



Short Communication

Enumeration of genetic variability parameters among genotypes of Indian Mustard [*Brassica juncea* (L.) Czern & Coss.]

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Abstract

Indian mustard is an important oilseed crop; improving its yield and productivity primarily depends on a deep understanding of the genetic variation and heritability of its yield-contributing traits. In order to assess this, an experiment was conducted using forty Indian mustard genotypes for thirteen quantitative traits at Agricultural Research Station, Ummedganj, Kota during Rabi 2022-23. The experiment laid in Randomized Block Design with three replications. Significant variation was observed among genotypes for all traits. Secondary branches per plant showed the highest PCV, while biological yield, harvest index, 1000-seed weight and primary branches exhibited moderate GCV and PCV. Number of siliquae per plant and seed yield per plant expressed moderate PCV. Minimal differences between GCV and PCV for 1000-seed weight, days to maturity, oil content and days to 50% flowering indicated strong genetic control. Traits such as 1000-seed weight, secondary branches, harvest index and biological yield which exhibited high heritability coupled with high genetic advance as percent of mean were identified as promising targets for improvement through simple selection. The genotypes viz., RKM 544, RKM 513, RKM 562, RKM 593 and RKM 530 were found best five genotypes based on their mean performance for seed yield per plant. Additionally, they performed better in terms of other attributes like number of siliquae per plant, number of secondary branches per plant and harvest index. Therefore, these genotypes have the potential to play a significant role in future endeavours aimed at improving crop productivity, particularly in Indian mustard breeding programmes.

Keywords: Genetic advance, genetic variability, heritability, Indian mustard

Introduction

Rapeseed-mustard, comprising oleiferous *Brassica* species, is an important oilseed group in India and ranks second after soybean in production. Among the four oilseed *Brassica* species, *Brassica juncea* dominates cultivation and contributes about 80% of the total rapeseed-mustard output in the country (Yadava *et al.*, 2011). Mustard seeds contain approximately 38-43% oil, which is considered healthy cooking oil due to its low saturated fat content and the presence of essential fatty acids such as linoleic and linolenic acids (Patel *et al.*, 2012). In India, rapeseed-mustard has emerged as a major commercial oilseed crop, according to the Ministry of Agriculture & Farmers Welfare's *Third Advance Estimates of Agricultural Production 2026*, the crop

occupied nearly 9.43 million hectares, with a production of around 13.77 million tonnes, with an average productivity of approximately 1461 kg/ha. However, the crop's performance varies widely across regions, as it is largely grown under rainfed or resource-poor conditions and often lacks access to improved, stress-resilient cultivars. As a result, despite its strong production base, India remains heavily dependent on imports to meet its edible oil needs, sourcing nearly 57% of its requirement from international markets, which places it among the world's major edible oil importers (Jat *et al.*, 2019).

Genetic improvement remains a key strategy to address this productivity gap. The presence of sufficient genetic variability in yield and related traits is a prerequisite for effective crop improvement, as it determines the scope

for selection and parent choice in breeding programmes (Sharma *et al.*, 2025). In Indian mustard, the evaluation of variability through parameters such as genotypic and phenotypic coefficients of variation, along with heritability and genetic advance, offers a reliable understanding of the inheritance pattern of economically important traits (Meena *et al.*, 2017). Since seed yield is a complex trait governed by multiple genes and strongly affected by environmental conditions, indirect selection through its component traits becomes essential. Heritability estimates indicate the extent to which observed variation is genetically controlled, whereas genetic advance as a percentage of the mean provides an estimate of the expected improvement from selection and highlights the role of additive gene effects (Rathore *et al.*, 2023). Thus, the present study was undertaken to evaluate genetic variability, heritability and genetic advance for yield and yield-related traits in Indian mustard, with the objective of identifying superior genotypes and enhancing selection efficiency for yield improvement.

