



Plant Archives

Journal homepage: <http://www.plantarchives.org>

DOI Url : <https://doi.org/10.51470/PLANTARCHIVES.2026.v26.no.1.325>

GENETIC DIVERSITY STUDIES IN CHICKPEA (*CICER ARIETINUM* L.) UNDER LATE SOWN CONDITIONS

Sanita Laguri^{1*}, Ravi Kumar¹, Kamleshwar Kumar¹, Savita Ekka², Shivam Mishra³, Yogendra Prasad¹,
Laxmi Kunkal¹, Preeti Kumari¹ and Anup Kumar Ravi¹

¹Department of Genetics and Plant Breeding, Birsa Agricultural University, Kanke, Ranchi - 834 006, India.

²Department of Plant Pathology, Birsa Agricultural University, Kanke, Ranchi - 834 006, India.

³Department of Agricultural Statistics, Birsa Agricultural University, Kanke, Ranchi - 834 006, India.

*Corresponding author E-mail : sanitalaguri.22@gmail.com

(Date of Receiving-18-01-2026; Date of Revision-08-03-2026; Date of Acceptance-28-03-2026)

ABSTRACT

An experiment was conducted during the *Rabi* season (2024-2025) in the Western Section of experimental farm, Department of Genetics and Plant Breeding at Birsa Agricultural University, Ranchi, to assess genetic diversity among Desi chickpea (*Cicer arietinum* L.) genotypes for yield and related traits. Thirty-eight genotypes, including three checks were evaluated in Randomized Block Design with three replications under normal field conditions. Observations were recorded for phenological, morphological, yield and quality traits and genetic divergence was estimated using Mahalanobis D² statistics. Analysis of variance revealed significant differences among the genotypes for all characters, indicating the presence of substantial variability. Phenotypic variance was generally higher than genotypic variance for most of the traits, reflecting environmental influence. Moderate to high heritability coupled with moderate to high genetic advance for several yield-contributing traits viz. suggested the predominance of additive gene action. Genetic divergence analysis grouped the genotypes into six clusters, with maximum inter-cluster distance observed between clusters V and VI, indicating wide genetic diversity. Cluster mean analysis showed that cluster II possessed superior performance for yield and its component traits, while cluster V was characterized by early maturity and higher protein content. The number of pods per plant contributed the maximum to total genetic divergence, followed by plant height and plant stand at harvest. The results suggest that selection of parents from genetically diverse clusters, particularly clusters V and VI, could be effectively utilized in chickpea improvement programmes to enhance yield and associated traits.

Key words : Chickpea, Genetic diversity, Mahalanobis D² statistics, Yield components, Heritability, Cluster analysis.

Introduction

Pulses play a vital role in Indian agriculture due to their contribution to soil fertility, sustainable cropping systems and nutritional security. As leguminous crops enhances the soil health through biological nitrogen fixation and reduce dependency on chemical fertilizers. In the Indian diet, pulses serve as the primary source of protein for a large vegetarian population. Among them Chickpea (*Cicer arietinum* L.) is the most important Rabi season pulse crop, predominantly grown under rainfed conditions using residual soil moisture, particularly in marginal and resource-poor environment. Chickpea is

globally recognized for its high nutritional value, providing quality protein, essential amino acids, dietary fibre and important micronutrients. India is the largest producer of chickpea and the crop plays a significant role in ensuring food and nutritional security as well as improving soil fertility and crop diversification. Despite its importance, chickpea productivity remains relatively low, largely due to limited genetic variability and the complex inheritance of yield and its component traits. Genetic diversity forms the basis of crop improvement programmes and enables the identification of superior genotypes for sustainable yield enhancement. Therefore, the present study was

undertaken to assess the genetic diversity for desirable traits.

