Character Association and Variability Analysis in Chickpea Germplasms

ABSTRACT

Chickpea is the leading legume grain crop source for protein and other nutritional content. Chickpea holds second rank in pulse production area and third in total production. There are totally ~~twenty-six~~26 germplasm and 11 traits were chosen for this study. All the traits were recorded on the optimum plant growth stages. The phenotypic correlation revealed that the seed yield per plant recorded positive correlation with plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per plant, biological yield, harvest index and seed index. Also, the biological yield and harvest index recorded positive direct effect on Seed yield per plant and the negative direct effect found in days to fifty percent flowering, plant height and number of pods per plant. The traits, days to ~~fifty percent~~50% flowering and plant height showed positive correlation and negative direct effect on seed yield per plant. Seed yield per plant recorded higher pcv and gcv value than other traits. The broad sense heritability and GAPM recorded higher value in seed yield per plant. The efficiency of selection will be improved by understanding the association among the traits and variability. This will be helpful in chickpea improvement plant breeding program.

Keywords: Cicer arietinum L.~~*chickpea*~~; ~~-~~ *correlation*; ~~-~~ *direct effect*; ~~-~~ *variability*

1. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the important legume grain crop having high amount of protein so far keep top in human dietary purpose. Also, it is the vital source of calcium, iron, phosphorous and other nutrients [1]~~ (Muehlbauer and Sarker 2017)~~. Compared to other pulses chickpea widely used as food legume because of it 40~~-~~% protein level in its weight. Also, chickpea has huge medicinal values like reducing cardiovascular diseases, diabetic and cancer risks [2]~~(Merga and Haji 2019)~~. Chickpea hold second rank in total pulse cultivated area (15.3~~-~~%) and rank third in production (15.42~~-~~%) in total pulse production. The total cultivated area under chickpea is 10.76 m ha and the production and productivity of 11.20 million tonne and 1032 kg~~/~~ ha~~$^{-1}$~~. (2017-18) [3]~~(Maurya and Kumar 2018)~~.

Due to increasing population there is a demand to increase the production of legumes for future need. Especially the improvement chickpea is necessary. So, utilization available genetic resources and studying the character association will helpful for choosing of parents for chickpea improvement breeding activities (Gowda *et al.,* 2015).

The yield is the dependent character with other yield attributing traits. The correlation and path analysis give the association information among the traits which helpful for targeted improvement

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of particular traits with the significant association of other traits (Naveed *et al.,* 2012). Thakur and Sirohi (2009) Identified the positive direct effect of seed yield per plant with biological yield, plant height, pods per plant, primary branches per plant, 100 seed weight and harvest index in chick pea.

Most of the yield attributing traits are quantitatively inherited and the improvement of those traits need complete understanding of heritability and genetic advance. Traits with high heritability can be improved easily but improvement of low heritability traits take more time and specific breeding strategies

The direct selection on yield will not be give reward and the combined improvement of yield attributing traits are essential. Exploitation of genetic resources is important for utilization of those in chickpea breeding activities (Kumar and Bahl 1992). Because genetic resources have lot of valuable genes for biotic stress tolerate, abiotic stress tolerance and quality related breeding.

So, the present aim of the study is analysing the association of characters with seed yield and understanding the selection methods also exploit the genetic resources which will be utilized in chickpea improvement breeding programs.

2. MATERIALS AND METHODS

2.1 Plant ~~g~~Genetic ~~m~~Material

The present experiment was conducted in experimental farm, Sam Higginbottom University of Agriculture, Technology & Sciences, ~~D~~during rabi 2019-2020. In the ~~T~~totally, ~~twenty six~~26 chickpea germplasm were selected for the association and genetic variability analysis. Germplasms were raised in randomized completely block design (RCBD) with two replications. The spacing of 30 × 10 cm provided with recommended fertilizer level (NPK@ 20:40:25 kg /ha^{-1}).

2.2 Evaluation of ~~t~~Traits

In the~~There are~~ totally, 11 traits were chosen for our study *viz.,* ~~D~~days to 50 % flowering, ~~D~~days to 50 % pod setting, plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per plant, biological yield, harvest index, seed index and seed yield per plant. The traits were recorded on the particular stage of the plant. Totally five plants were chosen for taking observation in each replication.

