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Research Article

GENETIC VARIABILITY AND ASSOCIATION STUDIES FOR YIELD ATTRIBUTING CHARACTERS IN CHICKPEA (*Cicer arietinum* L.)

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Abstract- The present investigation was undertaken with fifteen genotypes of Chickpea, (including one check) during Rabi 2017-18 in a randomized block design with three replications at field experimentation at Department of Genetics and Plant Breeding, Sam Higgin bottom University of Agriculture, Technology And Sciences. The data were recorded for twelve characters to study genetic variability, heritability, genetic advance, correlation and path analysis. Analysis of variance among 15 genotypes showed highly significant differences for all the characters indicated the presence of substantial amount of genetic variability. On the basis of mean performance the highest seed yield was observed in genotype Vishal. The estimates of GCV and PCV were maximum for seed per pod, economical yield, biological yield and pods per plant. High heritability estimate were recorded for days to maturity, seeds per pod, days to 50% flowering and plant height. Genetic advance varied from 1.40 to 136.60. Maximum was observed for biological yield (136.60) and days to maturity (128.91) and maximum genetic advance as percent of mean was recorded for biological yield (70.86), economical yield (35.89) and pods per plant (25.34). The characters like biological yield, pods per plant, seeds per pod, and days to 50% flowering were positively and significantly correlated with economical yield at genotypic and phenotypic level. Path analysis indicated that biological yield, 100 seed weight, days to maturity and plant heighthad maximum positive direct effect on economical yield indicating that these characters could be used as selection criteria for yield improvement.

Key words- Chickpea (*Cicer arietinum* L.), genetic variability, Correlation, Path analysis

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Introduction

Pulses are unique crops having in-built mechanism to trap atmospheric nitrogen in their root nodules and restore soil fertility. They are capable of thriving in harsh and fragile environments. Pulses are richest and cheapest source of protein and form major ingredient of diet of vegetarian population of the country. They contain 20 to 25 % proteins as against 8 to 15 % in cereals. Chickpea is rich source of proteins, carbohydrates, minerals and possesses high calories higher than any of the legume except groundnut and lupine seeds. Being fairly tolerant to soil moisture stress, pulses occupy important position in different cropping systems. Chickpea (*Cicer arietinum* L.) is an integral part of an Indian agriculture since time immemorial, because of its intrinsic value in terms of higher protein content, carbohydrates, minerals, nitrogen fixing ability and indispensability as alternative crop for crop diversification. Chickpea occupies a prime position among the pulses in the country with a maximum hectarage, production and its high nutritive value. It is known to have originated in Western Asia. It belongs to genus Cicer and tribe Cicereae, sub-order papilionaceae of order leguminoseae of the 39 known species distributed mainly in Central and Western Asia, two are found to be cultivated in India, *viz*; *Cicer arietinum* (2n = 14) which is most widely cultivated and *Cicer soongaricum* (2n = 16) cultivated in Western temperate and Alpine regions (9000-15000 ft. in altitude) of Himalaya. Chickpea contains about 12.4 to 31.5 percent protein, 2 to 4 percent oil and 56.5 percent carbohydrates besides ash, calcium, phosphorus and iron. Chickpea has got special importance in diet and is consumed in a variety of ways. It is mostly used in the form of dal (flour or parched). In other aspects, dal obtained after milling either from chickpea or from red gram, forms a major part of regular diet of vegetarians. Chickpea flour is cheap source for the preparation of different forms of Indian confectionery; tender leaves are used as vegetable, while dry plant parts above ground are used as cattle feed. Exudation from leaves called “amb” contains oxalic and malic acids which possess medicinal value and used for intestinal disorders, stomach aches, blood purification etc., germinating seeds are prophylactic against scurvy disease. The whole grains are also eaten as raw, boiled or roasted. It is a good soil renovating crop and at the same time can also serve as good cash crop. Though India is the largest producer of this crop, its productivity is low as compared to countries like Italy, Turkey, Iran, etc. There is a good scope to improve the productivity of this crop by varietal improvement and adopting the improved production technology on larger areas of the country [1-6]. The correlation coefficients are helpful in determining the components of a complex trait like yield, but the information on the relative importance of direct and indirect effects of each component character towards yield is not provided by such studies. Path coefficient analysis is helpful in partitioning the correlation coefficients in to its direct and indirect effect, so that the relative contribution of each component character to yield could be assessed. In view of these facts, fifteen Chickpea genotypes were evaluated in this study to estimate genetic variability, correlation coefficient and direct and indirect effect of different characters on seed yield to screen out the suitable genotype for exploitation in a breeding programme aimed at improving seed yield potential of chickpea [5-11].

