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STUDY OF GENETIC VARIABILITY AND CHARACTER ASSOCIATION IN CHICK PEA (*Cicer arietinum* L.)

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ABSTRACT
The present investigation was conducted to study genetic variability and character association among 20 chick pea genotypes including one check, which were evaluated during 2020-2021 Rabi using Randomized Block Design with three replications at a field experimental centre site of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. Correlation studies revealed that positive and significant correlation between seed yield per plant and biological yield, number of seeds per plant, number of pods per plant and number of secondary branches per plant. Path coefficient analysis revealed that biological yield had highest direct effect on seed yield per plant followed by Harvest index, number of primary branches per plant, plant height, number of pods per plant, days to maturity number of secondary branches per plant whereas days to 50% flowering, days to 50% pod setting, number of seeds per pod, number of seeds per plant showed negative direct effect on seed yield per plant. High heritability along with genetic advance was observed in number of seeds per plant. High GCV and PCV was recorded for number of pods per plant This experiment suggests that satisfying characters should be chosen for chick pea yield improvement based on the present analysis results.

KEY WORDS: chick pea, variability, genetic advance, GCV, PCV, heritability, path coefficient analysis, correlation.

INTRODUCTION

The common name chickpea is derived from the genus name *Cicer*. The plant was known as *Chich* or *Chich pea* in 18th century English (Hale, 1758). The similarity of the chickpea seed shape to the head of a ram (*aries* in Latin) is thought to be the origin of the species name *arietinum* (van der Maesen, 1987). Chickpea is commonly known as *garbanzo* in Spanish-speaking countries and the US, and *chana* or (*Bengal*) *gram* in India. Chickpeas are rich in protein and energy, which makes them great for animal feed. Raw chickpeas have been shown to be a healthier alternative than similar legumes, such as peas. Research has shown that chickpeas have no adverse effects on livestock, allowing animals to grow and produce milk equally as well as soy or cereal. For human consumption, chickpeas are nutrient dense, providing more than 20% daily Value of protein, dietary fiber, folate, and minerals like iron and phosphorous. They also provide a moderate amount of zinc, thiamin, vitamin B6, and magnesium. Cooked chickpeas are high in amino acids.

Chickpea (*Cicer arietinum* L.) is the premier pulse crop of India consumed by people from almost all parts of the country and grown on about 8.25 million ha. area with a production of 7.05 million tonnes which accounts for 67.2% of the world chickpea production. In Karnataka, the area under chickpea is around 6.50 lakh ha. with a production of 3.1 lakh tonnes at an average productivity of 620kg/ha. However, the overall production and productivity of the country is much lower than the other countries. There is an acute shortage of this pulse and as a result India is importing chickpea from other countries. Chickpea plant is cool season crop very sensitive to excess moisture, high humidity and cloudy weather, which adversely affect its yield through limited flower production and seed set (Kay, 1979). To formulate proficient breeding programme and for developing high-yielding varieties, it is essential to understand the genetics of the yield and related traits. Genetic parameters, *viz* PCV, GCV, Heritability, Genetic Advance helps the researchers in adopting the suitable breeding procedure to apply the selection for the improvement of deferent traits related to yield. The correlation studies between yield and contributing traits will be helpful in sorting out most associated contributing traits to yield.

MATERIALS AND METHOD

The experimental material used in the present research is comprised of 21 genotypes including standard check. The experiment was laid down in Randomized Block Design (RBD) with three replications. Each entry was sown in three rows with spacing 30 ×10 sq.cm inter and intra row spacing in 1X1 m plots. The material was sown in 11 November 2019. All recommended practices were followed and timely plant protection measures were taken to avoid damage through insect pests and diseases. Observations for different parameters were recorded on five random plants in each replication for each genotype except for days to maturity, days to 50% flowering and days to 50% pod setting which are recorded on plot basis. The mean data of each character was subjects to analysis of variance to test the level of significance suggested by the proportion of direct and indirect contributions of various characters to the total correlation was estimated through path coefficient analysis suggested by Wright

(1921) and elaborated by Dewey and Lu (1959) and GCV, PCV were worked out according to the methods of Burton, (1952) Heritability (Broad Sense) by Burton and Devane (1953),Genetic advance by Johnson *et al.,* (1955) and Correlation coefficient Al Jibouri *et al.* (1958) .

