Evaluation of Chickpea*(Cicer arietinum* L.) genotypes based on morphologicalin Agro-climaticRegions of Pprayagraj

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ABSTRACT

A field experiment was conducted during *Rabi* 2023-2024 at the experimental farm of Department of Genetics and Plant Breeding ,Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh .A Randomized Block Design With three Replications was conducted for the study.22 Characters were observed and recorded which included ten qualitative traits and twelve quantitative traits viz. days to 50 percent flowering, Days to pod initiation ,days to 50% pod setting ,plant height ,number of primary branches , number of secondary branches, number of pods per plant, number of seeds per pod, seed yield per plant, biological yield, harvest index, seed index. Among all the genotypes ICCV-10 recorded best performance for seed yield per plant, days to pod initiation, days to 50 percent pod setting followed by among all genotypes. Followed by PG-06102 among all the genotypes. High PCV and GCV where recorded in number of seeds per pod, number of primary branches. The number of seeds per pod recorded high heritability. High seed index is recorded under genetic advance.

Keywords: Chickpea genotypes, heritability, genetic advance.

INTRODUCTION

The pPulses are the most important constituents of vegetarian diet because they contain higher percentage of protein and oil as compared to cereals, pulses are known as “poor man’s meat and rich man’s vegetable” because they are high in protein and several essential amino acidse.g., lysine.

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Chickpea (Cicer arietinum L.) is one of the most important pulse crop. It is grown in almost all parts of the country. Chickpea is also known as king of pulses. The word Chickpea is derived from the Greek word kiros referring to a roman family cicero.Arietinum is derived from the Latin word arise meaning ram which refers to the ramsram’s head shape of Chickpea **(singh,1985**).It is self-pollinated crop and belongs to sub-family Papilonaceae of family Leguminaceae (**Bentham and hooker,1970)**now popularly known as Fabaceae and have chromosome number of 2n=2×=16.

Chickpea is primarily a crop of rainy season, however with the development of early varieties, it has proved to be an ideal crop for spring and summer seasons.The summer season provides an ideal opportunity for cultivating short duration pulses. For normal growth anddevelopmentthe recommended threshold temperature ranges from 5 to 35^0C and optimum

germination temperature is 20^0C**(Singh and Dhaliwal,1972)**. Chickpea can be grown on various soils ranging from very light, sandy loam to heavy textured clay soils with well drainage. A PH range 6.0 to 8.0.

Chickpea plays an important role in human nutrition as a source of protein, energy, fiber, vitamins, and minerals. It also contains high levels of calcium, iron, niacin, vitamin b and vitamin c.It is also helps to improve soil fertility pParticularly in dry lands**(yucee*t al.*2006).**Chickpea seeds contain on an average 25 to 29% protein, 41 to 50.8% carbohydrates, 8% crude fiber and 358calories, **(Bhanu et al. 2017).**

The major Chickpea production countries in Asia are India (65%), Pakistan (7.5%) and Turkey (6.5%). India grows Chickpea on 10.91million hectare area, producing 13.75million ~~tonnes~~tons**(FAO,2022)** and having productivity of 12.6 quintal per hectare. Chickpea isthird most important grain legume in the world after Dry beans and Garden peas being widely grow in sub-tropical and cold temperate regions. Its cultivation is mainly confirmed with Asia with 90% of global area and production (**Ali and Kumar 2001)**. India is the largest producer of chickpea in the world sharing 65.2% of area and 65.4% of production. Major Chickpea cultivated states in India are Madhya Pradesh, Rajasthan, Karnataka and Andhra Pradesh which contributes 90% of national production.

For improving yield and other characters in Chickpea, information on Genetic Variability is of great importance and required further effective screening of superior genotypes. Genetic crop improvement depends upon the exploration of traits diversity available in the Genepool by providing useful information in parents selection and further utilization through plant bBreeding approaches. Recent plant breeding methods have reduced the genetic diversity of cultivated chickpeas. Nonetheless, evaluating the new genotypes for key economic traits will help in the creation of improved cultivars (Naveed et al., 2015).

