Himachal Journal of Agricultural Research 45(1&2) : 15-19 (2019)

Correlation studies for yield and its components in chickpea under low input conditions

Jeevanjot Kaur and Neelam Bhardwaj*
Department of Crop Improvement
CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176 062, India.
*Corresponding author: neenabhardwaj@gmail.com

Manuscript Received: 26.11.2019; Accepted: 10.12.2019

Abstract

The present investigation was undertaken during *rabi* 2017 at Experimental Farm of the Department of Organic Agriculture and Natural Farming on the fourteen germplasm lines of chickpea to estimate the associations among various traits including their direct and indirect effects on seed yield and to identify potential genotypes under low input conditions. Correlation studies revealed that secondary branches per plant, pods per plant, nodule number, nodule fresh weight, nodule dry weight, biological yield per plant and harvest index were positively correlated with seed yield per plant at genotypic and phenotypic level whereas days to 50 per cent flowering and nitrogen fixation positively correlated with yield only at genotypic level. Secondary branches per plant, harvest index, nodule dry weight, nodule number, seeds per pod, biological yield per plant and pods per plant exhibited high direct effect implying that these traits can act as selection indices for seed yield. Among the different genotypes, best genotypes for seed yield were 18-II, 113-P, P-30-6 and DKG-964 under low input conditions.

Key words: Low input conditions, Character associations, Direct and indirect effects.

Green revolution met the requirement of food grains with growing population which generally include the use of high yielding varieties and agro-chemicals viz; synthetic fertilizers, pesticides, weedicides and herbicides etc. In conventional system, use of high yielding varieties integrated with high inputs have reached a plateau besides causing immense depletion in soil micro-nutrients. In-depth use of agrochemicals in misproportion has lead to soil erosion, surface and groundwater contamination, release of greenhouse gases, increased pest resistance, and loss of biodiversity, loss of soil organic matter and poor product quality (Ahmed *et al.* 2017). Micro flora and fauna of soil also got disturbed and resulted in poor soil quality (Chakarborti and Singh 2004). Sustainable system of agriculture such as organic agriculture has been proposed as a possible alternative to conventional system in an effort to reduce the harmful environmental effects of agriculture on human health and soil deterioration. Organic farmers are currently using varieties that are bred under conventional system and these varieties do not perform well under organic input conditions giving low yields (Bhardwaj *et al.* 2012). Hence there is need to breed varieties for organic input conditions separately to get more yields. Present study was conducted on chickpea (*Cicer arietinum* L.) as chickpea is third most important major pulse cultivated and consumed in India (Bhanu *et al*. 2017). Globally, the area under chickpea cultivation is 14.56 million ha with the production of 14.78 million tonnes. In India, it is one of the most important pulse crop grown over an area of 9.54 million ha and production 9.08 million tonnes (Anonymous 2017a). It is also an important pulse of Himachal Pradesh, where it covers an area of 360 ha with the production 386.08 tonnes (Anonymous 2017b).Chickpea contain 23% proteins, 64% total carbohydrates, 5% fat, 6 % crude fiber, 3% ash and a high mineral content (Oberoi *et al*., 2010). It is a notable contributor towards agricultural sustainability due to its ability to fix atmospheric nitrogen into available nitrogen and plays a significant role in the low input agriculture by reducing the dependence on inorganic nutrients and cost of experiment (Ahmed *et al.* 2017). However, its requirements for nitrogen fertilizers are lower than those of other crops to obtain higher yield and improved seed quality (Dhima *et al.* 2015). Hence the present study was conducted to find out important traits through correlation and path coefficient analysis contributing to yield of chickpea under low input conditions.