Materials and Methods

The experiment was conducted during the *Rabi* season of 2024-2025 at the experimental farm of the Department of Genetics and Plant Breeding, Birsa Agricultural University, Kanke, Ranchi under normal field conditions. A total of 38 Desi chickpea genotypes, including three check varieties, were evaluated in Randomized Block Design with three replications. Each genotype was planted in four rows covering 4.8 m² per plot at a spacing of 30 cm × 10 cm. Observations were recorded on five randomly selected plants per replication, except for days to 50 per cent flowering and days to maturity, which were recorded on a plot basis. Data were collected on days to 50 per cent flowering, days to maturity, plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per pod, hundred seed weight, plant stand at the time of harvesting, seed yield per plant and seed yield per plot. Protein content was estimated using the Micro-Kjeldahl method. The recorded data were subjected to analysis of variance to assess variability among genotypes and genetic diversity was evaluated using Mahalanobis D² statistics.

Results and Discussion

The analysis of variance revealed significant differences among the genotypes for all the characters studied (Table 1), indicating the presence of sufficient variability for effective selection. Similar findings were in agreement with Balasaheb *et al.* (2018) and Thapa *et al.* (2022). The observed variation in mean performance across genotypes for yield and its component traits (Table 2) further confirmed the existence of wide genetic diversity in the experimental materials. Estimates of variance parameters showed that phenotypic variance was generally higher than genotypic variance for most of the traits (Table 3), suggesting the influence of

environmental factors along with genetic effects corroborates with the findings of Singh *et al.* (2017), Ali *et al.* (2019) and Gupta *et al.* (2020). Moderate to high heritability coupled with moderate to high genetic advance for several yield-contributing traits indicated the predominance of additive gene action and the scope for improvement through selection (Table 4). Similar findings were reported by Kumar *et al.* (2020) and Chetariya *et al.* (2019).

Genetic divergence analysis using Mahalanobis D² statistics grouped the thirty-eight chickpea genotypes into six distinct clusters (Table 5), indicating the presence of substantial genetic diversity. Clusters I and II were the largest, each comprising ten genotypes, followed by cluster IV with seven genotypes, clusters III and VI with four genotypes each and cluster V with three genotypes. The maximum inter-cluster distance was observed between cluster V and cluster VI (34.608), suggesting the widest genetic divergence, while the minimum inter-cluster distance occurred between cluster I and cluster II (19.001), indicating close genetic similarity. The highest intra-cluster distance was recorded in cluster VI (12.350), reflecting greater variability within this cluster, whereas the lowest was observed in cluster III (6.508) (Table 6). Similar findings have been reported by Dwevedi *et al.* (2009).

Cluster mean analysis revealed differential performance of genotypes across clusters for yield and related traits (Table 7). Cluster II exhibited superior mean performance for yield per plant and major yield-contributing traits, while cluster V was characterized by early flowering, early maturity and higher protein content. Clusters III and VI showed desirable expression for specific traits such as number of pods per plant and plant height, respectively. Similar findings have been reported by Agrawal *et al.* (2018), Balasaheb *et al.* (2018) and Panwar *et al.* (2024).

The percentage contribution of yield-attributing traits

Table 1 : Analysis of Variance (Mean Sum of Square) for twelve traits in Chickpea.

Source of variation	df	DFP	DM	PH	NPB	NSB	NPP	NSP	HSW	PSH	PC	Y/plant	Y/plot
Replication	2	7.54	7.45	13.13	0.57	83.33	287.61	0.01	0.56	14.24	1.28	2.85	1732.46
Genotypes	37	72.46**	73.76**	126.74**	1.08**	35.37**	640.99**	0.11**	69.38**	45.17*	33.05**	55.89**	16593.77**
Error	74	1.15	1.19	25.22	0.19	7.72	99.88	0.04	0.32	28.14	0.41	5.02	5110.84

** = Significant at 1% and * = Significant at 5 % level of significance

d.f = Degree of freedom, DFP = Days to 50% flowering, DM = Days to maturity, PH = Plant height, NPB = Number of primary branches per plant, NSB = Number of secondary branches per plant, NPP = Number of pods per plant, NSP = Number of seeds per pod, HSW = 100-seed weight, PSH = Plant stand at the time of harvesting, PC = Protein content, Y/plant = Yield per plant, Y/plot = Yield per plot.

Table 2 : Mean Performance of thirty eight genotypes for twelve characters.

