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Short Communication

Variability and correlation studies for yield and yield contributing traits in *kabuli* chickpea

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ABSTRACT

Thirty M_5 desirable chickpea mutants were evaluated at Research Sub-Station (CSKHPV, Palampur) Akrot, Una during *rabi* 2018-19 for various agro-morphological traits. Genotypic and phenotypic coefficients of variation were found to be higher for number of primary branches, biological yield, number of pods per plant and seed yield per plant. PCV was moderate for plant height, 100-seed weight and harvest index. High heritability coupled with high genetic advance was observed for number of primary branches, biological yield, number of pods per plant and seed yield per plant while moderate heritability with high genetic advance was observed for harvest index. Seed yield per plant had positive and significant correlation with biological yield, number of pods per plant, 100-seed weight and harvest index. Path analysis revealed direct positive effect of biological yield, harvest index, days to 75% maturity and plant height with seed yield per plant. Selection index traits for increasing seed yield per plant are number of pods per plant, biological yield, 100-seed weight, harvest index and plant height.

Key words: Chickpea, correlation, mutants, path analysis, variability, yield

Chickpea (*Cicer arietinum* L.) is one of the most important grain legume and belongs to family Leguminosae or Fabaceae. The only cultivated species in the genus *Cicer, i*t is the third important pulse crop in the world (Jalota *et al*. 2006). Chickpea contains about 6% fat, which is important in the vegetarian diets of resource-poor consumers (Kishor *et al*. 2018). Broadly there are two types of chickpea, namely *Kabuli* grown in temperate regions, while *desi* grown in the semi-arid tropics (Muehlbauer and Singh 1987). The extent of genetic variability has been considered as an important factor, which is prerequisite for a successful hybridization aimed at producing high yielding progenies. To broaden the genetic base of chickpea, mutation breeding programme was initiated. Till date, more than 3,274 varieties in more than 224 plant species derived from mutagenesis programs have been officially released as listed in the FAO/IAEA Mutant Varieties Database (MVD). The knowledge of heritability helps plant breeders in predicting the behaviour of succeeding generations, making desirable selections and assessing the magnitude of genetic improvement through selection. The knowledge of interrelationship of grain yield with other important characters is necessary to determine characters associated with high grain yield. The inter-relationship between yield contributing traits could be grasped best if a coefficient assigned to each path in the diagram designed to measure the direct influence among them. Path coefficient analysis is a statistical technique of partitioning the correlation coefficients into its direct and indirect effects, so that the contribution of each character to yield could be estimated. The aim of the present study was to assess induced variations and association among yield and its contributing traits in mutants of *kabuli* chickpea (*Cicer arietinum* L.) derived from variety PG0027. Desirable top 30 mutants over the best check were selected and used in the present study.

The present study was conducted at CSK HPKV, Research Sub Station, Akrot, Distt. Una, Himachal Pradesh. The experimental material comprised of 30 desirable *Kabuli* chickpea mutants in M_5 generation derived from the variety PG0027. The mutants were generated using gamma rays treatments and first selection for yield and related traits was made in M_2 generation. This was followed by advancement of progenies and selection in each progeny. Top 30 mutants selected in M_4 for yield were used in the present study. The experiment was laid out in a randomized block design with three replications. At the time of maturity, the data were recorded on plot

basis (days to 50 per cent flowering, days to maturity) and on plant basis [plant height (cm), number of primary branches, biological yield (g), number of pods per plant, number of seeds per pod, 100-seed weight (g), harvest index (%) and seed yield per plant (g)] from five competitive plants. Analysis of variance was carried out as suggested by Panse and Sukhatme (1985); heritability (h^2), PCV and GCV were estimated as per the methods suggested by Burton and Devane (1953) and genetic advance as per the formula suggested by Johnson *et al.* (1955). The phenotypic and genotypic correlation co-efficients were estimated among all possible combination of characters in each mutant as suggested by Al-Jibouri *et al*. (1958) and path coefficient analysis was carried out according to Dewey and Lu (1959).

