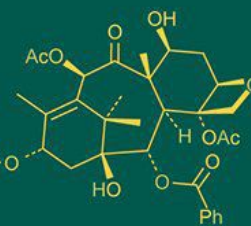
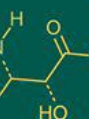
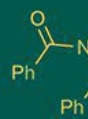
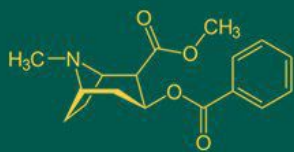


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Estimation of genetic variability, heritability, and genetic advance for quantitative traits in elite urd bean (*Vigna mungo* L.) genotypes under agro-climatic conditions of Chhattisgarh

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Abstract

Pulses play a vital role in global nutrition, yet yield improvement in urdbean (*Vigna mungo* L.) remains constrained by limited genetic diversity. The present study evaluated genetic variability and identified superior genotypes among 21 elite urdbean lines, including three check varieties (KU 96-3, NUL 7, and IPU 1102), through an Initial Varietal Trial (IVT) conducted during *Kharif* 2024 at IGKV, Raipur. The trial was laid out in a Randomized Complete Block Design (RCBD) with three replications, assessing twelve agronomic traits: days to 50% flowering, days to maturity, plant height, number of primary branches, number of clusters per plant, pod length (cm), number of pods per plant, number of seeds per pod, 100-seed weight (g), biological yield per plant (g), harvest index (%), and seed yield per plant (g). Analysis of Variance (ANOVA) revealed highly significant differences among genotypes for all traits, indicating substantial genetic variability. Across all traits, the Phenotypic Coefficient of Variation (PCV) exceeded the Genotypic Coefficient of Variation (GCV), reflecting environmental influence. Notably, clusters per plant (PCV: 22.07%, GCV: 18.45%) and seed yield per plant (PCV: 20.16%, GCV: 11.94%) showed high PCV with moderate GCV, suggesting moderate selection efficiency. High broad-sense heritability was observed for days to 50% flowering (90.18%), 100-seed weight (85.59%), days to maturity (83.15%), plant height (76.33%), and clusters per plant (69.92%). Traits such as plant height and clusters per plant also exhibited high genetic advance (24.66% and 31.79%, respectively), indicating additive gene action and effectiveness of direct selection. Conversely, harvest index showed high moderate heritability with moderate high genetic advance, implying non-additive gene effects.

Keywords: Additive gene action, broad sense heritability, genetic advance, genotypic coefficient of variation, phenotypic coefficient of variation

Introduction

Urdbean (*Vigna mungo* L. Hepper), a crucial self-pollinated diploid legume with a chromosome number of $2n=22$ belongs to the family Fabaceae and sub-family Papilionoideae (Dana, 1980) [2]. This pulse crop thrives across diverse soil and climatic conditions, playing a significant role in enhancing soil fertility through atmospheric nitrogen fixation (Gowda *et al.*, 2013) [6]. As the fourth most important pulse crop in India, following chickpea, pigeon pea, and green gram, urdbean is cultivated across 40.02 lakh hectares, yielding 26.31 lakh tonnes with an average productivity of 657 kg/ha (Directorate of Pulses Development, 2023). In Chhattisgarh, the crop covers 136.31 thousand hectares, producing 55.77 metric tonnes at a productivity of 409 kg/ha (Directorate of Extension Services, 2024; Krishi Darshika, 2024) [4].

Urdbean is recognized as a vital source of dietary protein, containing approximately 24-25% protein, alongside essential minerals such as phosphorus (983 mg/100g), calcium (138 mg/100g), and iron (7.57 mg/100g), and vitamins like niacin (1.447 mg/100g) and thiamine (0.273 mg/100g) (Sakila and Pandiyan, 2018) [10]. The availability of sufficient genetic variability is paramount for any crop improvement program, necessitating the assessment of parameters like phenotypic and genotypic coefficients of variance, heritability and genetic advance to develop high-yielding varieties. The availability of sufficient genetic variability is

paramount for any crop improvement program, necessitating the assessment of parameters like phenotypic and genotypic coefficients of variance, heritability, and genetic advance to develop high-yielding varieties (Deepalakshmi and Kumar, 2004) [3].