RESULT AND DISCUSSION

In present studies the analysis of variance revealed that the mean sum square of treatments for all the characters studied are found to be significant. This suggested that the selected genotypes were quite variable with considerable amount of variability among them. Similar result has been reported by Dehal *et al.* (2016) and Kumar *et al*. (2014). The magnitude of PCV is higher than GCV which indicates the influence of the environment on the expression of these traits, but the influence is less as the difference between the GCV and PCV is less, GCV and PCV are highest for number of pods per plant. Highest GCV (22.26) and PCV (23.97) was recorded for number of pods per plant and lowest GCV and PCV was recorded for days to 50% pod setting (Table -2).

Maximum heritability was recorded for number of seeds per plant followed by number of pods per plant, number of seeds per pod, harvest index, 100 seed weight, number of secondary branches per plant, number of primary branches per plant, plant height, biological weight, seed yield per plant and lowest heritability was recorded in days to 50%flowering days to 50% pod setting and days to maturity (Table- 2). Similar result has been reported by Shweta *et al.(*2013) , Vaghela *et al.* (2009), Waseem *et al.* (2014), Kumar *et al.* (2014). High heritability (90.80) coupled with genetic advance (34.08) was recorded for number of seeds per plant.

significant positive correlation was observed between seed yield per plant and biological yield per plant, number of seeds per plant, number of pods per plant, number of primary branches per plant, number of secondary branches per plant, harvest index, plant height, 100 seed weight and significant negative correlation between seed yield per plant and days to maturity, days to 50% flowering days to 50% pod setting to both genotypic and phenotypic level. Hence direct selection of these characters would be most effective for improvement of chickpea genotypes.

Path coefficient analysis studies showed that highest positive direct effect on seed yield was recorded for biological yield followed by Harvest index ,number of primary branches per plant ,plant height , number of pods per plant, days to maturity number of secondary branches per plant whereas days to 50% flowering, days to 50% pod setting , number of seeds per pod , number of seeds per plant showed negative direct effect on seed yield per plant at both genotypic and phenotypic level (Table:5) . Similar results were reported by Borate *et al*. (2010), Usman *et al.* (2012).

TABLE 1: Analysis of Variance for 13 quantitative characters of 21 chickpea genotypes

S.NO	Source of Variations	Mean Sum of Squares		
		Replicate (d.f=2)	Treatments (d.f=20)	Error (d.f=40)
1	Days to 50% flowering	32.333 **	65.810 ***	6.2
2	Days to 50% Pod setting	2.705	21.769 *	9.229
3	Plant height	55.633 *	81.751 ***	10.746
4	No. of Primary Branches per Plant	0.124 *	0.919 ***	0.023
5	No. of secondary Branches per Plant	0.133	5.716 ***	0.211
6	Days to Maturity	5.669	64.880 *	27.507
7	No. of Pods per Plant	93.212 *	622.331 ***	18.013
8	No. of seeds per Pod	0.020 *	0.191 ***	0.004
9	No. of seeds per plant	421.710 *	1132.784 ***	81.436
10	Biological Yield	51.976 *	106.269 ***	11.697
11	100 seed weight	4.706 *	32.481 ***	1.083
12	Harvest Index	280.868 *	96.177 ***	8.26
13	Seed yield per plant	14.720 *	11.303 ***	3.391

TABLE 2: Estimates of Genetic parameters for 13 quantitative characters in 21 Chick pea genotypes

S.no	Character	V_g	V_p	GCV	PCV	h^2(bs)	GA	GA as % mean
1	Days to 50% flowering	10.89	34.91	3.53	6.31	31.20	3.80	4.06
2	Days to 50% pod setting	3.46	11.09	1.70	3.05	31.20	2.14	1.96
3	Plant height	33.47	44.98	10.43	12.09	74.40	10.28	18.53
4	No. of primary branches	0.07	0.09	11.03	12.71	75.30	0.47	19.70
5	No. of secoundary branches	1.00	1.21	12.83	14.11	82.60	1.87	24.01
6	Days to maturity	10.92	35.02	2.37	4.24	31.20	3.80	2.73
7	No. of pods per plant	328.08	380.53	22.26	23.97	86.20	34.65	42.58
8	No. of seeds per pod	0.04	0.05	16.44	17.96	83.90	0.38	31.02
9	No. of seeds per plant	301.44	331.94	19.17	20.11	90.80	34.08	37.62
10	Biological weight	34.24	47.70	18.26	21.55	71.80	10.21	31.87
11	100 seed weight	7.19	8.69	17.49	19.23	82.70	5.02	32.77
12	Harvest index	32.08	38.56	13.40	14.69	83.20	10.64	25.17
13	Seed yield per plant	6.00	8.67	18.30	21.99	69.20	4.20	31.36