Materials and Methods

The present experiment was undertaken at field of Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences Allahabad, Utter Pradesh, india.duringrabi2017-18. Allahabad is located in the South-East part of Uttar Pradesh, India. Allahabad falls under agro-climatic zone IV, which is named as "Middle gangetic Plains". Soil of this reason is sandy loam and slightly alkaline. The site of experiment is located at 25.57º N latitude, 81.51ºE longitude and 98 meter above the sea level. The temperature falls down as low as 1-2ºC during summer. The average rainfall in this area is around during winter season especially in the months of December and January. The mercury rises up to 46-48ºC during summer. The average rainfall in this area is around 103.4 mm annually with maximum concentration during July to September with few showers and drizzles in winter also. The experimental material used for study consisted of 15 genotypes of chickpea which were obtained from Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri. The experimental material comprised 15 genotype name:-JAKI-9218, SAKI-9516,BDGNK 798,PKV 2, PKV 4,KRIPA,VIJAY(Phule G18),VIRAT, BDNG797, DIGVIJAY,VISHAL,PHULE VIKRAM,BCG-708,PG-739,BCG-944 (Check). 15 genotypes of chickpea were grown in this experiment. Experiment was done according to randomized block design with three replications, and recommended package of practices were followed to raise the crop. Seeds were sown with row to row spacing of 30 cm and plant to plant spacing of 10 cm. The data were recorded on five randomly selected plants of each replication for all characters but in case of days to 50% flowering and days to maturity, the observations were recorded on plot basis, pre-harvest observations are Days to 50% flowering, Plant height (cm), Number of primary branches per plant, Number of secondary branches per plant, Number of pods per plant, Number of seeds per pod, Days to maturity, and Post harvest observations are Biological yield (g), Harvest index (%), 100seed weight (g), Economical yield (g) and Yield per hectare (q/ha).Mean values were computed and data were analyzed for analysis of variance as suggested Fisher (1935) given in [Table-1]. phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were given by Burton (1952). Heritability in broad sense was given by Burton and Devane (1953). Genetic advance was given by Lush and Johnson *et al*. (1955). Genotypic and Phenotypic correlation coefficient was given by AlJibouri *et al*. (1958). Dewey and Lu (1959) was used to perform the path analysis for seed yield and yield components keeping seed yield is resultant variable and its components is casual variables.

Results and Discussion

The mean sum of squares due to genotypes showed significant differences for all twelve characters under study, suggested that the genotypes were genetically variable [Table-1). This indicates that there is ample scope for selection of promising lines from the present gene pool for yield. Thus, it indicates ample scope for selection for different quantitative characters for chickpea improvement.