The analysis of variance revealed that all the traits had significant variation at five per cent level of significance. The variation for number of days to 50 per cent flowering ranged from 102 to 133 days with over all mean of 120.83 days, and variation for days to 75 per cent maturity ranged from 156 to 177 days with overall mean of 169 days (Table 1). The estimates of the mean values indicated that plant height ranged from 54.20 cm to 83.77 cm with a mean value of 72.94 cm. Mean of number of primary branches was 3.14 with highest value of 5.20 and lowest value of 2.13. The variation for biological yield trait ranged from 24.00 g to 99.33 g with an average of 56.11 g. Mean number of pods per plant was found to be 48.50 with highest value of 89.67 and lowest value of 18.47. Average for number of seeds per pod ranged from 0.94 to 1.14 with an overall mean of 1.02. 100-seed weight ranged from 32.36 g to 49.06 g with overall mean of 40.28 g and mean for harvest index was found to be 33.99 with highest value of 45.37 and lowest value of 22.31. Seed yield per plant ranged from 7.67 g to 45.00 g with an average of 19.54 g. High PCV and GCV (>20%) was observed for number of primary branches, biological yield, number of pods per plant and seed yield per plant indicating that there is greater scope for selection for improvement of these characters (Table 1). These findings are in confirmation with Vaghela *et al*. (2009) and Dwivedi and Gabriyal (2009). The PCV was moderate (10-20%) for traits like plant height, 100-seed weight and harvest index. These observations are in alignment with the earlier reports by Nizama *et al*. (2013). However days to 50 per cent flowering, days to 75 per cent maturity and number of seeds per pod showed low value of PCV and GCV (<10%). Similar results were reported by Chopdar *et al*. (2017), Kishore *et al*. (2018) and Parida *et al*. (2018). The low GCV and moderate PCV were observed for plant height, 100-seed weight and harvest index. Similar observations were also reported earlier (Desai *et al*. 2015, Joshi *et al*. 2018, Katna *et al*. 2020).

High heritability coupled with high genetic advance as per cent of mean was observed for number of primary branches, biological yield, number of pods per plant and seed yield per plant suggesting that these characters are under the control of additive gene action and phenotypic selection for these traits may be effective. These results are in agreement with the reports of Vaghela *et al*. (2009), Arora *et al*. (2018), Barad *et al*. (2018) and Joshi *et al*. (2018). Moderate heritability along with moderate genetic advance was observed for harvest index as has been reported by Dwevedi and Gabriyal (2009). However, low heritability coupled with low genetic advance as per cent mean was observed for 100-seed weight (Table 1).

Correlation studies indicated higher magnitude of genotypic correlation than the corresponding phenotypic ones, indicating inheritance association among various traits. At both phenotypic and genotypic correlation level, seed yield per plant had positive and significant association with biological yield, number of pods per plant, 100-seed weight and

Table 1. Mean performance and variability parameters for various traits studied in chickpea mutants

Character	Mean ± SE(m)	Range		PCV (%)	GCV (%)	Heritability (%)	Genetic advance (% of mean)
		Minimum	Maximum				
Days to 50% flowering	120.83 ± 2.48	102.67	133.00	7.21	6.27	75.6	11.23
Days to 75% maturity	169.72± 2.07	156.00	177.00	3.87	3.24	70.1	5.59
Plant height (cm)	72.94 ± 1.57	54.20	83.77	10.44	9.75	87.3	18.77
Number of primary branches	3.14 ± 0.19	2.13	5.20	26.69	24.63	85.2	46.83
Biological yield (g)	56.11 ± 3.33	24.00	99.33	47.28	46.15	95.3	92.80
Number of pods per plant	48.50 ± 2.94	18.47	89.67	54.62	53.60	96.3	108.35
Number of seeds per pod	1.02 ± 0.03	0.94	1.14	7.34	4.63	39.8	6.02
100-seed weight (g)	40.28 ± 2.63	32.36	49.06	13.12	6.66	25.8	6.96
Harvest index (%)	33.99 ± 1.70	24.36	45.37	12.99	9.70	55.7	14.90
Seed yield per plant (g)	19.54 ± 1.69	7.67	45.00	54.20	52.09	92.3	103.10

harvest index (Table 2). Similar results were also reported by Thakur *et al*. (2015), Sharifi (2017) and Mohan and Thiyagarajan (2019).

Path coefficient analysis provides better means for selection by resolving the correlation coefficient of yield and its components into direct and indirect effects. At both phenotypic as well as genotypic level, high direct positive effect for seed yield per plant was contributed by biological yield followed by harvest index, days to 75 per cent maturity and plant height (Table 3). In order to obtain the cause and effect relationship between yield per se, ten yield components were studied in chickpea through path co-efficient analysis and the results are in agreement with previous reports from Padmavathi *et al*. (2013), Jakhar *et al*. (2016) and Tadesse *et al*. (2016).

Significant differences among the mutants for all the traits under study suggested prevalence of wide

Table 2. Estimates of phenotypic (P) and genotypic (G) correlation coefficient among various traits in chickpea mutants

Traits		Days to 75% maturity	Plant height (cm)	Number of primary branches	Biological yield (g)	Number of pods per plant	Number of seeds per pod	100-seed weight (g)	Harvest index (%)	Seed yield per plant (g)
Days to 50% flowering	P	0.937*	0.063	-0.072	-0.048	-0.066	0.022	-0.170*	-0.241*	-0.122
	G	0.960*	0.058	-0.066	-0.055	-0.076	-0.030	-0.349*	-0.317*	-0.138*
Days to 75% maturity	P		0.081	-0.063	-0.165	-0.177*	0.072	-0.150*	-0.232*	-0.217*
	G		0.103	-0.074	-0.204*	-0.220*	0.086	-0.364*	-0.365*	-0.275*
Plant height (cm)	P			0.078	0.300*	0.301*	-0.071	-0.145	-0.007	0.276
	G			0.086	0.334*	0.337*	-0.208*	-0.220	-0.024	0.311*
No. of primary branches	P				0.209*	0.217*	-0.222*	-0.102	0.007	0.159
	G				0.224*	0.232*	-0.409*	-0.183	-0.034	0.171
Biological yield (g)	P					0.994*	-0.275*	0.099	0.397*	0.970*
	G					0.998*	-0.471*	0.100	0.484*	0.979*
Number of pods per plant	P						-0.279*	0.051	0.403*	0.963*
	G						-0.476*	0.097	0.504*	0.978*
Number of seeds per pod	P							-0.095	0.192	-0.195
	G							-0.024	0.138	-0.379*
100-seed weight (g)	P								0.608**	0.243*
	G								0.643*	0.260*
Harvest index (%)	P									0.580*
	G									0.633*