Material and Methods

The present investigation was carried out during *Kharif* 2024 at the Research-cum-Instructional Farm, Department of Genetics and Plant Breeding, College of Agriculture, IGKV, Raipur, Chhattisgarh. The experimental material comprised 21 elite urdbean genotypes including three checks, from various research institutes across India (Table.1). The genotypes were evaluated for genetic variability and divergence. The experiment was laid out in a

Randomized Complete Block Design (RCBD) with three replications.

Each plot consisted of six rows, with spacing of 30 cm × 10 cm, and measured 4 × 1.8 m². Seeds were treated with SAAF, PSB, ZSB, and Rhizobium before sowing. Standard agronomic practices were followed throughout the crop season. Pest control was managed using Rocket and Indoxacarb. Data were recorded on 12 quantitative traits including days to 50% flowering, days to maturity, plant height (cm), number of primary branches per plant, number of clusters per plant, pod length (cm), number of pods per plant, number of seeds per pod, 100-seed weight (g), biological yield per plant (g), harvest index (%), and seed yield per plant (g).

Table 1: List of Experimental materials

Sl. No	Genotypes	Source	Sl. No	Genotypes	Source
1	KU 21-12	CSAUA & T, Kanpur	12	LBG 1006	RARS, LAM
2	BCU-22-5	BCKV, Mohanpur	13	RVSU 19-4	Sehore
3	KUG 1065	PAU, Ludhiana	14	SRBV-7029	Sri Rama Agri Genetic Pvt. Ltd
4	PU 2125	GBPUA & T, Pantnagar	15	MBG 1164	ARS, Madhira
5	KU 96-3 (Ch)	CSA, Kanpur	16	BDU 2021-1	ARS, Badnapur
6	DBG 24-16	UAS, Dharwad	17	IPU1102(Ch)	IIPR, Kanpur
7	RUB 15-08	BAU, Ranchi	18	VBG 21-018	NPRC, Vamban
8	RUG 310	RARI, Durgapura	19	IPU 19-8	IIPR, Kanpur
9	JU 24-1	Sagar	20	RU 2021-5	IGKV, Raipur
10	KPU 400-86	ARS, Kota	21	TU-24	BARC, Trombay
11	NUL 7 (Ch)	Nirmal Seed Pvt. Ltd			

Results and Discussion

Analysis of variance revealed highly significant differences among 21 urdbean genotypes for all 12 quantitative traits, indicating the presence of considerable genetic variability (Table.2). These findings are in agreement with earlier reports by Kumar *et al.* (2020) [8] and Aman *et al.* (2022) [1], suggesting ample scope for selection and improvement. Wide ranges were observed in several traits, such as days to 50% flowering (41.33-52.67 days), days to maturity (75.33-83.67 days), and seed yield per plant (3.5-6.2 g), reflecting inherent variability among the genotypes.

Estimates of genotypic and phenotypic coefficients of variation indicated that PCV was higher than GCV for all traits, suggesting environmental influence on trait expression. According to the classification proposed by Sivasubramanian and Madhavamenon (1973) [11] which categorizes variation as low (<10%), moderate (10- 20%),

and high (>20%). High PCV coupled with moderate GCV was recorded for number of clusters per plant (22.07% PCV, 18.45% GCV) and seed yield per plant (20.16% PCV, 11.94% GCV), which indicates the presence of moderate genetic variability with scope for selection. Traits like plant height (15.68% PCV, 13.70% GCV) and Traits like number of harvest index (19.00% PCV, 14.14% GCV), biological yield per plant (18.89% PCV, 11.58% GCV), number of pods per plant (18.52% PCV, 12.01% GCV) and plant height (15.68% PCV, 13.70% GCV) showed moderate values for both parameters, as also observed by Yadav *et al.* (2022) [13]. Low GCV and PCV were recorded in pod length (2.69%, 3.69%), days to maturity (2.62%, 2.87%) and number of seeds per pod (3.06%, 4.50%) (Fig.1), indicating limited variability as reported by Toppo *et al.* (2019) [12] and Jyothsna *et al.* (2016) [7].