Genotypic coefficient of variation (GCV) ranged from 4.36 % to 35.90 % while maximum GCV was for seeds per pod (35.90) followed by economical yield (29.42), biological yield (24.38%), pods per plant (22.65).Srivastava *et al*. (2017) and Yucel *et al*. (2006) also reported maximum GCV for seed yield per plant [12,13]. High magnitude of phenotypic coefficient of variation (PCV) was recorded for economical yield (38.30%), followed by no. of seeds per pod (36.86%), biological yield (30.25). The studies on phenotypic coefficient of variation characters indicated the magnitude of PCV was high in case of all characters. The values of PCV were higher than GCV for all the characters which reflect the influence of environment on the expression of characters. Maximum GCV and PCV was found in seed yield per plant followed by pods per plants, Biological yield. These finding agree with the Kumar *et al*. (2011) [14]. Heritability plays an important role in deciding the suitability and strategy for selection of a character. In the present study, heritability (%) ranged from 95.52 to 37.22 %. Maximum heritability observed for the days to maturity (95.52%) followed by seeds per pod (94.82%), days to 50% flowering (92.70%) and plant height (90.60 %).Gohil*et al*. (2011) and Tiwari *et al*. (2016) also reported high heritability for plant height. Therefore, selection of high heritability found character will be worth full for further improvement [Table-2) [15,16]. The genetic advance indicate a good scope for improvement for almost all the characters studied as revealed by the genetic advance expressed as percentage of mean. The genetic advanced (as percent of mean) varied from 0.85% to 70.89%. Maximum genetic advance as percent mean was recorded for biological yield (70.86) followed by economical yield (35.89), pods per plant (25.34). The high heritability estimates coupled with high genetic advance as percent of mean for plant height, biological yield, pods per plant, indicate that all these character are governed by additive gene action and as such are expected to exhibit improvement for such traits by direct selection. Days to 50% flowering, pods per plant, seed per pod and biological yield showed positive significant correlation at genotypic and phenotypic level with economical yield per plant hence selection for these traits could be helpful for the improvement of genotype.The positive correlation of grain yield with various traits was reported by Talebi and Rokhzadi (2013), with number of seeds per pod by Naik *et al*. (2012) [6,7]. Biological yield, 100 seed weight, days to maturity and plant height displayed positive direct effect on economic yield. This justifies that the presence of true relationship between these characters and economic yield, there by direct selection through these characters would result reasonable effect on economic yield while, primary branches per plant, pods per plant, depicted negative direct effect on grain yield.

Table-1 Analysis of variance for 12 characters of Chickpea

SN	Characters	Mean sum of square		
		Replications (d.f=2)	Genotypes (d.f=14)	Error (d.f=28)
1	Days to 50% flowering	2.28	110.84**	2.81
2	Plant height	31.1	265.95**	8.91
3	No. of Primary Branches/ Plant	0.002	0.40**	0.02
4	No. of Secondary Branches/ Plant	1.2	10.43**	0.41
5	Pods/ Plant	45.87	335.72**	16.5
6	Seeds/ Pod	0.01	0.77**	0.01
7	Days to maturity	2.01	96.11**	1.48
8	100 seed weight	3.67	33.96**	3.3
9	Biological Yield	477.48	3926.0**	598.56
10	Harvesting Index	2.7	128.19**	41.67
11	Economical Yield	51.21	1156.50**	217.32
12	Yield/Hectare	7.28	30.93*	11.13

**Significant at 1% level, *Significant at 5% level.

Conclusion

The experimental results concluded that Vishal followed by Phule-G-Vikram and BDNG-797 identified as best genotypes with high seed yield per plant as compared with BCG-944(Check). PKV-4 maturity 4 days early than check variety. Higher magnitude of heritability, genetic advance GCV and PCV were recorded for seed yield,pods/ plant, seed index.

Application of research: Correlation coefficient analysis seed yield per plant showed positive significant association with biological yield, seeds per pod, pods per plant and days to 50% flowering. Biological yield, 100 seed weight, days to maturity and plant height had positive direct effect on economic yield per plant. Thus, priority should be given to these characters for yield improvement in chickpea.

