Progressive Research 9 (Special) : 484-487 (2014) Society for Sci. Dev. in Agric. and Tech.

CORRELATION AND PATH ANALYSIS OF YIELD AND ITS CONTRIBUTING TRAITS IN CHICKPEA (*Cicer arietinum* L.)

Jaydev Kumar[1], Deepak Kumar Dwivedi[1], Shiva Nath[2], S.K. Singh[1], Lokendra Singh[1], A.P. Singh[3], U.K. Shukla[4] and Shanti Kumari[5]

[1]*Deptt. of Genetics and Plant Breeding,* [4]*Deptt. of Seed Science and Tech., C.S.A. Univ. of Agric. and Tech. Kanpur*

[2]*Deptt. of Genetics and Plant Breeding, N.D. Univ. of Agric. and Tech. Kumarganj, Faizabad*

[3]*Indian Institute of Pulses Research, Kanpur,* [5]*Deptt. of Genetics, IARI, New Delhi*

ABSTRACT

A field experiment was conducted to study correlation and path coefficient analyses among 104 genotypes for eleven traits of chickpea at Genetics and Plant Breeding Research Farm, N.D. University of Agriculture and Technology, Kumarganj, Faizabad during Rabi 2010-2011. Correlation studies revealed harvest index, pods/plant, biological yield/plant and days to maturity had highly positive significant relationship with seed yield/plant whereas, seed yield/plant showed positive significant association with days to 50% flowering. Path analysis showed highest direct effect of harvest index followed by biological yield on seed yield. Significant inter correlation and path coefficient analyses between traits are useful for breeding programme for improvement of seed yield.

Key words : *Chickpea, correlation and path analysis, yield, contributing, traits.*

Chickpea is one of the most important pulse crops of India. In India, it was grown in 8.75 mha area with a production of 8.25 mt (DAC, 2011). Among states, Madhya Pradesh (3.09 mt) and Maharashtra (1.11 mt) contributed maximum to the national production during 2009-10 in general. Chickpea has protein (19.5%), fat (1.4%), carbohydrates (57-60%), ash (4.8%) and moisture (4.9-15.59%). It helps to replenish soil fertility by fixing atmospheric N_2 via symbiosis. Few years ago, it was the cheap and most readily available source of protein. Despite its nutritional value and economic importance too, chickpea production is relatively low in country; this is primarily due to poor genetic makeup of the native cultivars. Besides other reasons, drought stress, poor management and biotic factors such as blight, wilt disease and pod borer are the major constraints to achieve full potential of high yielding varieties.

Yield is the major complicated trait that is an outcome of interaction of many plant characters and is highly influenced by environmental changes. Determination of correlation and path coefficients between yield and yield components are important parameters for the selection of desirable plant types for effective chickpea breeding scheme. Correlation coefficients show association among dependent characters and the degree of linear relationship between these traits (Table-1). It is not sufficient to describe this relationship when the causal and effect association among characters is needed (1). Path analysis is used to know causes. In other words, path analysis is used to determine the amount of direct and indirect effect of the causal components on the effect component. The plus point of path analysis is that it allows the partitioning of correlation coefficient into its components (2). Therefore, characters association (correlation) and path analysis studied would be useful in understanding the contribution of traits towards seed yield before making selection scheme of plants.

MATERIALS AND METHODS

A field experiment was conducted in an Augmented Block Design at Genetics and plant Breeding Research Farm, N.D. University of Agriculture and Technology, Kumarganj (Narendra Nagar), Faizabad during Rabi 2010-2011. The experimental material comprised of 104 genotypes of chickpea including elite lines and land races along with 4 popular varieties as checks viz.; HK 94-134, BG 1003, BG 256 and KWR 108. These genotypes were obtained from the germplasm maintained at Pulse Section of the university. Each line was grown in a single row of 4m length representing a plot in non-replicated way, while checks were replicated ten times. Row to row and plant to plant spacing was kept 30 cm and 10cm, respectively. On the basis of five randomly taken plants, data was recorded for days to 50 % flowering, days to maturity, number of

Table-1 : Analysis of variance for eleven characters in chickpea.

Source of variation	d.f.	Days to 50 flowering	Days to maturity	Primary branches/ plant	Secondary branches/ plant	Plant height (cm)	Pods/ plant	Seeds/ pod	Biological yield/ plant (g)	Seed yield/ plant	Harvest index (%)	100 seed weight (g)
Blocks	9	19.09**	25.32**	0.26**	0.93**	19.75**	30.92*	0.013**	17.03**	2.76**	20.89**	16.46**
Checks	3	261.70**	494.42**	1.97**	4.97**	218.73**	302.57**	0.055**	38.57**	26.13**	109.24**	40.32**
Error	27	2.05	2.69	0.04	0.15	4.60	10.04	0.00028	1.29	0.42	4.34	0.048
Total	39											

*, **, Significant at 5 and 1% levels, respectively.

primary branches/plant, number of secondary branches/plant, plant height (cm), pods/plant, seeds/ pod, biological yield/plant (g), seed yield/plant (g), harvest index (%) and 100-seed weight (g).

