harvest index (0.131) had considerable positive indirect effect on seed yield per plant via number of pods per plant by Tyagi and Koranne (1988); Patil *et al.,* (1989) and Altinbas and Sepetogly (1993). Biological yield per plant (0.163) and number of pods

per plant (0.114) had considerable positive indirect effect on seed yield per plant via number of clusters per plant by Tyagi and Koranne (1988) and Patil *et al.,* (1989). The component of residual effects of path analysis was 0.219 low residual effect indicated that character for path analysis were adequate and appropriate.

Significant and positive correlations were observed between growth characters as well as between growth characters and seed yield of cowpea, when the correlation coefficients were partitioned into direct and indirect effects. Highest positive direct effect on biological yield per plant (0.963) followed by harvest index (0.690) and number of pods per plant (0.157). While, high indirect effect on seed yield per plant was exhibited by test weight (0.381), number of seeds per pod (0.356), pod length (0.302) and number of flowers per plant (0.274) through biological yield per plant. It is concluded from the path analysis study that seed yield in cowpea can be improved by focusing on character biological yield per plant, harvest index, number of pods per plant and plant height.

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