TABLE 3: Phenotypic correlation coefficient for yield contributing traits of chickpea

	Days to 50% flowering	Days to 50% Pod setting	Plant height (cm)	No. of Primary Branches per Plant	No. of secondary Branches per Plant	Days to Maturity	No. of Pods per Plant.	No. of seeds per Pod	No. of seeds per plant	Biological Yield (g)	100 seed weight (g)	Harvest Index (%)	Seed yield per plant (g)
Days to 50% flowering	1	0.5871***	-0.1384	0.4290***	-0.2012	0.0787	0.2167	-0.2639*	-0.073	-0.0456	-0.0873	-0.1183	-0.1225
Days to 50% Pod setting		1	-0.0739	0.3195 *	-0.1467	0.1363	0.2046	-0.3756**	-0.0797	0.0285	-0.0831	-0.1986	-0.1198
Plant height (cm)			1	-0.1594	0.0211	0.3671**	-0.1787	0.0664	-0.0716	0.5450***	0.5179***	-0.3407**	0.250*
No. of Primary Branches per Plant				1	-0.1578	0.0636	0.0552	-0.3940**	-0.2035	0.115	0.3287 **	-0.0873	0.0874
No. of secondary Branches per Plant					1	-0.0937	0.2198	-0.0015	0.1877	0.3534**	0.0934	-0.0004	0.378**
Days to Maturity						1	-0.2798*	-0.1134	-0.3004 *	0.3310**	0.3708 **	-0.5992***	-0.1721
No. of Pods per Plant							1	-0.0546	0.7627***	0.2900 *	-0.4482***	0.1861	0.558**
No. of seeds per Pod								1	0.4893***	-0.1851	-0.3873**	0.3021 *	0.0319
No. of seeds per plant									1	0.178	-0.5762***	0.3938 **	0.574**
Biological Yield (g)										1	0.4894***	-0.4845***	0.653**
100 seed weight (g)											1	-0.3653**	0.152
Harvest Index (%)											-	1	0.322*
Seed yield per plant (g)													1