Research Category: Genetics and Plant Breeding

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Table-2 Genetic parameter for 12 biometrical charactersin15chickpea

S	Character	VG	VP	GCV(%)	PCV(%)	h^2(bs)%	GA	GA as % mean
1	Days to 50% flowering	36.01	38.83	6.92	7.18	92.7	8.78	15.26
2	Plant height	85.68	94.59	18.49	19.43	90.6	50.05	23.26
3	No of Primary branches/ plant	0.13	0.16	13.07	14.48	81.48	2.72	0.85
4	No. of secondary branches/ plant	3.34	3.75	19.57	20.74	89.04	9.34	4.55
5	Pods/ Plant	106.4	122.91	22.65	24.34	86.57	45.55	25.34
6	Seeds/ pod	0.25	0.27	35.9	36.86	94.82	1.4	1.29
7	Days to maturity	31.55	33.03	4.36	4.43	95.52	128.91	14.49
8	100 seed weight	10.22	13.52	15.25	17.57	75.57	20.93	7.34
9	Biological yield (g)	1109.15	1707.71	24.38	30.25	64.95	136.6	70.86
10	Harvest index (%)	28.84	70.52	10.17	15.9	40.9	52.83	9.07
11	Economic yield (g)	313.06	530.39	29.42	38.3	59.03	60.13	35.89
12	Yield (q/ha)	6.6	17.73	13.69	22.44	37.22	18.77	4.14

Table-3 Genotypic (G) and Phenotypic(P) correlation coefficients for component characters and economic yield in Chickpea

N	Character		Plant Height (cm)	Primary Branches/ Plant	Secondary Branches/ Plant	Pods Per Plant.	Seed Per Pod	Days to Maturity	100 Seed Weight (g)	Biological Yield (g)	harvest Index (%)	Economical Yield (g)
1	Days to 50% Flowering	G	0.248	-0.477*	0.107	0.132	0.434*	0.101	-0.054	0.473*	-0.227	0.429*
		P	0.216	-0.418*	0.117	0.118	0.384**	0.1	-0.094	0.340*	-0.134	0.307*
2	Plant Height (cm	G	1	-0.157	-0.524**	0.503**	-0.111	0.019	0.397*	0.03	0.249	-0.075
		P	1	-0.147	-0.485**	0.463**	-0.116	0.001	0.324*	0.035	0.099	-0.086
3	Primary Branches/ Plan	G		1	-0.029	-0.352*	-0.029	0.550**	-0.051	-0.248	0.313*	-0.473*
		P		1	0.005	-0.288	-0.032	0.504**	-0.019	-0.252	0.281	-0.365*
4	Secondary Branches/ Plan	G			1	-0.218	0.197	0.17	-0.390*	0.254	0.193	0.212
		P			1	-0.169	0.161	0.18	-0.302*	0.137	0.089	0.117
5	Pods Per Plant	G				1	0.047	0.003	0.256	0.647**	0.186	0.550**
		P				1	0.037	0.009	0.203	0.402*	0.086	0.302*
6	Seed Per Pod	G					1	0.211	-0.332*	0.648**	-0.398*	0.446*
		P					1	0.213	-0.258	0.507**	-0.207	0.369*
7	Days to Maturity	G						1	-0.410*	0.168	0.354*	-0.267
		P						1	-0.335*	0.135	0.27	-0.167
8	100 Seed Weight (g)	G							1	-0.398*	-0.389*	-0.381*
		P							1	-0.232	-0.193	-0.308*
9	Biological Yield (g)	G								1	-0.242	0.759**
		P								1	-0.096	0.675**
10	Harvest Index (%)	G									1	-0.17
		P									1	0.14

**Significant at 1% level,*Significant at 5% level

Table-4 Direct and indirect effects of yield components characters on economic yield in chickpea at genotypic level