S. no.	Genotypes	DFE	DM	PH	NPB	NSB	NPP	NSP	HSW (g)	PSH	PC	Y/plant (g)	Y/plot (g)
1	PG 368	74	122	61.40	4.00	15.60	57.67	1.47	23.27	90.33	14.43	14.83	633.33
2	Phule G 1620-7-5	71	119	55.83	3.57	15.07	56.00	1.37	29.63	91.00	16.17	21.80	600.00
3	BG 372 (NC)	77	125	42.00	4.07	19.73	67.33	1.80	14.70	94.00	18.03	12.50	733.33
4	IPCB 2019-32	78	127	53.00	3.77	17.20	46.33	1.77	22.23	93.33	13.17	11.77	700.00
5	IPC 2019-58	77	125	47.20	4.27	14.80	56.67	1.60	19.17	90.67	19.30	13.37	650.00
6	JG 2024-87	74	122	45.43	3.40	16.87	54.33	1.47	15.13	95.00	12.37	14.63	716.67
7	H 21-30	75	123	63.07	3.93	17.47	86.67	1.37	17.70	92.67	15.63	15.17	600.00
8	BG 4068	67	115	55.93	3.27	13.00	63.67	1.80	24.67	94.33	14.67	13.80	733.33
9	GLD20004	72	121	54.23	4.17	18.20	68.67	1.43	18.17	88.67	17.33	11.60	650.00
10	TSRCH 5(Green)	68	116	48.40	2.50	11.60	36.33	1.70	21.03	94.33	14.00	11.57	650.00
11	Pant G 186 (NC)	75	123	45.13	3.80	20.20	48.67	1.73	17.00	90.00	18.83	16.63	566.67
12	Phule G 171028	78	126	48.53	3.00	14.00	46.33	1.33	25.00	92.00	9.20	13.37	633.33
13	RVSSG-139	72	120	39.60	3.20	11.80	43.33	1.40	23.87	93.33	18.70	17.77	733.33
14	RSGD 1092	66	114	37.23	2.97	11.00	82.00	1.43	19.90	92.00	15.60	11.13	700.00
15	NDG 23-5	72	120	44.00	3.10	11.50	63.67	1.17	25.30	93.67	16.57	9.20	750.00
16	DLC 24-1	79	127	44.60	3.97	22.73	61.67	1.63	16.00	92.67	9.17	7.67	650.00
17	GNG 2299 (NC)	76	125	49.77	3.03	17.80	60.67	1.77	25.27	92.00	17.47	9.53	666.67
18	RVSSG-140	72	120	47.23	4.10	19.13	76.00	1.50	25.33	92.33	16.03	20.23	600.00
19	H 21-03	79	127	53.00	3.87	18.80	59.33	1.47	26.10	94.00	17.70	17.90	766.67
20	GJG 2103	74	123	49.20	3.77	18.40	76.00	1.70	29.83	91.00	18.00	20.23	550.00
21	IPC 2019-230	75	123	51.47	4.73	16.53	51.00	1.53	23.33	87.33	13.53	14.00	566.67
22	GNG-2666	79	127	45.07	3.47	15.20	51.00	1.73	16.27	92.00	10.17	10.20	600.00
23	JG 2024-88	76	125	57.93	3.43	12.40	52.00	1.43	29.43	93.00	10.13	19.53	600.00
24	GLD19076	76	124	58.20	3.57	13.73	34.33	1.30	22.33	88.67	16.57	8.63	633.33
25	NBeG 1137	76	124	50.33	3.63	21.20	80.33	1.70	30.10	89.67	12.17	25.33	550.00
26	BG 4057	74	122	47.83	3.57	15.60	55.00	1.83	29.70	92.33	9.13	19.30	600.00
27	GJG 2114	72	120	44.20	3.30	17.47	49.67	1.53	30.53	85.67	14.77	12.03	550.00
28	GNG-2641	75	123	57.33	3.27	14.27	56.33	1.83	18.53	90.67	15.67	14.00	600.00
29	RSGD 1249	72	120	48.93	4.07	16.47	78.67	1.47	16.03	89.00	17.67	11.70	550.00
30	RKG 24-3	54	102	35.13	1.77	5.93	35.67	1.50	23.80	91.67	17.37	12.53	650.00
31	NBeG 1923	73	121	52.80	2.13	16.93	41.67	1.50	18.20	84.33	8.53	10.47	550.00
32	BG 4058	75	123	52.27	3.13	16.33	44.67	1.60	25.17	91.00	15.47	13.07	600.00
33	PG 367	78	126	52.93	3.07	16.00	44.33	1.53	23.20	80.00	17.20	16.03	450.00
34	BRC 2024-20	76	124	37.43	3.97	12.47	46.00	1.50	16.10	86.67	18.77	7.83	550.00
35	KCD-8102	76	124	49.53	3.40	15.00	46.67	2.03	25.83	89.00	8.87	10.33	583.33
36	BRC 2024-18	67	115	50.33	4.07	21.27	86.67	1.23	20.83	79.00	10.17	12.37	500.00
37	RKG 24-4	78	126	51.27	4.37	21.07	65.00	1.70	29.60	91.33	16.90	20.30	550.00
38	Jammu Chickpea-5	83	131	56.73	3.30	18.27	34.00	1.50	23.07	81.33	17.63	7.07	516.67
	Lowest	54	102	35.13	1.77	5.93	34.00	1.17	15.13	79.00	8.53	7.07	450.00
	Highest	83	131	63.07	4.73	22.73	86.67	2.03	30.53	95.00	19.30	25.33	766.67
	Grand Mean	74	122	49.59	3.53	16.08	56.96	1.56	22.67	90.26	14.82	13.93	617.98
	CV%	1.45	0.89	10.13	12.47	17.28	17.55	12.63	2.51	5.88	4.31	16.09	11.57
	SEm(±)	0.62	0.63	2.90	0.25	1.60	5.77	0.11	0.33	3.06	0.37	1.29	41.27
	CD at 5%	1.74	1.77	8.17	0.72	4.52	16.26	0.32	0.93	8.63	1.04	3.65	116.31
	CD at 1%	0.87	0.89	4.10	0.36	2.27	8.16	0.16	0.46	4.33	0.52	1.83	58.37