Table 2: Variability Assessment for Urdbean Traits Using ANOVA

Sl. No	Characters	DF	Replication [2]	Treatment [20]	Error [40]
1	Days to 50% flowering		1.634	32.86**	1.15
2	Days to maturity		0.571	13.50**	0.85
3	Plant height (cm)		17.497	103.60**	9.70
4	Number of branches per plant		0.026	0.15**	0.06
5	Number of clusters per plant		5.493	13.57**	1.70
6	Pod length (cm)		0.037	0.05**	0.01
7	Number of pods per plant		33.623	38.27**	12.04
8	Number of seeds per pod		0.172	0.19**	0.05
9	100 seed weight (g)		0.024	0.17**	0.01
10	Biological yield (g)		2.741	10.37**	3.70
11	Harvest index (%)		8.201	95.41**	20.17
12	Seed yield per plant (g)		0.268	1.39**	0.53

*** Significant at 1 % probability.

High heritability was observed in days to 50% flowering (90.18%), 100-seed weight (85.59%), and days to maturity (83.15%), plant height (76.33%), and clusters per plant (69.92%), suggesting that these traits are less influenced by the environment and governed by additive gene effects, consistent with Aman *et al.*, (2022) ^[1]. Moderate heritability was found for harvest index (55.42%), pod length (53.30%), number of seeds per pod (46.16%), number of pods per plant (42.07%), and biological yield (37.57%), seed yield per plant (35.09%) and number of branches per plant (31.30%) indicating partial environmental influence. Genetic advance as percent of mean was highest for number

of clusters per plant (31.79%), followed by plant height (24.66%) and harvest index (21.69%), suggesting that these traits could be effectively improved through selection, as also reported by Rajwade *et al.* (2025) ^[9]. Moderate genetic advance was noted in number of pods per plant (16.05%), biological yield (14.62%), seed yield (14.57%), 100-seed weight (11.40%), and days to flowering (13.64%), indicating moderate gain from selection. Low GA as percent of mean was recorded in number of branches per plant (7.96%), days to maturity (4.92%), number of seeds per pod (4.28%) and pod length (4.05%), implying limited scope for improvement in these traits.

Table 3: Genetic variability parameters for yield attributing traits in urdbean genotypes

Sl. No.	Characters	Mean	Max	Min	GCV (%)	PCV (%)	H ² (%)	GA as % of mean
1	Days to 50% flowering (days)	46.63	52.67	41.33	6.97	7.34	90.18	13.64
2	Days to maturity (days)	78.43	83.67	75.33	2.62	2.87	83.15	4.92
3	Plant height (cm)	40.83	56.27	31.73	13.70	15.68	76.33	24.66
4	Number of primary branches per plant	2.51	3.02	2.01	6.90	12.34	31.30	7.96
5	Number of clusters per plant	10.78	15.07	7.13	18.45	22.07	69.92	31.79
6	Pod length (cm)	4.33	4.57	4.11	2.69	3.69	53.30	4.05
7	Number of pods per plant	24.60	32.50	19.10	12.01	18.52	42.07	16.05
8	Number of seeds per pod	7.04	7.73	6.67	3.06	4.50	46.16	4.28
9	100 seed weight (g)	3.89	4.53	3.57	5.98	6.46	85.59	11.40
10	Biological yield per plant (g)	12.88	17.20	9.40	11.58	18.89	37.57	14.62
11	Harvest index (%)	35.41	45.40	26.79	14.14	19.00	55.42	21.69
12	Seed yield per plant (g)	4.50	6.20	3.50	11.94	20.16	35.09	14.57