Materials and Methods

Fourteen diverse genotypes of chickpea including four checks were grown in a randomized complete block design with three replications in low input conditions. Each genotype was raised in a row of 3m length with row to row and plant to plant spacing of 30cm and 10cm respectively. At the time of sowing under organic input conditions vermicompost was applied at the rate of 5.0t/ha. The data were recorded on five random competitive plants for each genotype across replications on yield and related traits. The data on nodule number, fresh weight and dry weight was taken on three random plants at the time of flowering. Nitrogen fixation (ηmoles C_2H_4/fresh weight of root in g/2.5hr/plant) was determined through Gas Liquid Chromatograph (GC). The data were statistically analyzed as per Panse and Sukhatme (1987). The direct and indirect effects were calculated by the method suggested by Dewey and Lu (1959).

Results and Discussion

The analysis of correlation and path analysis with respect to the fourteen genotypes of chickpea are presented in table 1 and 2. The estimates of genotypic correlations, in general, were higher than their respective phenotypic correlations for all the traits indicating that there was an inherent association among the various characters under study and the phenotypic expression of correlations was lessened under the influence of environment.

Correlation studies revealed that eight characters exhibited significant and positive correlation with seed yield viz; secondary branches per plant, pods per plant, seeds per pod, nodule number per plant, nodule fresh weight per plant, nodule dry weight per plant, harvest index and biological yield per plant. Days to 50% flowering showed significant positive correlation with nitrogen fixation and significant negative correlation with 100-seed weight. Days to 75% maturity showed significant negative correlation with pods per plant, harvest index and biological yield per plant. Plant height showed significant positive correlation with primary branches per plant and 100-seed weight. Primary branches per plant showed significant positive correlation with nodule number whereas significant negative correlation with biological yield per plant. Secondary branches per plant showed significant positive correlation with pods per plant, seeds per pod, nodule number, nodule fresh weight, nodule dry weight, harvest index and biological yield per plant. Pods per plant showed significant positive correlation with nodule number, nodule fresh weight, nodule dry weight, harvest index and biological yield per plant. Nodule number showed significant positive correlation with nodule fresh weight and nodule dry weight. Nodule fresh weight showed significant positive correlation with harvest index and nodule dry weight. Nodule dry weight in turn showed significant positive correlation with harvest index while harvest index showed significant positive correlation with biological yield per plant.

Even though the correlation coefficients are helpful in determining the components of a complex trait like seed yield, an exact picture of the relative importance of direct and indirect influence of each component trait which is not provided by such studies as these estimates provide nature and magnitude but not its cause. Path coefficient (Wright 1921; Dewey and Lu 1959) under such circumstances plays an important role in partitioning the correlations into direct and indirect effects of a specific causal factor and in determining the degree of relationship between yield and its component effects. Path coefficient analysis provides better means for selection by resolving the correlation coefficient of yield and its components into direct and indirect effects. Therefore in the present investigation the direct and indirect effects of different characters on seed yield per plant were estimated. Eight traits showed significant and positive correlation with seed yield per plant but when direct and indirect contribution of the correlation were estimated at phenotypic levels, the direct effect were observed to be positive and high only for secondary branches per plant followed by harvest index, nodule number, biological yield per plant, pods per plant, seeds per pod and nodule dry weight whereas direct effect for rest of the traits were observed to be negligible. The significant positive correlation of seed yield per plant with nodule fresh weight was due to the indirect effect via secondary branches per plant, nodule number and harvest index. Namvar *et al.* (2011) studied the effects of organic nitrogen (N) on yield and nodulation of chickpea and revealed significant positive effects on yield and its attributes through number of primary and secondary branches, number of pods per plant, number of seeds per pod, biological yield and grain yield. Similarly Priyadarsini *et al.* (2017) and Chopdar *et al.* (2017) revealed that various characters viz., primary root number per plant, root length, root dry weight, shoot length, harvest index, number of seeds per pod, primary branches per plant and number of pods per

Table 1. Estimates of correlation coefficients among seed yield and related traits of chickpea under low input conditions at phenotypic and genotypic level