Identifying high yield and yield attributing genotypes keeping in the view that the experiment results as excutedas population gradually increasing. Production and the area under cultivation of Chickpea should be increased by bringing high yielding varieties.

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2. MATERIALS AND METHODS

The Experiment was conducted in the field experimentation center Department of Genetics and Plant Breeding, Naini Agriculture Institution, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh.dDuring *Rabi* 2023 – 2024.The material comprised of 16 Chickpea genotypes sown in Randomized Block Design with three replications with spacing of 30×10cm.

2.1. EXPERIMENTAL MATERIALS

LIST 1: LIST OF EXPERIMENTAL MATERIAL

S NO.	Genotypes	Source
1.	RSG-963	(ICRISAT) International Crops Research Institute for the Semi-Arid Tropics
2.	IPC-57-29	Indian Institute of pulse research (IIPR)

3.	C-1027	(ICRISAT) International Crops Research Institute for the Semi-Arid Tropics
4.	ICC-4958	(ICRISAT) International Crops Research Institute for the Semi-Arid Tropics
5.	PHULE-4-5	Mahatma Phule Krishi Vidyapeeth (MPKV)Pune
6.	ICC-2198	(ICRISAT) International Crops Research Institute for the Semi-Arid Tropics
7.	HIMACHAL CHANA-2	Himachal Pradesh Agriculture Institute (HPAU)
8.	ICC-11847	(ICRISAT) International Crops Research Institute for the Semi-Arid Tropics
9.	RBG-203	Indian Institute of pulse research (IIPR)
10.	ANETHYST	(ICRISAT) International Crops Research Institute for the Semi-Arid Tropics
11.	PG-96006	Indian Institute of pulse research (IIPR)
12.	PG-06102	Indian Institute of pulse research (IIPR)
13.	ICCV-10	(ICRISAT) International Crops Research Institute for the Semi-Arid Tropics
14.	PUSA-362(Check)	Indian Agricultural Research Institute (IARI) New-Delhi
15.	IPC-12-31	Indian Institute of pulse research (IIPR)
16.	IG-14	(ICRISAT) International Crops Research Institute for the Semi-Arid Tropics

2.2. OBSEVATIONS RECORDED

The data was recorded on five randomly selected plants in each plot in each replication for the traits for the ten qualitative traits which includes Anthocyanin pigmentation, plant growth habit, forage color, flower color, no of flowers for peduncle, pod size, seed size, seed shape, seed color, seed type and 12 Quantitative Traits which includes Days to 50% flowering, Days to Pod initiation, Days to 50% pod setting, Plant height, no of primary branches, no of secondary branches, no of pods per plant, no of seeds per pod, seed yield per plant, biological yield, harvest index, seed index.

Comment [ZR4]: Rewrite the sentence.

Analysis of variance was worked out to test the significance of F and T test (Panse and Sukhatame, 1985 and Singh and Choudhary, 1979). It was carried out according to procedure of RBD for each characters. Data analysis was done to estimate genotypic Coefficient of Variation (%) by Burton, Heritability (%) by Bruton and devane, 1953, Genetic advance by Johnson and Genetic advance as percent mean.

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3. RESULT AND DISSCUSION

A field experiment entitled "evaluation of chickpea (Cicer arietinum L.) Genotypes based on morphological traits in Agro climatic regions of Prayagraj-wWas conducted at field experimentation Centre, Department of Genetics and Plant Breeding, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh during Rabi season of 2023-2024.

3.1. QUALITATIVE TRAITS

Anthocyanin pigmentation: As per the data recorded in table 1 it was observed that the anthocyanin pigmentation on the stem was present in 6 genotypes and absent in 10 genotypes

Plant growth habit: From the data recorded in table 1 it was observed that the plant growth habit 5 genotypes were erect, 9 genotypes were semi erect and 2 genotypes had spreading growth habit.