Table 3 : Estimates of Genotypic variance, Phenotypic variance and Environmental variance for twelve characters.

Characters	Phenotypic Variance (σ_p^2)	Genotypic Variance (σ_g^2)	Environmental Variance (σ_e^2)
Days to 50% flowering	24.92	23.77	1.15
Days to maturity	25.38	24.19	1.19
Plant height (cm)	59.06	33.84	25.22
No. of primary branches per plant	0.49	0.29	0.19
No. of secondary branches per plant	16.94	9.22	7.72
No. of pods per plant	280.25	180.37	99.88
No. of seeds per pod	0.06	0.02	0.04
100 seed weight (g)	23.34	23.02	0.32
Plant stand at the time of harvesting	33.82	5.68	28.14
Protein content (%)	11.29	10.88	0.41
Yield per plant (g)	21.98	16.96	5.02
Yield per plot (g)	8938.48	3827.64	5110.84

Table 4 : Genetic estimates for twelve characters of 38 genotypes of Chickpea.

Characters	Phenotypic Coefficient of Variation (PCV%)	Genotypic Coefficient of Variation (GCV%)	Heritability (Broad sense)	Genetic Advance	Genetic Advance as per cent of mean
Days to 50% flowering	6.75	6.60	95.39	9.81	13.27
Days to maturity	4.13	4.03	95.33	9.89	8.11
Plant height (cm)	15.50	11.73	57.30	9.07	18.29
Number of primary branches	19.82	15.40	60.37	0.87	24.64
Number of secondary branches	25.59	18.88	54.41	4.61	28.69
Number of pods per plant	29.39	23.58	64.36	22.20	38.97
Number of seeds per pod	15.84	9.56	36.43	0.19	11.88
100-seed weight (g)	21.31	21.17	98.62	9.82	43.30
Plant stand at the time of harvesting	6.44	2.64	16.79	2.01	2.23
Protein content (%)	22.67	22.26	96.39	6.67	45.02
Yield per plant (g)	33.65	29.56	77.14	7.45	53.48
Yield per plot (g)	15.30	10.01	42.82	83.40	13.50

Table 5 : Grouping of 38 genotypes in six clusters.