Traits		Days to 75 % maturity	Plant height	Primary branches/ plant	Secondary branches/ plant	Pod length	Pod width	Pods/ plant	Seeds/ pod	Nodule number	Nodule fresh weight	Nodule dry weight	Nitrogen fixation	100-seed weight	Biological yield/ plant	Harvest index	Seed yield / plant
Days to 50 %	P	-0.11	0.00	-0.04	0.09	0.00	0.14	0.22	-0.11	0.10	0.00	0.11	0.37*	-0.37*	0.15	0.19	0.28
flowering	G	-0.10	-0.02	-0.05	0.10	0.14	0.50*	0.24	-0.21	0.12	0.00	0.08	4.05*	-0.57*	0.16	0.17	0.31*
Days to 75 %	P		0.19	0.21	-0.11	0.23	-0.09	-0.32*	0.15	0.15	-0.15	0.04	0.12	0.06	-0.37*	-0.34*	-0.28
maturity	G		0.28	0.37*	-0.19	0.69*	-0.01	-0.47*	0.30	0.17	-0.22	0.08	1.41*	0.06	-0.64*	-0.35*	-0.32*
Plant height	P			0.54*	0.10	0.05	0.02	-0.12	0.28	0.03	-0.08	0.21	0.02	0.39*	-0.29	-0.20	0.14
	G			0.89*	0.16	0.28	0.27	-0.08	0.51*	0.12	-0.12	0.35*	-0.62*	0.70*	-0.53*	-0.33*	0.16
Primary	P				0.10	0.10	-0.04	-0.08	0.17	0.35*	0.10	0.27	0.03	0.24	-0.35*	-0.23	0.09
branches/plant	G				0.16	-0.30	0.18	-0.12	0.47*	0.53*	0.18	0.41*	-0.34*	0.56*	-0.50*	-0.34*	0.22
Secondary	P					-0.02	0.10	0.75*	0.36*	0.45*	0.54*	0.57*	0.10	0.13	0.35*	0.42*	0.77*
branches/plant	G					-0.20	0.23	1.05*	0.53*	0.58*	0.64*	0.97*	1.07*	0.12	0.46*	0.56*	1.04*
Pod length	P						-0.12	-0.08	-0.20	0.06	0.04	-0.01	0.13	0.27	-0.19	-0.03	-0.18
	G						-1.42*	-0.27	-0.09	0.21	-0.09	0.31*	-3.92*	0.84*	0.01	0.19	0.11
Pod width	P							0.00	0.25	0.10	0.14	-0.01	0.28	-0.18	-0.05	-0.04	0.13
	G							0.30	0.31*	0.31*	0.38*	0.89*	4.42*	-0.53*	0.04	0.10	0.30
Pods / plant	P								0.29	0.34*	0.48*	0.49*	-0.14	0.01	0.32*	0.59*	0.71*
	G								0.37*	0.54*	0.70*	0.82*	2.65*	-0.23	0.68*	0.80*	1.11*
Seeds/ pod	P									0.10	-0.07	0.25	-0.09	-0.01	-0.29	0.06	0.33*
	G									0.19	0.05	0.33*	1.81*	0.03	-0.70*	0.14	0.52*
Nodule	P										0.65*	0.61*	-0.01	-0.02	0.03	0.15	0.47*
number	G										0.91*	0.85*	1.24*	0.01	-0.02	0.19	0.58*
Nodule fresh	P											0.47*	0.14	0.12	0.33*	0.34*	0.43*
weight	G											0.88*	-0.61*	-0.04	0.27	0.46*	0.67*
Nodule dry	P												-0.02	0.13	0.21	0.45*	0.63*
weight	G												1.57*	0.40*	0.31*	0.47*	0.90*
Nitrogen	P													-0.28	0.05	0.03	0.04
fixation	G													-3.27*	1.23*	1.78*	2.14*
100-seed	P														-0.05	-0.05	-0.06
weight	G														0.08	-0.13	0.13
Biological	P															0.42*	0.38*
yield/ plant	G															0.65*	0.40*
Harvest index	P																0.62*
	G																0.66 *