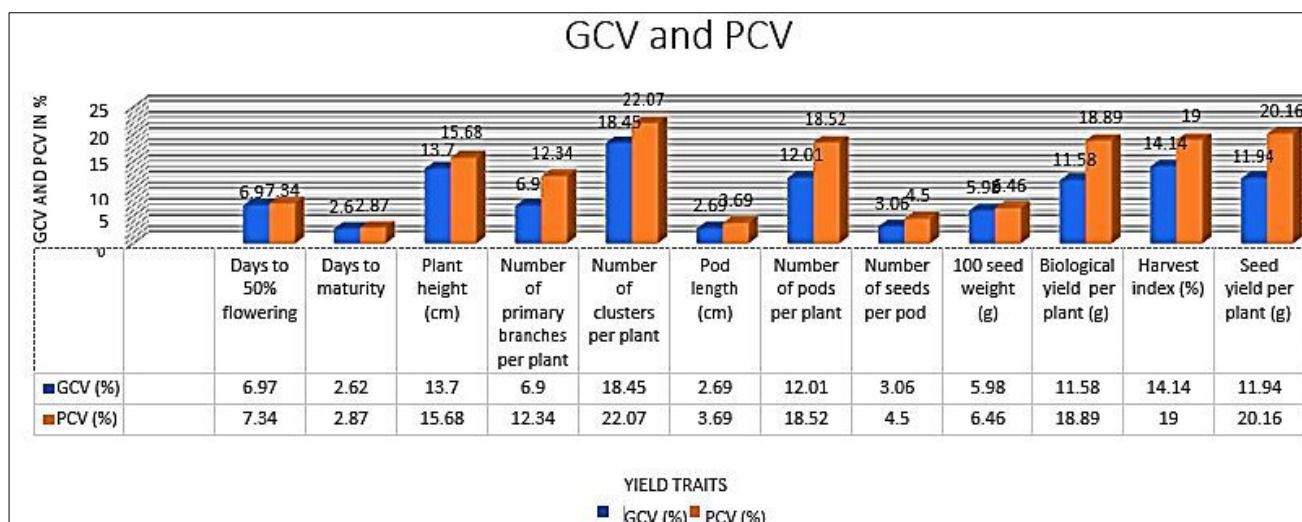


Fig 1: Graphical presentation of genotypic and phenotypic coefficient of variability for yield and its contributing traits

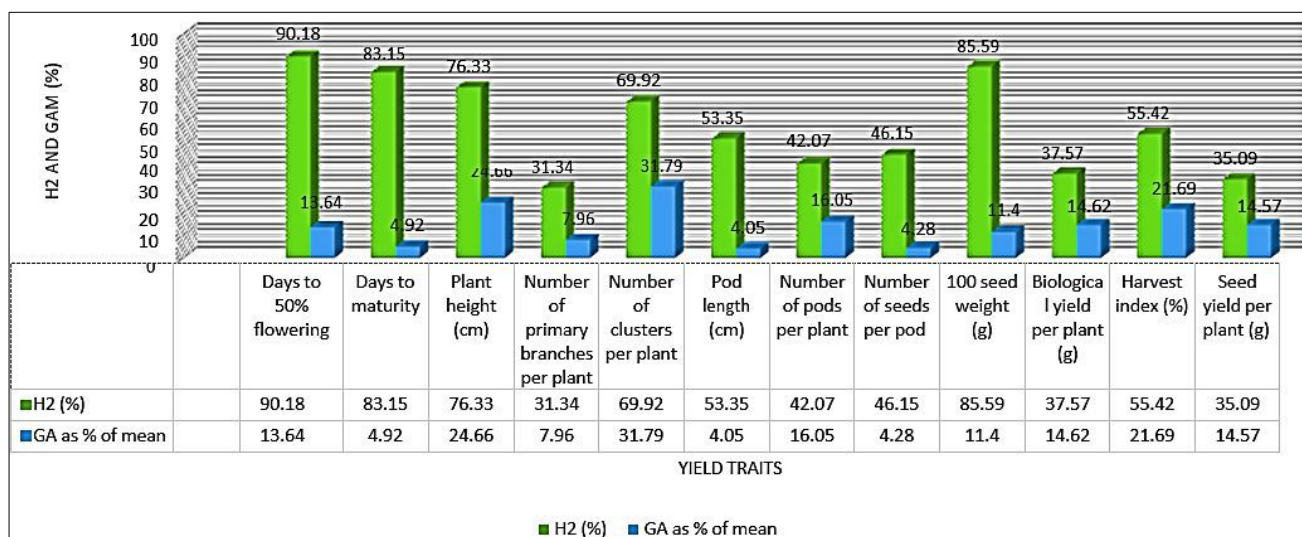


Fig 2: Graphical presentation of heritability and genetic advance as percent of means for yield and contributing traits

Traits such as number of clusters per plant (69.81%, 31.79%), plant height (76.26%, 24.66%), and 100-seed weight (85.59%, 11.40%) exhibited high heritability coupled with high to moderate genetic advance, indicating predominance of additive gene action (Fig.2). These traits can be effectively improved through direct selection (Table.3).

Overall, traits such as clusters per plant, plant height, and harvest index exhibit high genetic variability, heritability, and genetic advance, making them promising selection indices for yield improvement in urdbean.

Conclusion

The phenotypic coefficient of variation exceeded the genotypic coefficient for all traits, indicating notable environmental influence. High heritability coupled with high genetic advance as percent of mean was observed for number of clusters per plant, plant height, and harvest index, suggesting additive gene action. These traits are genetically stable and responsive to selection. Overall, they play a crucial role in enhancing seed yield in urdbean genotypes.

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