Materials and Methods

The forty Indian mustard genotypes were evaluated during the *Rabi* season of 2022-23 at the Agricultural Research Station, Ummedganj, Kota, Rajasthan. The experiment was laid out in a Randomized Block Design with three replications. Each genotype was grown in three rows of 4 m length, maintaining 30 cm row spacing and 10 cm plant spacing. Standard agronomic practices and required plant protection measures were uniformly followed throughout the crop period. Observations on plant height (cm), number of primary and secondary branches per plant, number of siliquae per plant, length of silique (cm), number of seeds per silique and 1000-seed weight (g) were recorded from five randomly selected plants per plot, whereas biological yield per plant (g), seed yield per plant (g) and harvest index (%) were estimated using the mean of ten plants. Days to 50% flowering, days to maturity and oil content (%) were recorded on a plot basis. Analysis of variance was performed following Panse and Sukhatme (1985), genotypic and phenotypic coefficients of variation were estimated as per Burton (1952), broad-sense heritability and genetic advance were calculated according to Allard (1960) and Johnson *et al.* (1955), respectively. GCV and PCV were further classified into three distinct categories as described by Shivasubramanian and Menon (1973). Heritability and genetic advance as % mean were also categorized into three classes as suggested by Robinson *et al.* (1949) and Johnson *et al.* (1955), respectively. Statistical analysis was carried out using Indostat software (version 8.2).

Results and Discussion

Analysis of variance

Analysis of variance showed highly significant differences for all thirteen traits as presented in Table 1, demonstrating presence of substantial genetic variability within the evaluated germplasm lines. Similar noteworthy variability for yield and its contributing traits have been also reported by Devi (2018), Singh *et al.* (2018), Chaurasiya *et al.* (2019), Rout *et al.* (2019), Akoju *et al.* (2020), Patel *et al.* (2021) and Nishad *et al.* (2022).

Mean performance of yield and its contributing traits

The mean performance of forty Indian mustard genotypes for all the studied traits is shown in Table 2. The mean value of days to 50% flowering and days to maturity were 46.28 days and 127.68 days, respectively. RKM 564, RKM 526, RKM 530 and Pusa Mahak were early maturing genotypes in this study. Plant height showed considerable variation, with RKM 571 being the shortest height genotype. The average number of primary and secondary branches per plant was 4.48 and 7.41, respectively, with RKM 513 exhibiting the highest branching ability. The number of siliquae per plant ranged widely from 185.30 to 263.57 with an average 206.64 and RH 725 recorded the highest values. Length of silique and number of seeds per silique also varied significantly, with RKM 593 performing best for both traits. The 1000-seed weight ranged from 3.77 to 7.14 g, with RKM 593 recording the highest value. Biological yield per plant ranged from 43.45 to 81.34 g with a mean 57.73 g and IC-597910 showed superior performance. Harvest index varied from 14.48% to 28.24% and oil content from 37.76 to 41.55%, with RKM 594 exhibiting the highest value for both the traits. Graphical representation of all the genotypes on the basis of seed yield per plant is shown in figure 1. Seed yield per plant varied from 9.90 g to 15.61 g, with RKM 544 recording the highest yield, followed by RKM 513, RKM 562, RKM 593, RKM 530 and RH 725. So, result exhibited a large variation for phenological, morphological, yield and quality traits, indicating substantial scope for selection. These findings are in agreement with earlier reports by Meena *et al.* (2017), Rout *et al.* (2019), Nishad *et al.* (2022) and Kumar *et al.* (2023).

Estimation of genetic variability parameters

The coefficient of variation, heritability in broad sense and genetic advance as percentage of mean was performed for all the thirteen characters, with the result presented in Table 3. The estimates of PCV were consistently higher than GCV across all the traits studied.

Table 1: Analysis of variance (ANOVA) for yield and its contributing traits in Indian mustard

Sources of variation	df	Mean sum squares												
		Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches/plant(no.)	Sec. branches/plant(no.)	Siliquae per plant (no.)	Siliqua length (cm)	Seeds/siliqua (no.)	1000-seed weight(g)	Biological yield/plant (g)	Harvest index (%)	Oil content (%)	Seed yield/plant (g)
Replications	2	1.53	0.48	23.00	0.08	0.54	49.72	0.10	0.08	0.01	4.43	0.90	1.45	0.15
Genotypes	39	19.57**	16.48**	480.97**	0.86**	6.50**	1115.73**	0.42**	4.22**	1.41**	233.66**	4.86**	29.02**	2.33**
Error	78	0.53	0.88	25.20	0.17	0.19	92.76	0.09	0.15	0.01	41.32	1.31	1.82	0.12