Foliage color: It can be observed from the data recorded from table 1 that the foliage color was dark green in 11 genotypes in 5 genotypes were light green colored.

Flower color: As per the data recorded in table 1 it can be observed that the flower color was light pink ~~color~~ in 6 genotypes, purple colored in 3 genotypes and pink colored in 7 genotypes

Number of flowers per peduncle: It can be observed the data recorded in table 1 that the number of flowers per peduncle were single flowered in 13 genotypes and twin flowered in 3 genotypes

Pod size: From the data recorded in table 1 it can be observed that the pod size was large sized in 10 genotypes medium, medium sized in 5 genotypes and small pod size in 1 genotype.

Seed color: As per the data recorded table 1 it can be observed that the gray colored seeds were observed in 1 genotype, brown colored in 4 genotypes, reddish colored in 2 genotypes, light brown in 2 genotypes, orange colored in 4 genotypes, yellow colored in 3 genotypes.

Seed shape: It can be observed the data recorded in table 1 that the seed shape in 8 genotypes seeds were angular in shape, 6 genotypes seeds were pea shaped and 2 genotypes seeds were owl's head shaped.

Seed size: As per the data recorded table 1 it can be observed that the seed size was large sized in 5 genotypes, medium sized in 6 genotypes small sized in 4 genotypes and very small sized in 1 genotype.

Seed type: It can be observed that the all the 16 genotypes were desi seed type.

Fig 1. Flower color present in 16Chickpea genotypes based on morphological characters

Fig 2. Anthocyanin pigmentation on stem present in 16 Chickpea genotypes based on morphological characters

Fig3. Different pod sizes present in 16 Chickpea genotypes

Fig 4. Different seed shape present in 16 Chickpea genotypes based on morphological traits

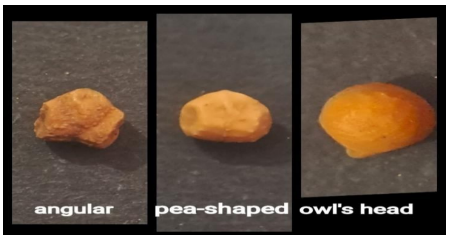

Fig5. Seed size present in 16 Chickpea genotypes based on morphological traits

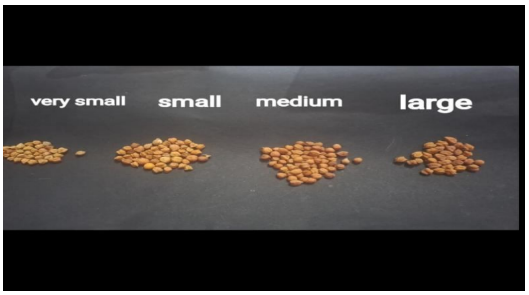

Fig 6. Different seed color present in 16 Chickpea genotypes

Yellow colororange color



Brown color light brown color reddish color

3.2. Quantitative traits

Days to 50% flowering: It were observed from the table 2 and fig 7 that the days to 50% flowering were least recorded in ICCV-10 genotype with 75.49 DAS and PG-06102 genotype with 75.61 DAS. The highest number of days for 50% flowering were recorded in C-1027 genotype with 89.73 DAS.

Days to pod initiation:It has been observed that lowest number of days to pod initiation was recorded in ICCV-10 genotype with 73.68 DAS and PG-06102 genotype .The highest number of days to pod initiation were recorded in C-1027 genotype with 87.56 DAS.