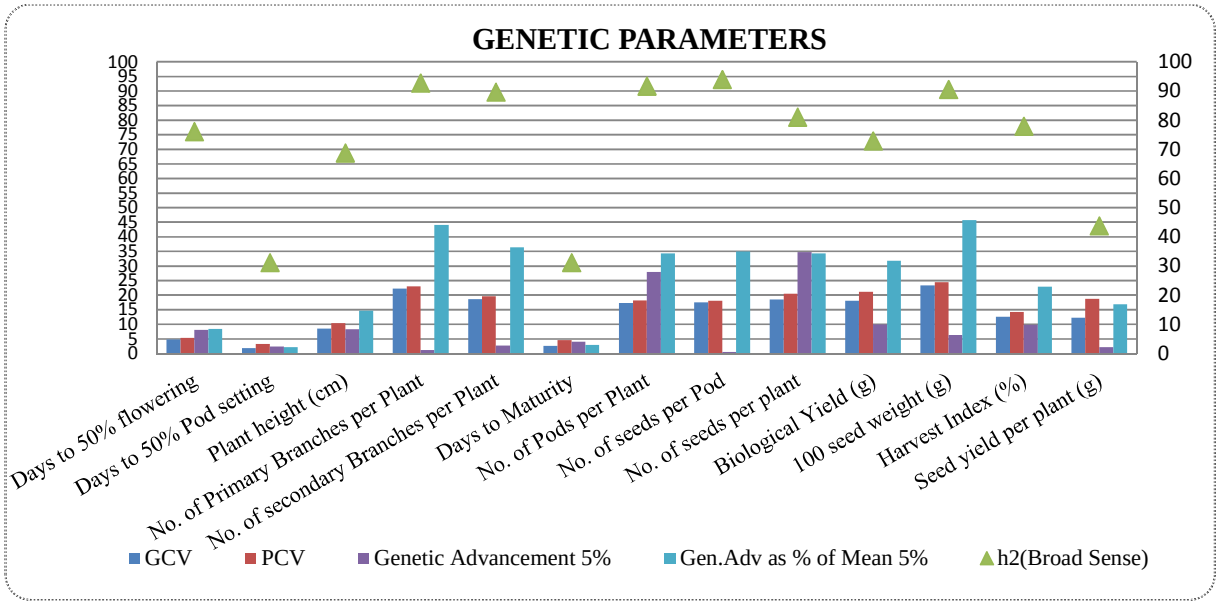

FIGURE 1. Histogram depicting GCV, PCV, Genetic advance and h2 for 13 quantitative characters of 21 chickpea genotypes

TABLE: 4 Genotypic correlation coefficient for yield contributing traits of chickpea

	Days to 50% flowering	Days to 50% Pod setting	Plant height (cm)	No. of Primary Branches per Plant	No. of secondary Branches per Plant	Days to Maturity	No. of Pods per Plant.	No. of seeds per Pod	No. of seeds per plant	Biological Yield (g)	100 seed weight (g)	Harvest Index (%)	Seed yield per plant (g)
Days to 50% flowering	1	1.0641	-0.1187	0.509**	-0.262*	0.0468	0.2112	-0.324**	-0.1573	-0.176	-0.0729	-0.1654	-0.369**
Days to 50% Pod setting		1	-0.464**	0.542**	-0.1427	-0.0161	0.320*	-0.713**	-0.290*	-0.1434	-0.253*	-0.458**	-0.610**
Plant height (cm)			1	-0.2066	0.0293	0.767**	-0.278*	0.0399	-0.2037	0.671**	0.606**	-0.616**	0.1829
No. of Primary Branches per Plant				1	-0.172	0.1091	0.0517	-0.436**	-0.252*	0.1294	0.350**	-0.0986	0.125
No. of secondary Branches per Plant					1	-0.1983	0.2149	-0.0213	0.1485	0.367**	0.1195	-0.0453	0.449**
Days to Maturity						1	-0.498**	-0.1619	-0.571**	0.717**	0.684**	-1.135**	-0.394**
No. of Pods per Plant.							1	-0.0837	0.768**	0.2047	-0.482**	0.1401	0.600**
No. of seeds per Pod								1	0.493**	-0.277*	-0.413**	0.276*	-0.1122
No. of seeds per plant									1	-0.0276	-0.647**	0.335**	0.441**
Biological Yield (g)										1	0.598**	-0.759**	0.565**
100 seed weight (g)											1	-0.407**	0.304*
Harvest Index (%)												1	0.0972
Seed yield per plant (g)													1