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2.3 Statistical ~~a~~Analysis

Analysis of variance calculated by the methods suggested by Panse and Sukhatme (1967). The coefficient of variation was analysed as per Burton (1954). Heritability in broad sense and genetic advance were assessed and correlation coefficients at phenotypic and genotypic level were calculated by the methods suggested by Al-Jibouri *et al.,* (1958). Path coefficients were estimated according to Dewey and Lu (1959). All the statistical analysis were done using the indostat software system.

3. RESULTS AND DISCUSSION

The analysis of variance ~~of RCBD design~~ in chickpea showed all the traits found to significant differ~~. The mean sum of square of treatment, replication and error reported in~~ (Table 1).

The mean value of the following traits was reported in ~~t~~Table 2 *viz.,* days to 50 % flowering (63.577), days to 50 % pod setting (88.795), plant height (55.478), number of primary branches per plant (3.949), number of secondary branches per plant (5.533), number of pods per plant (42.115), number of seeds per plant (53.362), biological yield (20.067), harvest index (47.661), seed index (18.003) and seed yield per plant (8.467) (Table 2). Syed *et al.,* (2012) studied 24 genotypes and 10 traits in chickpea and found association among the traits.

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The association of the characters among genotypes observed by the phenotypic and genotypic correlation. In case of phenotypic correlation, the seed yield per plant is found to significantly positively correlated with plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per plant, biological yield, harvest index and seed index. The days to 50 % flowering and days to 50 % pod setting reported to highly significantly positive correlated with seed yield per plant (Table 3). Malik *et al.,* (2010) reported grain yield per plant found to positively correlated with days to maturity, primary branches, secondary branches, number of pods per plant, biological yield and harvest index and negatively correlated with 100 seed weight.

The biological yield is significantly positively correlated with plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per plant, biological yield, harvest index, seed index and seed yield per plant (Table 3). Arshad *et al.,* (2002) found biological yield recorded positively correlated with plant height, pods per plant, grain yield and harvest index. In compare to genotypic correlation all the taken traits found to highly significantly positively correlated with seed yield per plant.

In path coefficient analysis the traits, BY and HI recorded positive direct effect on ~~S~~seed yield per plant. The DF50, PH and NPPP found to recorded negative direct effect on seed yield per plant without significant (Table 4 and Fig. 1). Yücel *et al.,* (2006) found plant height, Primary branch number, Secondary branch number, full pods number, seed number, 1000 seed weight and harvest index recorded positive direct effect on seed yield per plant.

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Only two traits (BY and HI) showed both positive direct effect and positive correlation on single plant yield and rest of the traits showed insignificant direct and indirect effect with seed yield per plant. The influence of other traits causes difference in correlation and direct effect (Table 4 and Fig. 1).

The highest genotypic and phenotypic coefficient of variation observed in seed yield per plant (24.687 and 26.063) followed by number of pods per plant (19.027 and 20.207). The minimum amount of genotypic coefficient of variation and phenotypic coefficient of variation recorded in days to 50 % pod setting (0.911 and 1.615) followed by days to 50 % flowering (2.639 and 4.321) (Table 5). Yücel *et al.,* (2006) found higher Genotypic coefficient of variation in seed number (12.83) and

secondary branch number (12.33) and the maximum phenotypic coefficient of variation in secondary branch number (22.56) and seed number (17.88).

The highest broad sense heritability observed in seed yield per plant (89.7 %) followed by number of pods per plant (88.7 %) and the lowest broad sense heritability recorded in days to 50 % flowering (31.8) followed by days to 50 % flowering (37.3) (Table 5 and Fig. 2). Yücel *et al.,* (2006) reported the following traits showed maximum broad sense heritability *viz.,* seed number (51.66), 1000 seed weight (36.48) and first pod height (31.45).

The genetic advance as percentage of mean recorded the maximum value in seed yield per plant (48.171) followed by number of pods per plant (36.9.6) and the minimum genetic advance as percentage of mean found in days to 50 % pod setting (1.058) followed by days to 50 % flowering (3.321) (Table 5). Parameshwarappa *et al.,* (2012) reported the maximum genetic advance as percentage of mean in days to fifty percent flowering, 100 seed weight and yield per plant.

4. CONCLUSION

The character association and variability study in chickpea concluded that the seed yield per plant can be directly increased through the positive selection of biological yield and harvest index. In case of correlation all the taken traits positively increase the single plant yield. The maximum variability observed in the traits seed yield per plant followed by number of pods per plant. This information will be helpful in choosing of parents and selection in chickpea improvement breeding program.