RESULTS AND DISCUSSION

Data analysis was done for all the eleven characters. Analysis of variance (ANOVA) for Augmented Block Design revealed much variability among the genotypes for all the attributes. Analysis of variance indicated significant differences among the checks as well as in blocks for all the traits under the study at one per cent probability level except pods/plant whereas it showed only as significant at five per cent probability level in blocks (Table-1).

Correlation among the characters may be consequence of pleiotropy or linkage among the genes controlling the traits. From the breeder's point of view the type of association of seed yield and its components of paramount importance. The lower values of phenotypic correlation may be attributed due to modifying effect of environment on the real association of traits at the gene level. Therefore, the magnitude of inter-relationship among different characters is most useful for yield and its knowledge is useful for the breeders in making effective selection scheme based on the correlated and non correlated responses. The results pertaining to phenotypic correlation coefficients revealed that seed yield had positive and highly significant association with days to maturity, pods/plant, biological yield/plant and harvest index whereas, seed yield was significantly and positively correlated with days to 50% flowering. These results suggested that improvement of seed yield in chickpea is linked with these traits and selection of these characters might have good impact on seed yield/plant. The degree of inter-relationship was highest for harvest index followed by biological yield/plant and pods/plant, respectively. The high positive correlation of harvest index and pods/plant with seed yield/plant maybe attributed due to the increase in number of primary branches/plant and secondary branches/plant resulting increase number of pod^{-1}. Similar results were reported by (3). Days to 50% flowering, number of secondary branches/plant, plant height, pods/plant and biological yield/plant were observed positive and highly significantly correlated with each others. Days to 50% flowering showed positive and highly significant correlation with days to maturity and biological yield/plant while, it also showed positive and significant association with seed yield/plant *i.e.,* delay flowering with maturity results to increase the biological yield. Same finding were observed by (4). Seeds/pod had negative and highly significant impact on 100 seed weight means increment in seeds/pod was responsible for reduction in seed size giving rise low 100-seed weight.

Biological yield/plant exhibited highly significant positive association with days to 50% flowering, secondary branches/plant, plant height and pods/ plant, while it revealed significant relationship with days to maturity and primary branches/plant. This relationship showed that more biological yield was due to late flowering and maturity which increased the number and length of secondary branches/plant led the development of taller plant. Positive and significant association was noted for days to maturity with biological yield/plant. These results were in good agreement with (5). As for as primary branches/plant is concerned it showed positive and highly significant correlation with secondary branches/plant and plant height, whereas it had positively significant correlation with biological yield/plant and pods/plant. Similarly,

Table-2: Estimates of phenotypic correlation coefficients between eleven characters in chickpea genotypes

Characters	Days to 50% flowering	Days to maturity	Primary branches/ plant	Secondary branches/ plant	Plant height (cm)	Pods/plant	Seeds/ pod	Biological yield/plant (g)	Harvest index (%)	100-seed weight (g)	Seed yield/ plant
Days to 50% flowering	1.000	0.9354**	0.0210	-0.0917	-0.0572	0.1651	0.1299	0.2583**	0.1760	-0.0265	0.2449*
Days to maturity		1.000	0.0325	-0.0646	0.0087	0.1545	0.0988	0.2461*	0.1867	0.0527	0.2525**
Primary branches/plant			1.000	0.4590**	0.3179**	0.2163*	-0.0910	0.2251*	0.0349	-0.1076	0.1190
Secondary branches/plant				1.000	0.3768**	0.2994**	-0.0870	0.3406**	0.0187	-0.1367	0.1652
Plant height (cm)					1.000	0.1256	0.1429	0.4849**	-0.0593	-0.0485	0.1418
Pods/plant						1.000	-0.1216	0.5576**	0.6409**	-0.0358	0.7769**
Seeds/pod							1.000	-0.0307	-0.0220	-0.6074**	-0.0377
Biological yield/plant (g)								1.000	0.1456	0.0639	0.5271**
Harvest index (%)									1.000	0.1720	0.9135**
100-seed weight (g)										1.000	0.1771

*, **, Significant at 1 and 1% levels, respectively.

Table-3: Direct and indirect effects of ten characters on seed yield per plant in chickpea germplasm.