** Significant at 1% level; df = Degree of freedom

Secondary branches per plant exhibited the highest PCV, while 1000-seed weight, harvest index, number of primary branches per plant and biological yield per plant showed moderate PCV and GCV. Number of siliquae per plant and seed yield per plant expressed moderate PCV. These results are in close agreement with earlier reports by Verma *et al.* (2016), Yadav *et al.* (2017), Maurya *et al.* (2018), Rout *et al.* (2019), Swetha *et al.* (2019), Pandey *et al.* (2020), Nishad *et al.* (2022) and Kumar *et al.* (2023). Low PCV and GCV were observed for number of seeds per siliqua, plant height, days to 50% flowering, oil content, days to maturity and length of siliqua, indicating limited variability for these traits. Similar results for length of siliqua earlier reported by Rout *et al.* (2019) and Lakra *et al.* (2020). A relatively wide difference between PCV and GCV was recorded for biological yield per plant, seed yield per plant, number of primary branches per plant and length of siliqua, suggesting a strong environmental influence on their expression. In contrast, 1000-seed weight, days to maturity, oil content, days to 50% flowering, number of seeds per siliqua, plant height and number of secondary branches per plant showed narrow differences between PCV and GCV, indicating predominance of genetic control and greater reliability for selection.

Heritability and genetic advance as percentage of mean varied from 47.49 to 98.22% and 3.41 to 38.66%, respectively. Most of the characters showed high heritability in this study except length of siliqua, number of primary branches per plant and seed yield per plant having moderate heritability. This result is agreement with earlier reports by Maurya *et al.* (2018), Narayan *et al.* (2022) and Choudhary *et al.* (2023). High heritability coupled with high genetic advance was observed for 1000-seed weight, number of secondary branches per plant, harvest index and biological yield per plant, indicating predominance of additive gene action and effectiveness of direct selection. Similar result for most of the traits reported by Mohan *et al.* (2017), Maurya *et al.* (2018), Ray *et al.* (2019), Rout *et al.* (2019), Mandal *et al.* (2022), Mishra *et al.* (2022) and Choudhary *et al.* (2023). High heritability with moderate genetic advance was recorded for days to 50% flowering, number of seeds per siliqua, plant height and number of siliquae per plant, suggesting involvement of both additive and non-additive gene action. Similar findings for number of seeds per siliqua and number of siliquae per plant were also recorded by Tiwari *et al.* (2017), Maurya *et al.* (2018), Mandal *et al.* (2022) and Mishra *et al.* (2022). Oil content and days to maturity showed high heritability but low genetic advance, indicating non-additive gene action and suitability for heterosis breeding. Moderate heritability accompanied with moderate genetic advance was

Table 2: Range and mean performance of forty Indian mustard genotypes for thirteen characters studied