TABLE 5: Direct and indirect effect of 13 parameters in chick pea

		Days to 50% flowering	Days to 50% Pod setting	Plant height	No. of Primary Branches per Plant	No. of secondary Branches per Plant	Days to Maturity	No. of Pods per Plant	No. of seeds per Pod	No. of seeds per plant	Biological Yield	100 seed weight	Harvest Index	Seed yield per plant
Days to 50% flowering	P	-0.0274	-0.0161	0.0038	-0.0118	0.0055	-0.0022	-0.0059	0.0072	0.002	0.0012	0.0024	0.0032	-0.1225
	G	-0.0597	-0.0635	0.0071	-0.0304	0.0156	-0.0028	-0.0126	0.0193	0.0094	0.0105	0.0043	0.0099	-0.369**
Days to 50% Pod setting	P	-0.0221	-0.0376	0.0028	-0.012	0.0055	-0.0051	-0.0077	0.0141	0.003	-0.0011	0.0031	0.0075	-0.1198
	G	-0.0811	-0.0762	0.0353	-0.0413	0.0109	0.0012	-0.0244	0.0544	0.0221	0.0109	0.0193	0.0349	-0.610**
Plant height	P	-0.0041	-0.0022	0.0296	-0.0047	0.0006	0.0109	-0.0053	0.002	-0.0021	0.0161	0.0153	-0.0101	0.250*
	G	-0.0171	-0.0666	0.1438	-0.0297	0.0042	0.1102	-0.0399	0.0057	-0.0293	0.0964	0.0871	-0.0886	0.01829
No. of Primary Branches per Plant	P	0.0305	0.0227	-0.0113	0.0711	-0.0112	0.0045	0.0039	-0.028	-0.0145	0.0082	0.0234	-0.0062	0.0874
	G	0.0781	0.0832	-0.0317	0.1535	-0.0264	0.0167	0.0079	-0.0669	-0.0387	0.0199	0.0538	-0.0151	0.125
No. of secondary Branches per Plant	P	-0.0017	-0.0013	0.0002	-0.0014	0.0086	-0.0008	0.0019	0	0.0016	0.003	0.0008	0	0.378**
	G	-0.0069	-0.0038	0.0008	-0.0046	0.0265	-0.0053	0.0057	-0.0006	0.0039	0.0097	0.0032	-0.0012	0.449**
Days to Maturity	P	0.0008	0.0015	0.004	0.0007	-0.001	0.0108	-0.003	-0.0012	-0.0032	0.0036	0.004	-0.0065	-0.1721
	G	0.0045	-0.0015	0.0734	0.0104	-0.019	0.0957	-0.0477	-0.0155	-0.0547	0.0686	0.0655	-0.1086	-0.394**
No. of Pods per Plant	P	0.0269	0.0254	-0.0222	0.0069	0.0273	-0.0348	0.1243	-0.0068	0.0948	0.0361	-0.0557	0.0231	0.558**
	G	0.0775	0.1175	-0.102	0.019	0.0789	-0.1828	0.367	-0.0307	0.2817	0.0751	-0.1768	0.0514	0.600**
No. of seeds per Pod	P	0.0061	0.0086	-0.0015	0.0091	0	0.0026	0.0013	-0.023	-0.0113	0.0043	0.0089	-0.0069	0.0319
	G	0.0062	0.0137	-0.0008	0.0084	0.0004	0.0031	0.0016	-0.0192	-0.0095	0.0053	0.0079	-0.0053	-0.1122
No. of seeds per plant	P	0.0013	0.0015	0.0013	0.0037	-0.0034	0.0055	-0.014	-0.009	-0.0184	-0.0033	0.0106	-0.0072	0.574**
	G	0.0351	0.0646	0.0454	0.0562	-0.0331	0.1274	-0.1711	-0.11	-0.2229	0.0062	0.1442	-0.0746	0.441**
Biological Yield	P	-0.0454	0.0284	0.5425	0.1145	0.3517	0.3294	0.2886	-0.1842	0.1772	0.9953	0.4871	-0.4822	0.653**
	G	-0.2234	-0.182	0.8512	0.1642	0.4663	0.9099	0.2599	-0.3513	-0.0351	1.2693	0.7596	-0.9629	0.565**
100 seed weight	P	0.0053	0.0051	-0.0317	-0.0201	-0.0057	-0.0227	0.0274	0.0237	0.0353	-0.03	-0.0612	0.0224	0.152
	G	0.0133	0.0463	-0.1166	-0.0641	-0.0219	-0.1252	0.0882	0.0756	0.1184	-0.1095	-0.183	0.0744	0.304*
Harvest Index	P	-0.0929	-0.1558	-0.2673	-0.0685	-0.0004	-0.4702	0.146	0.2371	0.309	-0.3802	-0.2866	0.7847	0.322*
	G	-0.1957	-0.5413	-0.7287	-0.1166	-0.0536	-1.3426	0.1657	0.327	0.3959	-0.8975	-0.4811	1.183	0.0972
Seed yield per plant	P	-0.1225	-0.1198	0.250*	0.0874	0.378**	-0.1721	0.558**	0.0319	0.574**	0.653**	0.152	0.322*	1
	G	-0.369**	-0.610**	0.1829	0.125	0.449**	-0.394**	0.600**	-0.1122	0.441**	0.565**	0.304*	0.0972	1

CONCLUSION

The present studies using estimates of Anova, Genetic parameters such as variability (GCV and PCV), Genetic advance, heritability, correlation and path coefficient analysis concluded that characters like number of pods per plant, biological weight, 100 seed weight, plant height and number of secondary branches were more reliable for improvement of yield in chickpea hence utmost importance should be given to these characters during selection.

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