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Table 1. ANOVA in twenty-six chickpea germplasm

Source of variation	Treatment means sum of square	Replication mean sum of square	Error mean sum of square
DF50	13.17647**	2.567698	4.729827
DP50	3.366322**	0.03436	1.403425
PH	40.30105**	2.282436	5.688836
NPBP	1.379528**	0.08359	0.12519
NSBP	0.586113**	0.08359	0.10279
NPPP	200.854197**	9.028843	8.21458
NSPP	279.335637**	15.42922	14.022296
BY	35.941332**	11.16667	5.447733
HI	120.038787**	25.19426	17.887805
SI	3.634646**	0.754358	0.796492
SYPP	16.983815**	0.206667	0.6248

Table 2. The yield and yield attributing traits value in twenty-six chickpea germplasm

Genotypes	Days to 50 flowering	Days to 50 % pod setting	Plant Height	Number of primary branches per plant	Number of secondary branches per plant	Number of Pods per plant	Number of Seeds per plant	biological yield	Harvest index	Seed index	Seed yield per plant
C-18121	64.933	89.600	57.400	3.867	5.133	34.067	39.200	18.133	39.010	17.133	7.067
C-223	62.867	87.467	55.300	5.000	5.667	51.567	62.867	28.867	41.243	18.733	11.533
IPC-05-62	66.133	90.400	54.400	3.933	4.867	42.433	52.133	21.133	46.733	17.333	9.333
C-207	61.133	87.467	51.267	3.600	4.800	35.800	46.200	17.400	47.617	17.933	8.267
PC-6006	64.733	88.933	58.933	4.933	6.000	54.467	68.000	23.600	48.960	17.333	11.533
C-201	65.067	89.667	52.800	4.467	5.667	51.000	63.400	22.133	50.600	18.800	11.133
C-18122	60.000	87.333	45.400	3.133	4.467	33.600	43.267	17.267	38.537	15.867	6.600
IPC-10-134	65.867	88.933	57.000	3.533	5.000	34.000	44.333	15.600	47.840	18.200	7.333
C-210	63.467	87.467	53.733	3.533	5.200	37.333	43.933	16.467	46.990	17.467	7.600
KSG-931	64.333	88.867	57.933	4.400	5.533	47.933	58.067	18.133	52.113	16.933	9.467
C-224	63.333	88.400	50.067	3.800	5.067	40.533	52.200	18.800	54.723	16.533	10.067
C-1028	63.467	88.333	51.800	3.133	4.867	34.133	43.667	18.067	39.757	17.667	7.067
KPG-59	64.733	89.533	57.600	5.533	6.133	58.333	71.533	27.133	62.153	19.867	16.600
IPC-04-52	66.600	90.000	54.667	4.667	5.800	54.200	69.200	26.000	49.887	20.000	12.667
C-18123	61.800	87.200	56.533	3.400	5.400	38.600	52.200	18.467	49.927	18.133	9.133
C-1025	58.333	88.267	53.067	3.467	5.200	36.600	47.400	19.667	41.360	17.600	8.000
C-203	62.800	88.000	59.133	4.800	6.000	54.933	68.133	22.333	55.210	18.067	12.267
C-222	63.533	88.133	54.333	3.467	5.067	36.933	51.333	17.667	49.390	18.333	8.733
C-213	59.200	88.267	57.733	3.267	5.000	35.067	47.067	21.600	36.457	17.533	7.800
IPC-05-24	63.867	89.000	60.800	3.400	5.000	37.667	51.000	20.133	44.780	17.867	8.667
C-18125	63.333	88.667	56.133	3.733	5.467	37.800	49.267	16.867	48.223	17.000	7.933
ICCY-10	66.200	90.933	59.733	4.133	5.267	41.400	55.133	18.800	48.897	18.400	9.200
IPCO-2K-25	65.667	91.000	62.200	5.000	6.200	54.933	68.267	23.867	60.623	20.200	13.533
GNG-1958	64.200	88.400	51.867	3.400	5.200	34.400	43.733	17.467	42.123	16.600	7.267
PUSA-362	63.733	89.000	56.133	3.467	5.200	36.733	48.133	18.800	46.833	19.333	8.667
UDAY (check)	63.667	89.400	56.467	3.600	5.533	40.533	47.733	17.333	49.193	19.200	8.467
Mean	63.577	88.795	55.478	3.949	5.336	42.115	53.362	20.067	47.661	18.003	9.459
C.V.	3.421	1.334	4.299	8.960	6.009	6.805	7.018	11.631	8.874	4.957	8.357