Days to 50% pod setting

It has been observed that lowest number of days to 50% pod setting recorded in ICCV-10 genotype with 91.38 DAS and the PG-06102 genotype with 92.64 DAS

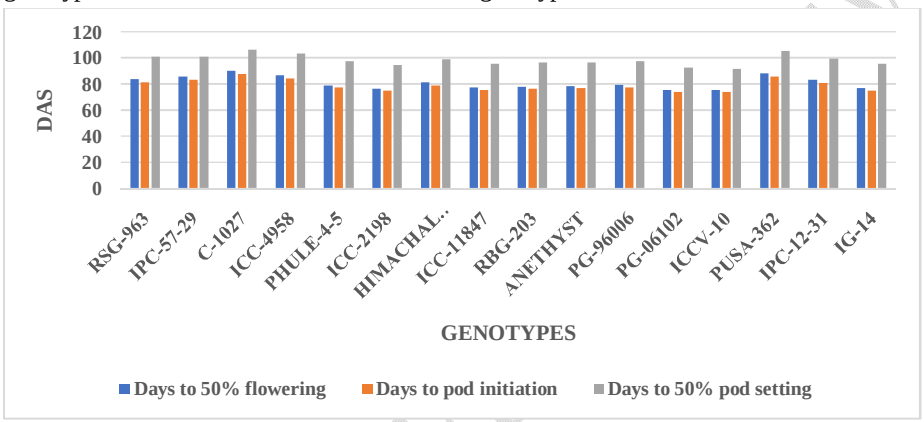

Fig 7. Graphical representation on effect of Prayagraj agro-climatic conditions on days to 50% flowering, days to pod initiation, days to 50% pod setting in 16 genotypes

Plant height(cm):A perusal of data on plant height was recorded during the experimental crop growth period at various intervals, revealing a significant increase in plant height from 60 DAS to 90 DAS, which was recorded and tabulated in Table 2 and Fig.8.

Comment [ZR5]: Could be rewrite by showing the highest and lowest result.

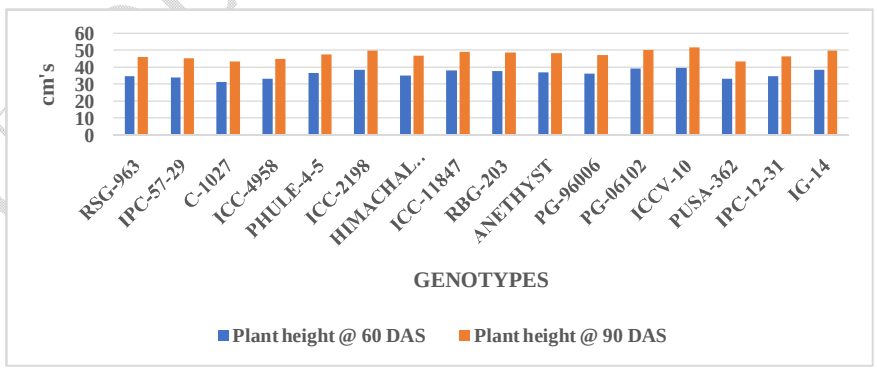

Fig 8:Graphical representation on effect of Prayagraj agro-climatic conditions on plant height in 16 genotypes

Number of Primary branches: It has been observed that the highest number of primary branches were observed in ICCV-10 genotype with 4.83 branches and ~~t~~The lowest number of

primary branches were observed in C-1027 genotype with 2.67 branches.

Number of Secondary branches: It has been observed that the highest number of secondary branches were observed in ICCV-10 genotype with 21.59 branches and ~~The~~the lowest number of secondary branches were observed in C-1027 genotype with 14.29 branches.

Number of Pods per plant: It were observed that highest number of pods per plant were observed in ICCV-10 genotype with 55.37 pods~~.~~and the lowest number of pods per plant were observed in C-1027 genotype with 40.64 pods.

Number of Seeds per pod: As per the data recorded in Table 2 and Fig.10 it can be observed that highest number of seeds per pod were recorded in ICCV-10 genotype with 2.15 seeds and t~~T~~he lowest number of seeds per pod were recorded in C-1027 genotype with 1.02 seeds.