S	Character	Days to 50% Flowering	Plant Height (cm)	Primary Branches / Plant	Secondary Branches/ Plant	Pods Per Plant.	Seed Per Pod	Days to Maturity	100 Seed Weight (g)	Biological Yield (g)	Harvest Index (%)	Economic Yield (g)
1	Days to 50% Flowering	0.0451	0.0112	-0.0216	0.0049	0.0060	0.0196	0.0046	-0.0025	0.0213	-0.0103	0.4290
2	Plant Height (cm)	0.0538	0.2169	-0.0342	-0.1139	0.1091	-0.0243	0.0042	0.0862	0.0067	0.0541	-0.0752
3	Primary Branches/ Plant	0.0357	0.0118	-0.0747	0.0022	0.0263	0.0022	-0.0411	0.0038	0.0186	-0.0234	-0.4736
4	Secondary Branches/ Plant	-0.0147	0.0713	0.0040	-0.1358	0.0296	-0.0268	-0.0232	0.0530	-0.0345	-0.0263	0.2122
5	Pods Per Plant.	-0.0363	-0.1379	0.0965	0.0598	-0.2742	-0.0130	-0.0008	-0.0703	-0.1774	-0.0512	0.5507
6	Seed Per Pod	0.0247	-0.0064	-0.0017	0.0112	0.0027	0.0568	0.0120	-0.0189	0.0369	-0.0226	0.4466
7	Days to Maturity	0.0235	0.0045	0.1279	0.0396	0.0007	0.0492	0.2323	-0.0955	0.0392	0.0823	-0.2677
8	100 Seed Weight (m)	-0.0472	0.3437	-0.0443	-0.3377	0.2215	-0.2872	-0.3553	0.8646	-0.3444	-0.3366	-0.3816
9	Biological Yield (m)	0.2312	0.0150	-0.1216	0.1242	0.3162	0.3168	0.0825	-0.1946	0.4886	-0.1186	0.7597
10	Harvest Index (%)	-0.1350	0.1482	0.1862	0.1150	0.1108	-0.2364	0.2103	-0.2311	-0.1441	0.5937	-0.1708

Table-5 Direct and indirect effects of yield components characters on economic yield in chickpea at phenotypic level

S	Character	Days to 50% Flowering	Plant Height (cm)	Primary Branches/ Plant	Secondary Branches/ Plant	Pods Per Plant.	Seeds Per Pod	Days to Maturity	100 Seed Weight (gm)	Biological Yield (gm)	harvesting Index (%)	Economic Yield
1	Days to 50% Flowering	-0.2994	-0.0647	0.1251	-0.0349	-0.0353	-0.1149	-0.0300	0.0280	-0.1017	0.0401	0.3074
2	Plant Height (cm)	0.1356	0.6269	-0.0922	-0.3040	0.2903	-0.0730	0.0002	0.2030	0.0221	0.0624	-0.0857
3	Primary Branches/ Plant	0.0269	0.0095	-0.0643	-0.0003	0.0185	0.0020	-0.0324	0.0012	0.0162	-0.0181	-0.3649
4	Secondary Branches/ Plant	0.0078	-0.0325	0.0003	0.0670	-0.0113	0.0108	0.0120	-0.0202	0.0092	0.0059	0.1166
5	Pods Per Plant.	-0.0584	-0.2295	0.1426	0.0836	-0.4955	-0.0185	-0.0047	-0.1005	-0.1991	-0.0425	0.3019
6	Seeds Per Pod	-0.1312	0.0398	0.0109	-0.0550	-0.0128	-0.3418	-0.0729	0.0882	-0.1732	0.0709	0.3691
7	Days to Maturity	0.0588	0.0002	0.2959	0.1057	0.0055	0.1254	0.5876	-0.1967	0.0792	0.1585	-0.1672
8	100 Seed Weight (gm)	-0.0446	0.1544	-0.0089	-0.1438	0.0967	-0.1230	-0.1596	0.4768	-0.1107	-0.0921	-0.3075
9	Biological Yield (gm)	0.0282	0.0029	-0.0209	0.0114	0.0334	0.0421	0.0112	-0.0193	0.0831	-0.0080	0.6753
10	harvesting Index (%)	0.0246	-0.0182	-0.0515	-0.0163	-0.0157	0.0380	-0.0495	0.0354	0.0176	-0.1833	0.1399

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