S.E.	1.256	0.684	1.377	0.204	0.185	1.655	2.162	1.348	2.442	0.515	0.456
C.D. 5%	3.567	1.943	3.912	0.580	0.526	4.700	6.141	3.828	6.936	1.464	1.296
C.D. 1%	4.755	2.590	5.215	0.774	0.701	6.267	8.187	5.103	9.247	1.951	1.728

Table 3. Phenotypic and genotypic correlation coefficient in chickpea

	DF50	DP50	PH	NPBP	NSBP	NPPP	NSPP	BY	HI	SI	SYPP
DF50	1	0.6132***	0.2155	0.2850*	0.1872	0.2681*	0.2421*	0.1127	0.3084**	0.2657*	0.272*
DP50	0.876**	1	0.3481**	0.182	0.1536	0.2337*	0.1993	0.1399	0.2293*	0.3077**	0.249*
PH	0.587**	0.693**	1	0.3927***	0.5099***	0.3751***	0.3890***	0.2753*	0.2913**	0.3548**	0.359**
NPBP	0.637**	0.667**	0.491**	1	0.8036***	0.8968***	0.8500***	0.6963***	0.5344***	0.4278***	0.850**
NSBP	0.586**	0.609**	0.656**	0.911**	1	0.7560***	0.7309***	0.5466***	0.5055***	0.4468***	0.719**
NPPP	0.546**	0.531**	0.445**	0.991**	0.980**	1	0.9648***	0.7491***	0.5892***	0.4224***	0.911**
NSPP	0.505**	0.536**	0.464**	0.947**	0.948**	0.982**	1	0.7698***	0.5772***	0.4293***	0.918**
BY	0.254*	0.385**	0.328**	0.889**	0.761**	0.872**	0.858**	1	0.0822	0.4027***	0.784**
HI	0.630**	0.558**	0.455**	0.731**	0.825**	0.748**	0.774**	0.462**	1	0.4059***	0.667**
SI	0.523**	0.666**	0.587**	0.588**	0.751**	0.650**	0.685**	0.664**	0.614**	1	0.542**
SYPP	0.472**	0.522**	0.432**	0.953**	0.923**	0.952**	0.954**	0.866**	0.834**	0.737**	1

Table 4. Direct and indirect effect of various traits on seed yield per plant in chickpea

	DF50	**DP50**	**PH**	**NPBP**	**NSBP**	**NPPP**	**NSPP**	**BY**	**HI**	**SI**	**SYPP**
DF50	**-0.0144**	-0.0089	-0.0031	-0.0041	-0.0027	-0.0039	-0.0035	-0.0016	-0.0045	-0.0038	0.272*
DP50	0.0197	**0.0321**	0.0112	0.0058	0.0049	0.0075	0.0064	0.0045	0.0074	0.0099	0.249*
PH	-0.0094	-0.0152	**-0.0437**	-0.0171	-0.0223	-0.0164	-0.017	-0.012	-0.0127	-0.0155	0.359**
NPBP	0.0204	0.013	0.0281	**0.0714**	0.0574	0.0641	0.0607	0.0497	0.0382	0.0306	0.850**
NSBP	0.0045	0.0037	0.0124	0.0195	**0.0243**	0.0183	0.0177	0.0133	0.0123	0.0108	0.719**
NPPP	-0.0207	-0.0181	-0.029	-0.0694	-0.0585	**-0.0773**	-0.0746	-0.0579	-0.0456	-0.0327	0.911**
NSPP	0.0121	0.0099	0.0194	0.0424	0.0365	0.0481	**0.0499**	0.0384	0.0288	0.0214	0.918**

BY	0.079	0.0981	0.1931	0.4882	0.3833	0.5253	0.5398	**0.7012**	0.0577	0.2824	0.784**
HI	0.1804	0.1341	0.1704	0.3126	0.2956	0.3446	0.3376	0.0481	**0.5849**	0.2374	0.667**
SI	0.0003	0.0003	0.0004	0.0005	0.0005	0.0005	0.0005	0.0004	0.0004	**0.0011**	0.542**