Seed yield per plant: It can be observed from the Table 2 and Fig.10 that the seed yield per plant was recorded highest in ICCV-10 genotype with 17.64gm. the lowest seed yield per plant was recorded in C-1027 genotype with 10.75gm.

Biological yield: As per the data recorded in Table2 and Fig.10 it can be observed that highest biological yield was recorded in ICCV-10 genotype with 35.89gm. the lowest biological yield was recorded in C-1027 genotype with 24.73gm.

Harvest index: From the data recorded in Table2 and Fig.10 it can be observed that highest harvest index was recorded in IPC-12-31 genotype with 53.33% and genotype ANETHYST with 52.19% fig 101027 genotype with 43.48%.

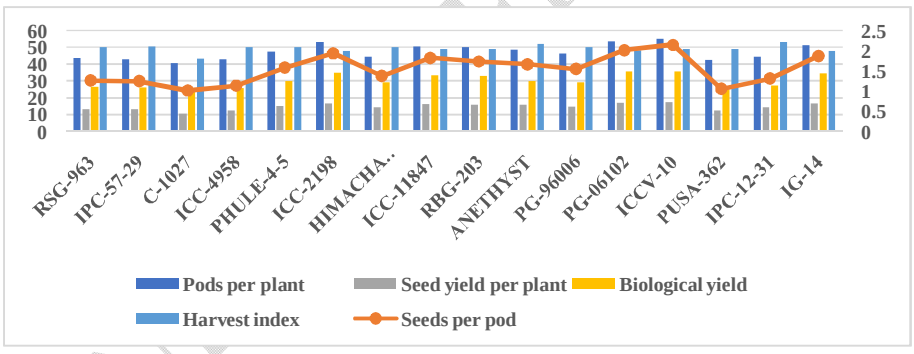

Fig9.Graphical representation on effect of Prayagraj Agro-climatic conditions on pods per plant, seeds per pod, seed yield per plant, biological yield and harvest index in 16 genotypes

Seed index: It can be observed from the table 2 that the highest seed index was recorded in ICCV-10 genotype with 363.48gm and the lowest biological yield was recorded in C-1027 genotype with 218.64gm.

Variability parameters:

Genotypic coefficient of variation measures the magnitude of genetic variability present in the crop and reflects the heritable portion of variability. It is therefore considered to be more useful than phenotypic coefficient of variation. Moreover, the difference between phenotypic and genotypic coefficients of variation indicates the operation of environmental factors (**Dhanwani*et al.*, 2013**).

Comment [ZR6]: Fig 10 doesn't show any mean data.

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Phenotypic and genotypic co-efficient of variance: Among the 12 quantitative characters, high estimates of GCV and PCV were recorded for No. of seeds per pod (22.93, 23.10). The high estimates of PCV and GCV for these traits like seeds per pod and moderate estimates of PCV and GCV for these traits like primary branches, secondary branches, seed yield per plant, biological yield, seed index suggested that the possibility of yield improvement through selection of these traits.

Heritability: In the present study, high heritability values were recorded for number of seeds per pod (98.52%), primary branches, secondary branches, seed yield per plant, biological yield, seed index, days to 50% flowering, days to pod initiation, days to 50% pod setting, plant height @ 60DAS (80.98%), plant height @ 90DAS, pods per plant, harvest index.

Genetic advance: In the present study, genetic advance for different traits revealed that it varied from 0.73 to 85.90. High genetic advance (above 20%) was observed in seed index (85.90%). Lowest (below 10%) values of genetic advance were observed for pods per plant, days to 50% flowering, days to pod initiation, biological yield, days to 50% pod setting, secondary branches, plant height @ 60DAS, plant height @ 90DAS, seed yield per plant, harvest index, primary branches, seeds per pod.

Genetic advance as per mean: Genetic advance as a percent of mean ranged from 3.67 to 46.89. High genetic advance as a percent of mean was observed for number of seeds per pod (46.89%), primary branches, seed index. Moderate genetic advance as a percent of mean was observed in number of pods per plant. Low genetic advance as a percent of mean was observed in plant height @ 90DAS, days to 50% pod setting.