P= Phenotypic correlation

G= Genotypic correlation

Table 2. Estimates of direct and indirect effects of different traits on seed yield of chickpea under low input conditions at phenotypic level and genotypic level

Traits		Days to 50% flowering	Days to 75 % maturity	Plant height	Primary branches/ plant	Secondary branches/ plant	Pod length	Pod width	Pods / plant	Seeds/ pod	Nodule number	Nodule fresh weight	Nodule dry weight	Nitrogen fixation	100-seed weight	Biological yield/ plant	Harvest index	Correlation with grain yield
Days to 50 %	P	**0.06**	0.01	0.00	0.00	0.03	0.00	0.00	0.02	-0.00	0.03	0.00	0.01	0.00	0.04	0.02	0.06	0.28
flowering	G	**-0.27**	-0.05	-0.04	0.01	0.06	-0.01	-0.13	0.19	0.13	-0.01	0.00	-0.04	-0.17	0.54	0.03	0.07	0.31*
Days to 75 %	P	-0.01	**-0.12**	0.04	0.00	-0.04	-0.02	0.00	-0.03	0.01	0.04	0.02	0.00	0.00	-0.01	-0.05	-0.11	-0.28
maturity	G	0.05	**0.47**	0.46	-0.07	-0.11	-0.03	0.00	-0.39	-0.19	-0.01	-0.09	-0.04	-0.06	-0.06	-0.11	-0.14	-0.32*
Plant height	P	0.00	-0.03	**0.23**	0.01	0.04	0.00	0.00	-0.01	0.02	0.01	0.01	0.01	0.00	-0.04	-0.04	-0.06	0.14
	G	0.04	0.13	**1.65**	-0.18	0.09	-0.01	-0.07	-0.06	-0.32	-0.01	-0.05	-0.17	0.03	-0.66	-0.09	-0.13	0.16
Primary	P	0.00	-0.02	0.12	**0.01**	0.04	-0.01	0.00	-0.01	0.01	0.10	-0.02	0.01	0.00	-0.03	-0.04	-0.07	0.09
branches/plant	G	0.04	0.17	1.47	**-0.20**	0.09	0.01	-0.05	-0.10	-0.30	-0.04	0.07	-0.20	0.01	-0.53	-0.08	-0.14	0.22
Secondary	P	0.01	0.02	0.02	0.00	**0.40**	0.00	0.00	0.07	0.02	0.12	-0.09	0.03	0.00	-0.02	0.04	0.13	0.77*
branches/plant	G	-0.02	-0.09	0.26	-0.03	**0.58**	0.01	-0.06	0.86	-0.33	-0.04	0.25	-0.48	-0.05	-0.11	0.08	0.23	1.04*
Pod length	P	0.00	-0.03	0.00	0.00	-0.01	**-0.07**	0.00	-0.01	-0.01	0.02	-0.01	0.00	0.00	-0.03	-0.02	-0.01	-0.18
	G	-0.04	0.32	0.47	0.04	-0.11	**-0.04**	0.37	-0.22	0.06	-0.01	-0.03	-0.15	0.16	-0.79	0.00	0.08	0.11
Pod width	P	0.01	0.01	0.01	0.00	0.04	0.01	**0.03**	0.00	0.02	0.03	-0.02	0.00	0.00	0.02	-0.02	-0.01	0.13