Table 5. Genetic parameters of yield and yield attributing traits on chickpea

	GCV (%)	**PCV (%)**	**h^2(Broad Sense) (%)**	**GAPM (%)**
Days to 50 flowering	2.639	4.321	37.3	3.321
Days to 50 % pod setting	0.911	1.615	31.8	1.058
Plant Height	6.123	7.481	67	10.322
Number of primary branches per plant	16.375	18.667	77	29.593
Number of secondary branches per plant	7.522	9.627	61	12.108
Number of Pods per plant	19.027	20.207	88.7	36.906
Number of Seeds per plant	17.623	18.969	86.3	33.729
biological yield	15.888	19.691	65.1	26.409
Harvest index	12.243	15.121	65.6	20.421
Seed index	5.403	7.333	54.3	8.201
Seed yield per plant	24.687	26.063	89.7	48.171

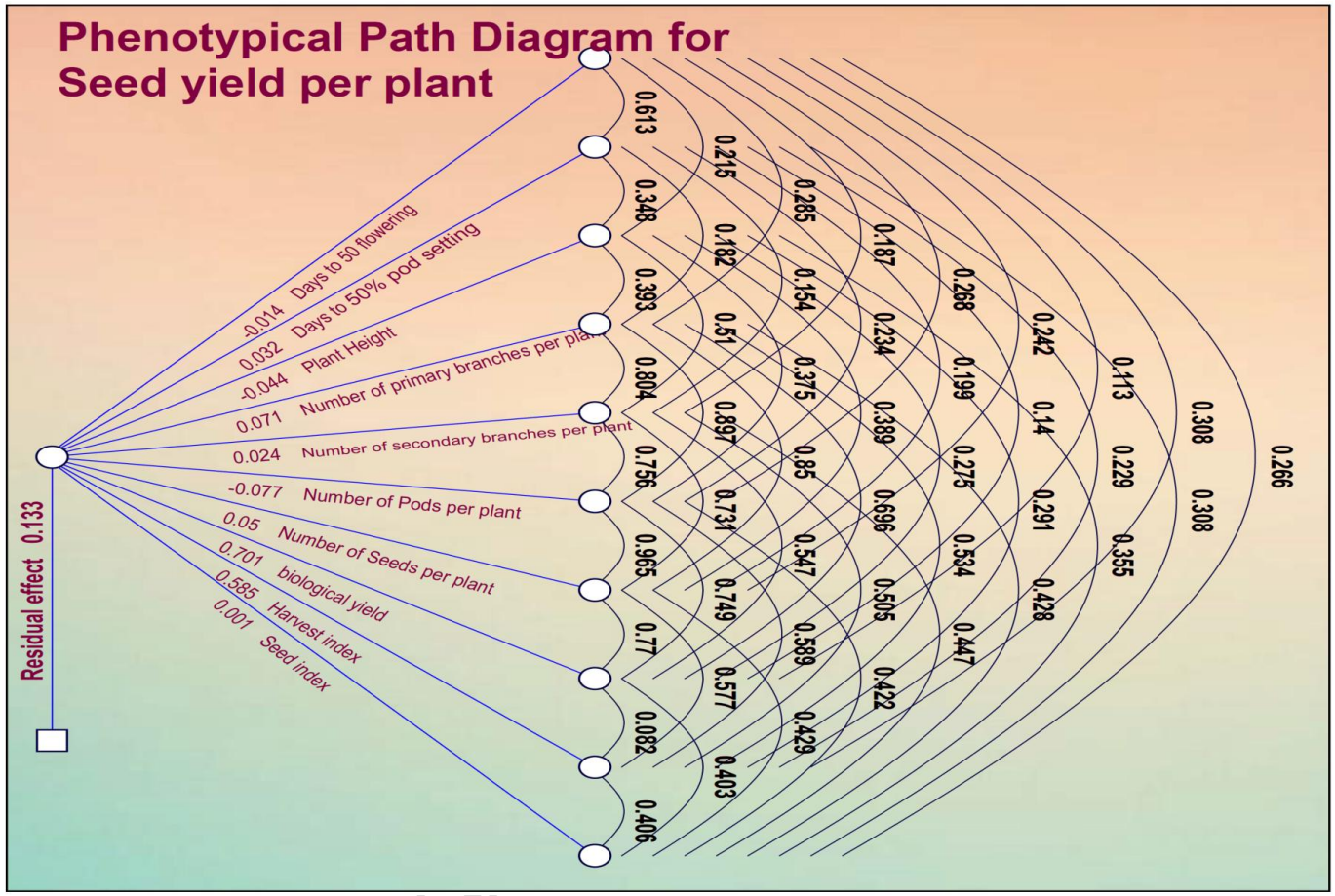
Phenotypical Path Diagram for
Seed yield per plant
Residual effect 0.133
-0.014 Days to 50 flowering
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Fig. 1. The phenotypic path diagram indicating direct and indirect effect of traits on seed yield per plant on chickpea