Characters	Days to 50% flowering	Days to maturity	Primary branches/ plant	Secondary branches/ plant	Plant height (cm)	Pods/ plant	Seeds/pod	Biological yield/plant (g)	Harvest index (%)	100-seed weight (g)	Correlation coefficients with seed yield/plant
Days to 50% flowering	-0.0295	0.211	-0.0001	-0.0015	0.0005	0.0015	0.0003	0.1035	0.1495	-0.0002	0.2449*
Days to maturity	-0.0276	0.0225	-0.0002	-0.0011	-0.0001	0.0014	0.0002	0.0986	0.1585	0.0003	0.2525**
Primary branches/plant	-0.0006	0.0007	-0.0067	0.0076	-0.0029	0.0020	-0.0002	0.0902	0.0296	-0.0007	0.1190
Secondary branches/plant	0.0027	-0.0015	-0.0031	0.0165	-0.0035	0.0027	-0.0002	0.1365	0.0159	-0.0008	0.1652
Plant height (cm)	0.0017	0.0002	-0.0021	0.0062	-0.0093	0.0011	0.0003	0.1942	-0.0503	-0.0003	0.1418
PalphaPods/plant	-0.0049	0.0035	-0.0014	0.0049	-0.0012	0.0091	-0.0002	0.2234	0.5439	-0.0002	0.7769**
Seeds/pod	-0.0038	0.0022	0.0006	-0.0014	-0.0013	-0.0011	0.0019	-0.0123	-0.0187	-0.0037	-0.0377
Biological yield/plant (g)	-0.0076	0.0055	-0.0015	0.0056	-0.0045	0.0051	-0.0001	0.4006	0.1236	0.0004	0.5271**
Harvest index (%)	-0.0052	0.0042	-0.0002	0.0003	0.0005	0.0058	0.0000	0.0583	0.8486	0.0011	0.9135**
100-seed weight (g)	0.0008	0.0012	0.0007	-0.0023	0.0004	-0.0003	-0.0012	0.0256	0.1460	0.0061	0.1771

Residual effect = 0.0803, Direct effects on main diagonal (bold figures) secondary branches/plant revealed extremely significant association with plant height, biological yield/plant and pods/plant. The increase in secondary branches resulted more biomass and more number of pods/ plant because pods/plant was positively related with secondary branches/plant. Similar results have been observed by (6) which indicated the inherent relationship among the traits and masking effects of environments on the phenotypic expression of characters.

Path coefficient analysis measure the direct influence of one variable upon the other and permits separation of correlation coefficient into component of direct and indirect effects. Portioning of total correlation into direct and indirect effects provide actual information on contribution of characters. In other hands, path analysis employed to establish the reliability of independent variables (days to 50% flowering, days to maturity, number of primary branches/plant, number of secondary branches/plant, plant height, pods/plant, seeds/pod, biological yield/ plant, harvest index and 100-seed weight) on the dependent one *i.e.,* seed yield/plant (Table-2). This analysis also helps plant breeders to identity the characters that could be used as selection criteria in chickpea breeding programme. Path analysis for seed yield/plant revealed that harvest index showed highest positive direct effect towards seed yield. These results agree with the earlier reports of (7). Primary branches/plant, plant height and days to 50% flowering exhibited negative direct effect on seed yield. The maximum indirect and positive effect on seed yield was showed by pods/plant *via* harvest index, whereas positive indirect effect on seed yield also exhibited by plant height and secondary branches/plant *via* biological yield/plant. Similar findings were also recorded by (7). For seeds/pod, the direct effect was positive while its association with seed yield was observed to be negative indicating the importance of restricted selection model for exploitation of the direct effect noticed. Primary branches/plant, plant height and days to 50% flowering had negative or very low direct effect. These results indicated that harvest index, biological yield/plant, secondary branches/plant and seeds/pod were important yield contributing traits. The positive contribution of days to 50% flowering indicated that our selection criteria should be focused on delay maturing germplasm for improved responses. (The residual effect (0.0803) was represented that there are some more components that are contributing towards seed yield). Comparative view based on the both correlation and path coefficient analysis indicated that there are some common characters which have been responsible for more the seed yield/plant; these characters are like harvest index, biological yield/plant, pods/plant, secondary branches/plant, days to maturity, seed weight and seeds/pod. These traits showed positive direct effect on seed yield.

On the basis of results, it can be concluded that for increasing the seed yield by selecting desirable plant types emphasis should be given to high harvest index, biological yield/plant, more secondary branches/ plant, pods/plant and 100-seed weight. These traits showed positive direct effect along with significant and positive association with seed yield except secondary branches/plant, seeds pod and 100-seed weight due to some biotic and abiotic factors. Therefore, these traits are likely to be successfully employed for the selection of high yielding chickpea genotypes.

REFERENCES

1. Toker, C. and Cagirgan, M.I. (2004). The use of phenotypic correlations and factor analysis in determining characters for grain yield selection in chickpea (*Cicer arietinum* L.). *Hereditas. 140 :* 226-228.
2. Dewey, D.R. and Lu, K. (1959). Correlation and path coefficients of crested wheat grass seed production. *Agron. J. 51:* 515-518.
3. Jeena, A.S. and Arora, P.P. (2002). Path analysis in relation to selection in chickpea. *Legume Research 22(2) :* 132-133.
4. Yucel, D.O.; Anlarsal, A.E. and Yucel, C. (2006). Genetic variability, correlation and path analysis of yield, and yield components in chickpea (*Cicer arietinum* L.). *Turk. J. Agric. & Forestry. 30 :* 183-88.
5. Singh, A.P. and Shiva Nath (2012). Correlation and path analysis of yield and yield component in chickpea. *Progressive Research 7(1) :* 82-84.
6. Singh, S.P. (2007). Correlation and path analysis in chickpea. International Journal of Plant Science, Muzaffarnagar 2(1): 1-4.
7. Yucel, D.; Ozveren and Anlarsal, A.E. (2010). Determination of selection criteria with path coefficient analysis in chichpea breeding. *Bulg. J. Agric. Sci. 16 :* 42-48.