Table 3. Estimates of direct and indirect effects on seed yield at phenotypic (P) and genotypic (G) level for various traits in chickpea mutants

Traits		Days to 50% flowering	Days to 75% maturity	Plant height (cm)	Number of primary branches	Biological yield (g)	Number of pods per plant	Number of seeds per pod	100-seed weight (g)	Harvest index (%)	Seed yield per plant (g)
Days to 50% flowering	P	**-0.0769**	0.0431	0.0009	0.0021	-0.0577	0.0201	-0.0001	0.0007	-0.0546	-0.1223
	G	**-0.1464**	0.0967	0.0018	0.0012	-0.1351	0.1228	0.0013	0.0017	-0.0824	-0.1384*
Days to 75% maturity	P	-0.072	**0.046**	0.0012	0.0018	-0.1975	0.0551	-0.0002	0.0006	-0.0524	-0.2174*
	G	-0.1405	**0.1008**	0.0031	0.0014	-0.5009	0.358	-0.0036	0.0018	-0.0948	-0.2747*
Plant height (cm)	P	-0.0048	0.0037	**0.0143**	-0.0023	0.359	-0.0936	0.0002	0.0006	-0.0015	0.2756
	G	-0.0084	0.0103	**0.0305**	-0.0016	0.8229	-0.5467	0.0088	0.0011	-0.0062	0.3109*
No. of primary branches	P	0.0055	-0.0029	0.0011	**-0.0294**	0.2493	-0.0674	0.0007	0.0004	0.0016	0.1590
	G	0.0096	-0.0075	-0.0026	**-0.0187**	0.5521	-0.377	0.0173	0.0009	-0.0089	0.1705
Biological yield (g)	P	0.0037	-0.0076	0.0043	-0.0061	**1.1949**	-0.3093	0.0009	-0.0004	0.0897	0.9702*
	G	0.008	-0.0205	0.0102	-0.0042	**2.4616**	-1.6213	0.0199	-0.0005	0.1259	0.9791*
Number of pods per plant	P	0.005	-0.0081	0.0043	-0.0064	1.1874	**-0.3112**	0.0009	-0.0002	0.091	0.9628*
	G	0.0111	-0.0222	0.0103	-0.0043	2.4571	**-1.6242**	0.0201	-0.0005	0.1311	0.9785*
Number of seeds per pod	P	-0.0017	0.0033	-0.001	0.0065	-0.3291	0.0867	**-0.0033**	0.0004	0.0434	-0.1950
	G	0.0044	0.0086	-0.0064	0.0077	-1.1604	0.7734	**-0.0423**	-0.0001	0.0359	-0.3792*
100-seed weight (g)	P	0.0131	-0.0069	-0.0021	0.003	0.1178	-0.0159	0.0003	**-0.0039**	0.1374	0.2428*
	G	0.0511	-0.0367	-0.0067	-0.0034	0.2462	-0.1582	-0.001	**-0.0049**	0.1671	0.2602*
Harvest index (%)	P	0.0185	-0.0106	-0.0001	-0.0002	0.4741	-0.1252	-0.0006	-0.0024	**0.2262**	0.5796*
	G	0.0464	-0.0368	-0.0007	0.0006	1.1916	-0.8189	-0.0058	-0.0032	**0.2601**	0.6333*

Residual effect = 0.1037 (P), 0.0279 (G) *Significant at 5% level, respectively.

range of genetic variability and scope of selection for these traits. Mean performance revealed that mutants *viz*., A5P5-5-1, A8P4-1-1, C20P6-5-2, C48aP1-4-3, C48aP3-3-1, M50P3-1-3, N20P3-1-3 were the best for yield and its contributing traits. High phenotypic and genotypic coefficient of variation was observed for number of primary branches, biological yield, number of pods per plant and seed yield per plant indicating that selection for these traits will be beneficial because of additive gene action. High heritability and genetic advance for number of primary branches, biological yield, number of pods per plant and seed yield per plant indicated that selection of these traits will yield maximum genetic gain in the upcoming generation. Correlation and path coefficient analysis indicated that higher seed yield per plant can be obtained by maintaining characters like plant height, biological yield, number of pods per plant, 100-seed weight and harvest index.

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