	G	-0.14	0.00	0.45	-0.04	0.13	0.05	**-0.26**	0.24	-0.20	-0.02	0.15	-0.44	-0.19	0.50	0.03	0.04	0.30
Pods/ plant	P	0.01	0.04	-0.03	0.00	0.30	0.01	0.00	**0.10**	0.02	0.09	-0.08	0.02	0.00	0.00	0.04	0.19	0.71*
	G	-0.06	-0.22	-0.12	0.02	0.61	0.01	-0.08	**0.82**	-0.23	-0.04	0.27	-0.41	-0.11	0.22	0.11	0.32	1.11*
Seeds/ pod	P	-0.02	-0.02	0.06	0.00	0.14	0.01	0.01	0.03	**0.07**	0.03	0.01	0.01	0.00	0.00	-0.04	0.02	0.33*
	G	0.08	0.14	0.83	-0.09	0.30	0.00	-0.08	0.30	**-0.63**	-0.01	0.02	-0.16	-0.08	-0.03	-0.12	0.05	0.52*
Nodule number	P	0.01	-0.02	0.01	0.00	0.18	0.00	0.00	0.03	0.01	**0.28**	-0.11	0.03	0.00	0.00	0.00	0.05	0.47*
	G	-0.03	0.08	0.19	-0.10	0.34	-0.01	-0.08	0.44	-0.12	**-0.07**	0.36	-0.42	-0.05	-0.01	0.02	0.08	0.58*
Nodule fresh	P	0.00	0.02	-0.02	0.00	0.21	0.00	0.00	0.05	0.00	0.18	**-0.17**	0.02	0.00	-0.01	0.04	0.11	0.43*
weight	G	0.00	-0.10	-0.20	-0.03	0.32	0.00	-0.10	0.57	-0.03	-0.06	**0.39**	-0.44	0.03	0.04	0.05	0.18	0.67*
Nodule dry	P	0.01	-0.03	0.05	0.00	0.23	0.00	0.00	0.05	0.02	0.17	-0.08	**0.05**	0.00	-0.01	0.03	0.14	0.63*
weight	G	-0.01	0.04	0.58	-0.08	0.56	-0.01	-0.23	0.67	-0.20	-0.06	0.35	**-0.50**	-0.07	-0.38	0.05	0.19	0.90*
Nitrogen	P	0.02	-0.02	0.01	0.00	0.04	-0.02	0.01	-0.01	-0.01	0.00	-0.02	0.00	**-0.01**	0.03	0.01	0.01	0.04
fixation	G	-1.11	0.66	-1.02	0.07	0.62	0.14	-1.14	2.17	-1.14	-0.08	-0.24	-0.78	**-0.04**	3.09	0.20	0.72	2.14*
100-seed	P	-0.02	-0.02	0.09	0.00	0.05	-0.02	-0.01	0.00	0.00	-0.01	-0.02	0.01	0.00	**-0.10**	-0.01	-0.02	-0.06
weight	G	0.16	0.03	1.16	-0.11	0.07	-0.03	0.14	-0.19	-0.02	0.00	-0.01	-0.20	0.14	**-0.95**	0.01	-0.05	0.13
Biological	P	0.03	0.05	-0.07	0.00	0.14	0.01	0.00	0.03	-0.02	0.01	-0.06	0.01	0.00	0.00	**0.12**	0.13	0.38*
yield/ plant	G	-0.05	-0.30	-0.87	0.10	0.27	0.00	-0.01	0.56	0.44	0.00	0.11	-0.16	-0.05	-0.07	**0.17**	0.26	0.40*
Harvest index	P	0.01	0.05	-0.04	0.00	0.17	0.00	0.00	0.06	0.00	0.04	-0.06	0.02	0.00	0.01	0.05	**0.31**	0.62*
	G	-0.05	-0.17	-0.54	0.07	0.33	-0.01	-0.03	0.65	-0.08	-0.01	0.18	-0.24	-0.07	0.12	0.11	**0.40**	0.66 *