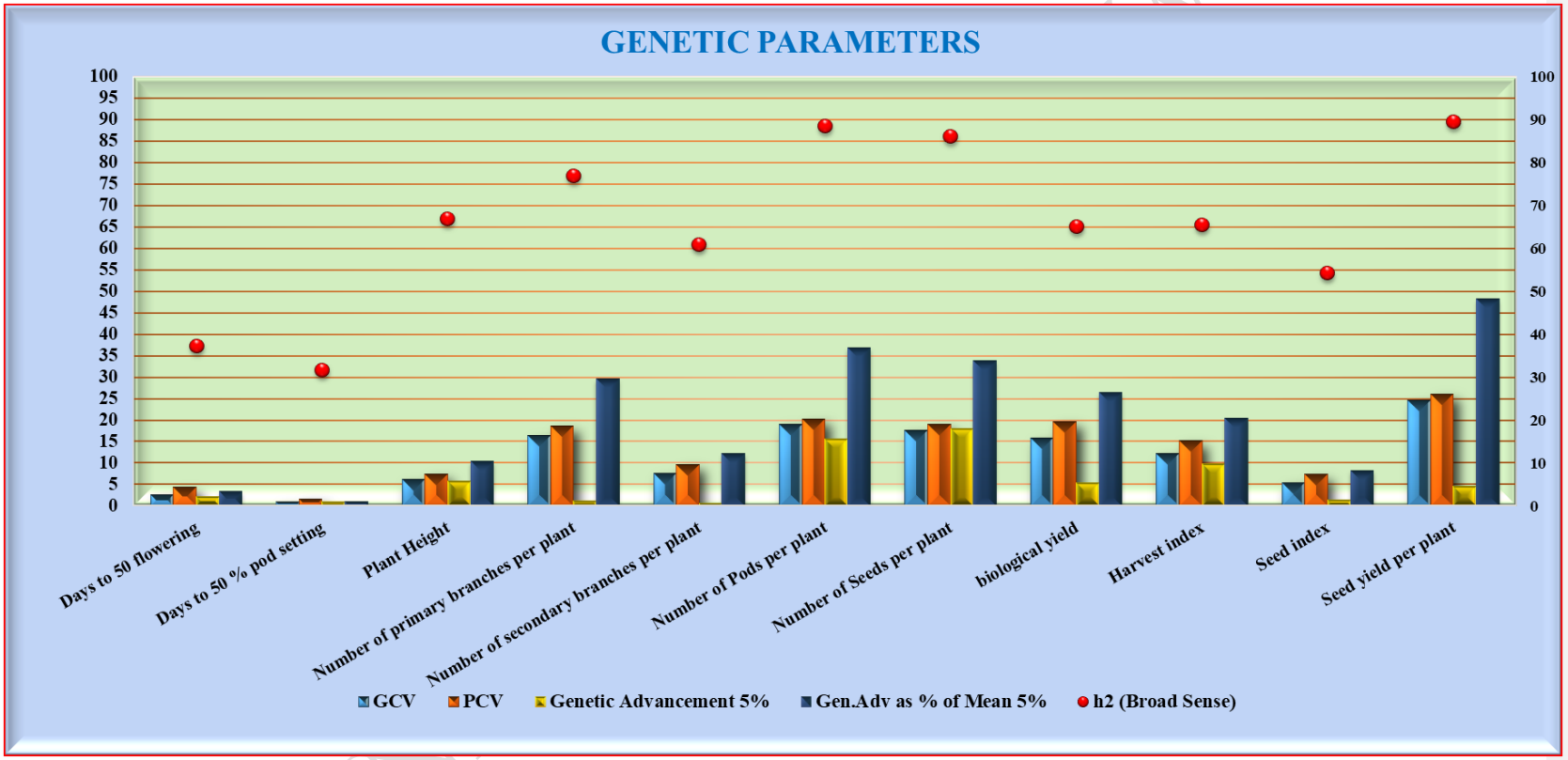

Fig. 2. The genetic variabilities of chickpea's germplasm