4. DISCISSION:

The Agro-climatic conditions of Prayagraj, during November to April, are typically characterized by the cool and dry weather with occasional winter rains. These conditions have a significant impact on the morphological characteristics of Chickpea. During this period, temperatures are favourable for chickpea growth. Moderate temperatures help in better vegetative growth, contributing to increased plant height, branching, and leaf area. Cooler temperatures also enhance the photosynthetic efficiency and reduce respiratory losses, which can positively influence biomass accumulation.

Comment [ZR10]: Not clear and not specific. It only focused on the climatic factor and haven't included any discussion on the obtained results.

5.CONCLUSION:

Form the present investigation, it is concluded that among 16 Chickpea genotypes, based on the mean performance ICCV-10(were found superior in seed yield per plant The morphological characterization will be relevant for subsequent Dus (Distinctness, Uniformity, and Stability)testing evaluation. DUS tests are performed to determine that a new variety is Distinct from current varieties. Significant difference was recorded for all the seed yield and its components indicating large amount of variability in the genotypes. The magnitude of genotypic coefficient of variance and phenotypic coefficient of variation recorded high in number of seeds per pod. From this study it is concluded that genotype ICCV-10, PG-06102 of Chickpea is found to be suitable for Agro- Climatic regions of Prayagraj.

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Table 1. DUS Distinctness, Uniformity and Stability Characters in 16 Chickpea genotypes based on 10 qualitative trait

Genotypes	Anthocyanin pigmentation	Plant growth habit	Foliage color	Flower color	No. Of flowers per peduncle	Pod size	Seed color	Seed shape	Seed size	Seed type
RSG-963	Present	Erect	Dark green	Light pink	Single	Medium	Grey	Angular	Medium	Desi
IPC-57-29	Absent	Erect	Dark green	Purple	Single	Large	Brown	Angular	Medium	Desi
C-1027	Present	Semi-erect	Dark green	Light pink	Single	Large	Reddish	Pea-shaped	Small	Desi
ICC-4958	Absent	Semi-erect	Light green	Pink	Single	Large	Light brown	Angular	Large	Desi
PHULE4-5	Present	Erect	Light green	Pink	Twin	Large	Orange	Pea-shaped	Small	Desi
ICC-2198	Absent	Semi-erect	Dark green	Light pink	Single	Medium	Orange	Owl's head	Small	Desi
HIMACHAL CHANA-2	Absent	Semi-erect	Dark green	Pink	Single	Large	Light brown	Angular	Medium	Desi
ICC-11847	Absent	Spreading	Dark green	Purple	Twin	Medium	Yellow	Pea-shaped	Very small	Desi
RBG-203	Absent	Spreading	Dark green	Pink	Single	Medium	Yellow	Pea-shaped	Large	Desi
ANETHYST	Absent	Erect	Light green	Light pink	Single	Large	Brown	Angular	Small	Desi
PG-96006	Present	Semi-erect	Dark green	Light pink	Twin	Large	Brown	Angular	Medium	Desi
PG-06102	Absent	Semi-erect	Dark green	Pink	Single	Small	Orange	Angular	Large	Desi
ICCV-10	Present	Semi-erect	Light green	Purple	Single	Large	Reddish	Pea-shaped	Medium	Desi
PUSA-362	Present	Semi-erect	Light green	Light pink	Single	Large	Yellow	Owl's head	Large	Desi
IPC-12-31	Absent	Semi-erect	Dark green	Light pink	Single	Medium	Orange	Pea-shaped	Medium	Desi
IG-14	Absent	Erect	Dark green	Pink	Single	Large	Brown	Angular	Large	Desi

Table2. Effect of Prayagraj agro-climatic conditions on the quantitative traits in 16 Chickpea genotypes