P= Phenotypic correlation
G= Genotypic correlation

plant were significantly positively correlated with yield (both at genotypic and phenotypic level) indicating that an intense selection for these characters will improve seed yield in chickpea. Raval and Dobaria (2003) studied significant positive correlation and highest direct effects of biological yield per plant, 100-seed weight, number of pods per plant, harvest index, number of secondary branches per plant and plant spread at both genotypic and phenotypic levels towards maximum seed yield. Ramanappa *et al.* (2013) observed highly significant positive association with number of pods per plant, harvest index, number of primary branches, plant height, and number of seeds per pod similarly Srivastava *et al.* (2017) revealed that seed yield per plant exhibited significant with biological yield per plant and harvest index. Shafique *et al.* (2016) conducted correlation and path studies in chickpea and revealed that maximum positive direct toward seed yield was exerted by number of pods per plant.

Conclusion

Under low input conditions, seed yield per plant had significant positive correlation and highest direct effects with secondary branches per plant, pods per plant, seeds per pod, nodule number, nodule dry weight, harvest index and biological yield per plant. Hence these traits can be considered as the best selection indices for increasing the seed yield per plant under low input organic conditions.

References

Ahmed N, Rameshwar, Saini JP, Sharma RP, Punam and Seth M. 2017. Performance of chickpea under organic and inorganic sources of nutrients at different soil moisture regimes in chickpea-okra cropping system. Himachal Journal of Agricultural Research **43**(1): 23-28.

Anonymous. 2017a. Food and Agricultural Organization of the United Nations. http://www.FAOstat.fao.org.

Anonymous. 2017b. Statistical year book of Himachal Pradesh.p 70-73.

Bhanu AN, Singh MN, Tharu R and Saroj SK. 2017.Genetic variability, correlation and path coefficient analysis for quantitative traits in chickpea genotypes. Indian Journal of Agricultural Research **51**: 425-430.

Bhardwaj N, Rana V and Saini JP. 2012. Correlation analysis of yield and yield components in wheat under organic vis-a-vis inorganic input conditions. Crop Improvement (Special Issue). pp 253-254.

Chakarborti M and Singh NP. 2004. Biocompost: a novel input to the organic farming. Agrobios Newsletter 2 (8): 14-15.

Chopdar DK, Baudh B, Sharma PP, Dubey RB, Brajendra and Meena BL. 2017.Studies on genetic variability, character association and path analysis for yield and its contributing traits in chickpea (*Cicer arietinum* L.).Legume Research **40**: 824-829.

Dewey DR and Lu KH. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. Agronomy Journal **51**: 510-515.

Dhima K, Stefanos VS and Eleftherohorinos I. 2015. Effect of cultivar, irrigation and nitrogen fertilization on chickpea productivity. Journal of Scientific Research **6** (2): 1187-1194.

Namvar A, Sharifi RS, Sedghi M, Zakaria RA, Khandan T and Eskandarpour B. 2011. Study on the effects of organic and inorganic nitrogen fertilizer on yield, yield components, and nodulation state of chickpea (*Cicer arietinum* L.). Communications in Soil Science and Plant Analysis **42**: 1097-1109.

Panse VG and Sukhatme PV. 1987. *Statistical Methods for Agricultural Workers.* Indian Council of Agricultural Research, New Delhi p 359.

Priyadarsini L, Singh PK, Chatterjee C, Sadhukhan R and Biswas T. 2017.Estimation of genetic variability of nodulation characters and their association with different agromorphic characters and yield in chickpea (*Cicer arietinum* L.).International Journal of Agronomy and Agricultural Research **6**: 1928-1935.

Ramanappa TM, Chandrashekara K and Nuthan D. 2013.Analysis of variability for economically important traits in chickpea (*Cicer arietinum* L.). International Journal of Research in Applied, Natural and Social Sciences **1**: 133-140.

Raval LJ and Dobariya KL. 2003. Yield components in improvement of chickpea *(Cicer arietinum* L.). Annals of Agricultural Research **24**: 789-794.

Shafique MS, Ahsan M, Mehmood Z, Abdullah M, Shakoor A and Ahmad MI. 2016.Genetic variability and interrelationship of various agronomic traits using correlation and path analysis in Chickpea (*Cicer arietinum* L.). Academia Journal of Agricultural Research **4**: 82-85.

Srivastava S, Lavanya GR and Lal GM. 2017. Genetic variability and character association for seed yield in chickpea. Journal of Pharmacognosy and Phytochemistry **6**: 748-75.

Wright S. 1921. The method of path coefficient. Annals of Mathematical Statistics **5**: 160-169.