Genotype	Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches/ plant(no.)	Sec. branches/ plant(no.)	Siliquae per plant (no.)	Siliqua length (cm)	Seeds/ siliqua (no.)	1000- seed weight(g)	Biological yield/ plant (g)	Harvest index (%)	Oil content (%)	Seed yield/ plant (g)
RH749	47.00	129.67	162.67	4.93	7.07	203.90	5.79	12.83	5.41	56.74	23.76	40.18	13.47
RH725	47.00	127.33	172.00	4.87	10.27	263.57	6.34	15.70	5.60	57.94	25.65	40.05	14.83
DRMRJ31	48.67	127.33	165.00	4.90	9.83	246.03	5.85	13.67	5.51	61.98	23.84	40.66	14.77
NRCHB101	47.67	131.33	173.67	5.20	7.13	236.10	5.46	12.07	5.44	59.27	22.73	40.94	13.38
PM 27	46.00	129.00	178.00	4.80	6.03	195.50	6.08	13.20	5.44	56.45	25.61	41.37	14.46
NP1231	45.00	125.00	189.00	3.30	5.20	194.87	5.29	13.53	4.65	64.88	21.65	39.79	14.04
NP1232	48.33	129.67	165.67	4.07	7.30	204.57	5.82	13.80	4.73	56.05	21.09	41.38	11.83
RVM2	44.00	129.00	170.33	4.40	8.67	197.87	6.02	12.87	5.35	57.67	21.08	39.08	12.14
Uravashi	48.33	127.33	194.33	4.53	5.77	211.33	5.67	13.87	5.40	65.15	19.99	40.34	13.00
DRMR 2059	51.67	131.67	168.67	4.40	8.33	216.63	5.85	13.27	4.95	51.67	21.96	39.80	11.36
Kranti	48.00	128.33	183.00	4.93	9.40	191.27	5.47	12.20	4.79	57.56	23.53	39.57	13.54
PM 30	49.33	129.67	171.67	4.87	7.77	207.90	5.78	13.03	4.39	48.66	26.28	39.82	12.77
Pusa Mahak	44.33	124.67	168.33	4.40	5.13	196.27	5.49	12.57	4.52	50.47	23.61	39.77	11.88
Pusa Tarak	45.67	126.33	158.33	4.27	5.90	210.50	5.07	12.37	4.57	53.76	24.19	39.02	12.93
RH30	45.67	125.67	174.00	5.33	8.67	237.93	5.59	12.53	4.26	49.68	24.29	38.94	12.06
IC-597889	45.33	127.67	159.67	4.37	9.20	190.17	5.44	11.63	3.77	44.00	22.41	39.67	9.89
IC-597910	49.67	129.33	160.00	4.30	5.30	188.17	5.47	11.30	4.01	81.33	14.48	39.72	11.74
GM3	45.67	130.01	179.00	4.07	5.27	186.80	5.81	13.53	4.05	61.83	19.15	39.66	11.83
RGN48	44.33	127.00	168.00	4.27	6.97	185.43	4.68	12.40	4.77	62.96	19.36	40.31	11.98
JM 1	50.43	128.00	160.00	3.83	7.30	197.20	5.36	13.00	4.26	63.37	18.27	41.14	11.62
CS54	43.33	128.67	192.67	5.13	7.90	200.53	5.66	13.93	4.47	66.38	19.56	38.96	12.98
EJ20	46.67	125.67	206.67	3.97	6.67	186.93	5.74	13.67	4.49	63.35	20.06	38.96	12.70
RKM 54-1	50.37	130.67	195.67	4.47	7.77	192.63	5.88	13.17	4.72	51.32	25.79	40.81	13.21
RKM 54-2	43.67	124.67	178.67	4.60	7.97	227.27	5.70	13.13	5.32	53.65	24.87	39.36	13.34
RKM 513	46.67	125.67	173.00	5.80	11.60	244.83	5.45	13.33	3.89	76.17	20.16	40.92	15.19
RKM 526	48.33	122.67	163.67	4.90	8.83	204.40	5.47	12.67	4.15	55.66	21.10	41.30	11.74
RKM 530	42.33	123.33	164.00	4.77	8.93	208.47	4.98	12.33	4.09	73.03	20.61	39.18	15.00
RKM 536	48.33	130.03	156.00	4.07	7.50	201.70	5.04	13.93	4.93	59.72	19.73	40.15	11.75
RKM 544	50.33	127.67	164.00	4.60	7.20	247.83	5.81	13.07	5.12	62.11	25.13	37.76	15.61
RKM 546	42.34	125.67	155.67	4.20	6.07	199.67	5.03	13.23	4.28	49.60	25.65	39.83	12.74
RKM 559	47.67	126.33	167.33	4.13	6.27	202.90	5.80	13.27	4.51	68.89	19.28	41.10	13.26
RKM 561	41.33	127.00	164.00	4.80	6.73	209.77	5.80	15.30	4.48	52.92	24.96	40.57	13.21
RKM 562	44.33	127.00	186.67	4.60	8.13	208.70	5.67	11.23	4.88	54.77	27.50	40.21	15.04
RKM 564	44.67	121.67	167.67	5.70	8.60	201.60	5.09	14.87	4.14	70.12	18.98	39.77	13.05