Cluster	Number of Genotypes	Genotypes
I	10	PG 368, IPC 2019-58, H 21-30, BG 4068, TSRCH 5(Green), IPC 2019-230, GLD19076, GNG-2641, RSGD 1249, BRC 2024-20
II	10	Phule G 1620-7-5, BG 372 (NC), Pant G 186 (NC), DLC 24-1, RVSSG-140, H21-03, NBeG 1137, GJG 2114, BG 4058, RKG 24-4
III	4	IPCB 2019-32, GLD20004, GNG 2299 (NC), GJG 2103
IV	7	JG 2024-87, Phule G 171028, RVSSG-139, GNG-2666, JG 2024-88, BG 4057, KCD-8102
V	3	RSGD 1092, NDG 23-5, RKG 24-3
VI	4	NBeG 1923, PG 367, BRC 2024-18, Jammu Chickpea-5

to genetic divergence revealed that number of pods per plant contributed the maximum (25.30%) to total genetic diversity, followed by plant height (17.82%), plant stand

at harvest (12.16%), days to maturity (11.36%), days to 50% flowering (10.90%) and number of secondary branches per plant (9.41%). Other traits contributed

Table 6 : Average inter and intra cluster distance values among six clusters for 38 genotypes of chickpea.

Cluster No.	Cluster I	Cluster II	Cluster III	Cluster IV	Cluster V	Cluster VI
Cluster I	7.953	19.001	23.122	20.607	25.512	26.445
Cluster II		6.999	21.587	19.907	26.589	25.629
Cluster III			6.508	24.174	26.692	29.543
Cluster IV				8.799	26.802	28.481
Cluster V					12.083	34.608
Cluster VI						12.350

Table 7 : Cluster mean of different traits.

Cluster No.	Cluster Size	DFP	DTM	PH	NPB	NSB	NPP	NSP	HSW	PSH	PC	YPP
I	10	73.47	121.47	52.94	3.76	14.59	56.73	1.56	20.22	90.48	16.02	12.49
II	10	75.33	123.33	48.59	3.78	19.17	60.87	1.60	24.42	91.23	15.52	16.75
III	4	74.75	123.75	51.55	3.68	17.90	62.92	1.67	23.88	91.17	16.49	13.28
IV	7	75.57	123.76	47.70	3.35	14.41	49.81	1.60	23.60	92.43	11.22	15.02
V	3	64.00	112.00	38.79	2.61	9.48	60.44	1.37	23.00	92.44	16.51	10.96
VI	4	75.17	123.17	53.20	3.14	18.12	51.67	1.44	21.33	81.25	13.38	11.48

Table 8 : Per cent contribution of each trait towards genetic divergence.

Source	Contribution %
Days to 50% flowering	10.90
Days to maturity	11.36
Plant height	17.82
Number of primary branches per plant	0.14
Number of secondary branches per plant	9.41
Number of pods per plant	25.30
Number of seeds per pod	0.01
100-seed weight	3.48
Plant stand at the time of harvesting	12.16
Protein content	4.36
Yield per plant	5.07

relatively less, including yield per plant (5.07%), protein content (4.36%) and hundred seed weight (3.48%), while number of primary branches per plant (0.14%) and number of seeds per pod (0.01%) showed minimal contribution. These results indicate that a limited number of key traits predominantly governed genetic divergence among the genotypes (Table 8). Similar findings were reported by Jakhar *et al.* (2016), Agrawal *et al.* (2018), Reddy and Lal (2021).

Conclusion

The grouping of chickpea genotypes into distinct clusters with wide inter-cluster distances confirmed the presence of substantial genetic diversity among the experimental material. The high divergence observed between clusters V and VI, along with marked differences in cluster mean performance, suggests the

potential usefulness of selecting parents from genetically distant clusters for hybridization. The predominance of traits such as number of pods per plant, plant height, plant stand at the time of harvesting and phenological traits in contributing to genetic divergence indicates their key role in governing variability. Overall, the results highlight that effective improvement in yield and associated traits can be achieved by exploiting genetically diverse genotypes and focusing selection on a limited number of major yield-attributing characters.