GENOTYPES	Days to 50% flowering	Days to pod initiation	Days to 50% pod setting	Plant height @ 60 DAS	Plant height @ 90 DAS	No. of primary branches	No. Of secondary branches	No. of pods per plant	No. of seeds per pod	Seed yield per plant	Biological yield	Harvest index	Seed index
RSG-963	83.87	81.64	100.76	34.67	46.22	2.96	16.73	43.72	1.27	13.49	26.71	50.52	257.61
IPC-57-29	85.56	83.48	101.29	34.23	45.61	2.92	16.34	43.14	1.25	13.38	26.37	50.75	248.34
C-1027	**89.73**	**87.56**	**106.48**	**31.48**	**43.32**	**2.67**	**14.29**	**40.64**	**1.02**	**10.75**	**24.73**	**43.48**	**218.64**
ICC-4958	86.64	84.43	103.74	33.49	45.27	2.83	14.71	42.88	1.14	12.89	25.68	50.24	241.29
PHULE-4-5	78.73	77.39	97.49	36.63	47.79	3.51	18.23	47.48	1.59	15.17	30.13	50.40	284.61
ICC-2198	76.37	74.57	94.76	38.81	50.24	4.37	20.84	53.46	1.94	16.79	35.21	47.74	339.84
HIMACHAL CHANA-2	81.64	79.26	98.74	35.49	46.81	3.14	17.64	44.78	1.38	14.73	29.18	50.50	274.24
ICC-11847	77.59	75.48	95.61	38.22	49.38	4.12	20.21	50.67	1.83	16.48	33.52	49.24	313.56
RBG-203	77.84	76.23	96.39	37.74	48.88	3.84	19.77	50.39	1.74	16.27	33.28	48.97	304.62
ANETHYST	78.26	76.71	96.71	37.31	48.59	3.65	19.65	48.77	1.67	15.77	30.24	**52.19**	298.13
PG-96006	79.43	77.54	97.58	36.18	47.24	3.38	17.87	46.57	1.55	14.86	29.56	50.34	281.39
PG-06102	**75.61**	**73.89**	**92.64**	**39.43**	**50.49**	**4.61**	**21.38**	**53.89**	**2.02**	**17.22**	**35.64**	48.40	**347.31**
ICCV-10	75.49	73.68	91.38	39.64	51.78	4.83	21.59	55.37	2.15	17.64	35.89	49.16	363.48
PUSA-362	88.35	85.47	105.51	33.18	43.64	2.74	14.61	42.53	1.06	12.43	25.31	49.16	237.53
IPC-12-31	83.27	80.73	99.43	35.12	46.37	3.06	17.12	44.35	1.32	14.62	27.43	53.33	262.61
IG-14	76.68	74.69	95.43	38.65	49.81	4.23	20.53	51.74	1.88	16.64	34.61	48.09	331.24
MEAN	**80.94**	**78.92**	**98.37**	**36.27**	**47.59**	**3.55**	**18.22**	**47.52**	**1.55**	**14.95**	**30.22**	**49.53**	**287.78**
S.Em	1.06	0.93	1.28	0.66	0.90	0.05	0.34	0.71	0.03	0.26	0.52	1.44	5.32
Sed	1.49	1.32	1.81	0.93	1.27	0.07	0.48	1.01	0.04	0.36	0.74	2.04	7.53
C.V	2.26	2.05	2.25	3.14	3.28	2.49	3.22	2.60	2.89	2.99	2.99	5.05	3.20
C.D(5%)	3.05	2.69	3.69	1.90	2.60	0.15	0.98	2.06	0.07	0.75	1.50	4.17	15.37
C.D(1%)	4.11	3.63	4.97	2.56	3.50	0.20	1.32	2.78	0.10	1.00	2.03	5.61	20.70