RKM 571	45.33	130.00	146.00	4.17	6.57	191.60	5.71	12.73	5.28	45.12	26.76	41.48	12.06
RKM 587	44.67	129.00	174.33	3.97	6.83	197.93	5.82	15.93	5.16	48.55	25.20	40.44	12.24
RKM 588	47.67	128.67	161.00	3.70	6.37	188.17	5.87	12.70	5.40	43.82	27.55	39.89	12.06
RKM 590	43.33	129.33	166.33	3.80	6.67	185.30	5.88	13.53	5.39	50.77	25.25	41.35	12.81
RKM 593	42.43	129.67	172.00	4.03	6.53	202.17	6.51	16.47	7.13	58.25	25.80	41.04	15.02
RKM 594	45.33	129.67	152.67	3.87	6.57	201.20	6.20	15.47	6.40	43.45	28.24	41.55	12.23
Minimum	41.33	121.67	145.80	3.30	5.13	185.30	4.68	11.23	3.77	43.45	14.48	37.76	9.89
Maximum	51.67	131.67	206.67	5.80	11.60	263.57	6.51	16.47	7.13	81.33	28.24	41.55	15.61
Mean	46.28	127.68	170.73	4.48	7.41	206.64	5.64	13.33	4.86	57.73	22.88	40.15	12.97
SE	0.60	0.77	4.05	0.34	0.36	7.86	0.24	0.32	0.08	5.25	1.10	0.29	0.93
CD @ 5%	1.19	1.52	8.16	0.68	0.71	15.66	0.47	0.63	0.15	10.45	2.19	0.57	1.86
CV%	1.58	0.73	2.94	9.27	5.90	4.66	5.16	2.90	1.90	11.13	5.89	0.88	8.83

Table 3: Estimates of coefficient of variation, heritability and genetic advance as % of mean for thirteen characters in Indian mustard

Characters	GCV (%)	PCV (%)	Heritability % (broad sense)	Genetic Advance	Genetic Advance as % of Mean
Days to 50% flowering	5.44	5.67	92.24	4.98	10.77
Days to maturity	1.79	1.93	85.58	4.35	3.41
Plant height (cm)	7.23	7.79	86.13	23.61	13.83
No. of primary branches per plant	10.72	14.17	57.19	0.75	16.70
No. of sec. branches per plant	19.60	20.46	91.70	2.86	38.66
No. of siliquae per plant	8.94	10.08	78.61	33.73	16.32
Length of siliqua (cm)	5.98	7.90	57.25	0.53	9.32
No. of seeds per siliqua	8.74	9.21	90.09	2.28	17.09
1000-seed weight (g)	14.12	14.24	98.22	1.40	28.82
Biological yield per plant (g)	13.87	17.79	60.81	12.86	22.28
Harvest index (%)	13.16	14.42	83.29	5.66	24.74
Oil content (%)	2.14	2.31	85.60	1.63	4.07
Seed yield per plant (g)	8.39	12.18	47.49	1.55	11.91

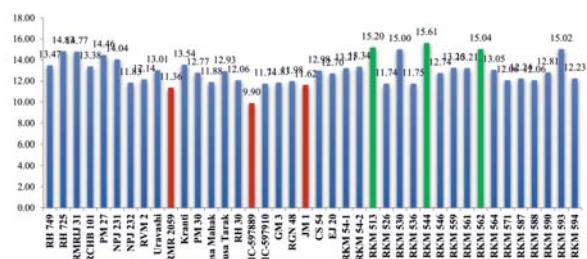


Fig. 1: Graphical representation of general performance of all the genotypes on the basis of seed yield per plant (g)

observed for number of primary branches per plant and seed yield per plant, align with previous studies by Akabari and Niranjana (2015) and Singh *et al.* (2018).

Conclusion

Statistical analysis revealed significant variation among all genotypes for the thirteen traits, indicating substantial genetic diversity and potential for selecting superior lines for genetic improvement in Indian mustard. Among the traits, secondary branches per plant showed the highest PCV, while biological yield, harvest index, 1000-seed weight and primary branches exhibited moderate GCV and PCV. Most of the traits had high heritability, except length of siliqua, primary branches and seed yield. High heritability combined with high genetic advance exhibited by 1000-seed weight, secondary branches, harvest index and biological yield suggests additive gene action suitable for improvement through simple selection. RKM 544, RKM 513, RKM 562, RKM 593 and RKM 530 performed better for seed yield and its contributing traits, making them highly promising candidates for improving future Indian mustard crops.

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