Acknowledgement

I sincerely acknowledge Birsa Agricultural University, Ranchi, for providing the required facilities and support. Grateful acknowledgment is also extended to the Department of Genetics and Plant Breeding, BAU, Kanke for experimental fields and logistical support.

References

- Agrawal, T., Kumar A., Kumar S., Kumar A., Kumar M, Satyendra and Perween S. (2018). Assessment of Genetic Diversity in Chickpea (*Cicer arietinum* L.) Germplasm under Normal sown condition of Bihar. *Int. J. Curr. Microbiol. App. Sci.*, **7(04)**, 3552-3560.
- Ali, A., Fatima Z., Yasmeen F. and Anwar S. (2019). Morphological and physiological parameters of chickpea genotypes under drought stress. *J. Agricult. Res.*, **57(3)**, 303-314.
- Balasarheb, B.A., Magar A.S., Gadade S.B. and Suresh B.G. (2018). Genetic Diversity studies in Chickpea (*Cicer arietinum* L.) Germplasm. *Int. J. Curr. Microbiol. App. Sci.*, **7(9)**, 2757-2763.
- Chetariya, C.P., Pithia M.S. and Raval L.J. (2019). Spectrum of genetic variation in Desi chickpea (*Cicer arietinum* L.) under normal and late sown condition. *J. Pharmacog.*

- Phytochem.*, **8(5)**, 72-75.
- Dwevedi, K.K. and Lal G.M. (2009). Assessment of genetic diversity of cultivated chickpea (*Cicer arietinum* L.). *Asian J. Agricult. Sci.*, **1(1)**, 7-8.
- Gupta, D., Sharma R., Chauhan R.S. and Singh R. (2020). Response of chickpea (*Cicer arietinum* L.) genotypes to water-limited conditions. *Int. J. Agricult., Environ. Biotechnol.*, **13(2)**, 185-192.
- Jakhar, D.S., Singh R. and Kamble M.S. (2016). Genetic Diversity Studies in Chickpea (*Cicer arietinum* L.) in Kolhapur region of Maharashtra. *Bangladesh J. Bot.*, **45(3)**, 459-464.
- Kjeldahl, J. (1883). New Method for the Determination of Nitrogen. *Chem. News*, **48(1240)**, 101-102.
- Kumar, A., Kumar M., Chand P., Singh S.K., Kumar P. and Gangwar L.K. (2020). Studies on genetic variability and inter relationship among yield and related traits of parents and F₁ population in Chickpea (*Cicer arietinum* L.). *J. Pharmacog. Phytochem.*, **9(3)**, 1434-1438.
- Mahalanobis, P.C. (1936). On the generalized distance in statistics. *Proc. Nat. Inst. Sci. India*, **2(1)**, 49-55.
- Panwar, D., Singh A., Harish R., Lakshmeesha H.B., Sanjay and Vamsidharreddy N. (2024). Assessment of Genetic Diversity among Quantitative Traits of Chickpea Genotypes. *Arch. Curr. Res. Int.*, **24(5)**, 51-58.
- Reddy, M.A. and Lal G.M. (2021). Assessment of genetic diversity for different quantitative traits in chickpea (*Cicer arietinum* L.). *The Pharma Innov. J.*, **10(9)**, 2135-2139.
- Singh, K., Kumar A. and Jain N.K. (2017). Assessment of genetic variability, correlation and path analysis for yield and yield components in chickpea (*Cicer arietinum* L.) under rainfed condition. *J. Pharmacog. Phytochem.*, **6(4)**, 294-298.
- Thapa, R.S., Singh T., Kumar A., Kumar H. and Pratap D. (2022). Genetic divergence, variability and character association analysis in chickpea (*Cicer arietinum* L.) genotypes under normal and late sown conditions. *Elect. J. Plant Breed.*, **13(2)**, 616-623.