Table.3.Genetic variability parameters in 12 quantitative traits

Traits	GCV	PCV	h^2 (Broad sense)	GENETIC ADVANCE	GA (%) OVER MEAN
Days to 50% flowering	5.67	6.11	86.30	8.79	10.86
Days to pod initiation	5.52	5.88	87.90	8.41	10.65
Days to 50% pod setting	4.20	4.76	77.65	7.49	7.62
Plant height @ 60 DAS	6.49	7.21	80.98	4.36	12.02
Plant height @ 90 DAS	4.82	5.83	68.38	3.91	8.21
Number of Primary branches	19.78	19.94	98.45	1.44	40.43
Number of Secondary branches	13.33	13.71	94.47	4.86	26.68
Number of Pods per plant	9.61	9.96	93.16	9.08	19.12
Number of Seeds per pod	22.93	23.10	98.52	0.73	46.89
Seed yield per plant	12.86	13.21	94.87	3.86	25.81
Biological yield	13.05	13.39	95.02	7.92	26.21
Harvest index	3.27	6.02	29.61	1.82	3.67
Seed index	14.83	15.17	95.54	85.90	29.85

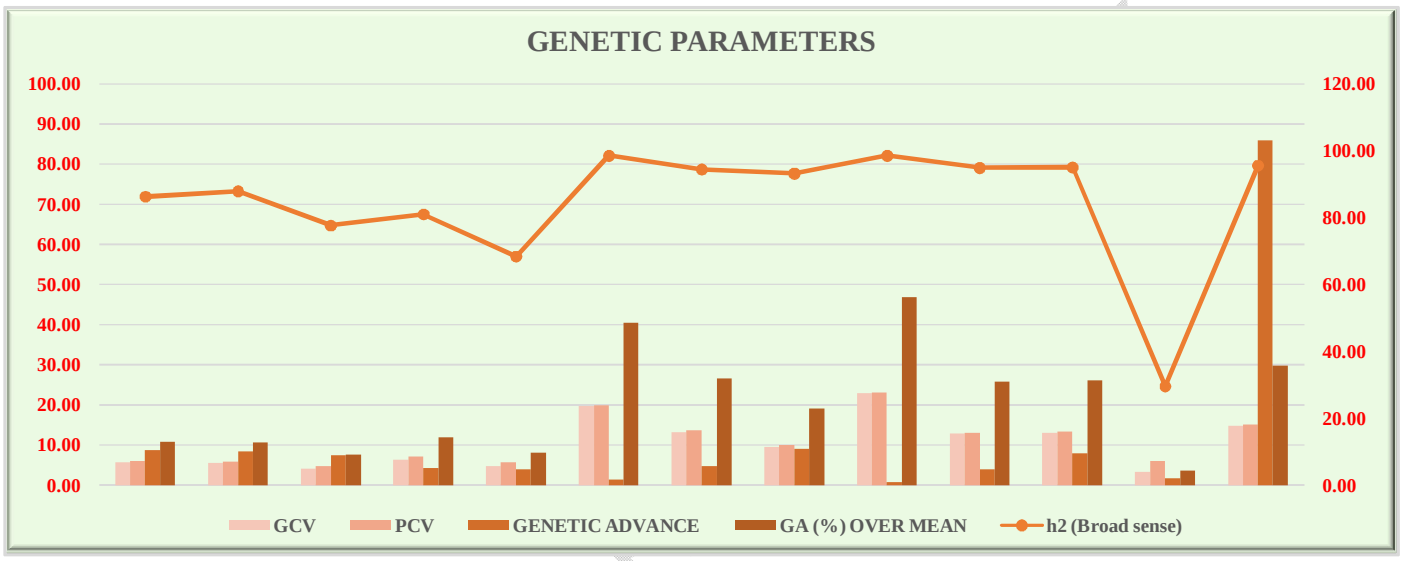

Fig 10.Histogram showing Genotypic Coefficient of Variation and Phenotypic Coefficient of Variation, Genetic advance and h^2 (Broad sense) for 13 quantitative traits in chickpea genotypes