ORIGINAL RESEARCH PAPER

Volume-8 | Issue-6 | June-2019 | PRINT ISSN No. 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

STUDIES ON HERITABILITY AND GENETIC ADVANCE OF INDIAN MUSTARD (*BRASSICA JUNCEA* L.)

Agricultural Science

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KEYWORDS

INTRODUCTION

Rapeseed-mustard (*Brassica juncea* L.) is the second important oilseed crop of the country after soybean and plays a very significant role in the oil economy by contributing about 30 percent to the total oilseed production. The genus *Brassica* mainly includes *Brassica juncea*, *Brassica carinata* and *Brassica napus* as tetraploid species and *Brassica rapa*, *Brassica nigra* and *Brassica oleracia* as diploid species. *Brassica juncea* is a major winter oil seed crop of India occupying 6.39 m ha with total production of 7.41m tones and average productivity of 1104kg/ha (Anonymous, 2010). India occupies third position among the mustard growing countries in the world India stands first both in acerage and production of rapeseed and mustard in Asia. The crops are cultivated in an area of 70 lakh ha with a production of 81 lakh tonnes and with an average yield of 1149 kg/ha (Anon., 2006).

Indian mustard is the second most important source of edible oil after soybean. The oil content of the seeds ranges from 35 to 48 per cent. The oil obtained is the main cooking medium in northern India and cannot be easily replaced by the any other edible oil. The seeds and oil are used as a condiment in the preparation of pickles and for flavouring curries, lubricants, hair oil and medicines. The oil cake is mostly used as a cattle feed. The leaves of young plants are used as green vegetable. The use of mustard oil for industrial purpose is rather limited on account of its high cost.

Though this crop is grown all over the country in one or the other from, however, Rajasthan, Uttar Pradesh, Madhya Pradesh, Gujarat, Punjab, Haryana, Bihar, Orissa, Himachal Pradesh and West Bengal are the major rapeseed growing states. A large number of high yielding area specific varieties have been developed in Indian mustard but unfortunately ,in spite of having the varieties with the yield potential of 2.0-2.5t/ha, our national average is very low as compared to the rapeseed growing countries of the west. Moreover, yield level is also not sustainable and fluctuates year after year leading to fluctuation in area and production. The fluctuation is because of many factors like growing of this crop on marginal lands either rain fed or with limited irrigation facilities, non-availability of resistance/tolerance varieties for biotic and abiotic stresses for difference sowing condition, hence, the yield levels fluctuate year after year.

The major biotic stresses as have been reported in the AICRP Rapeseed Mustard Annual reports are white rust and aphids. The crop is more vulnerable to these biotic stresses when the weather is favourable for pathogens /pests and the chances of their incidence increase further when the temperature at the time of sowing are two major recurrent constrains along with frost which affected this crop intermittently.

Yield is a complex character dependent on a number of other characters. Improvement of crop plants depends upon the magnitude of genetic variability of different quantitative characters. Therefore, the measurement evaluation and manipulation as genetic variability in desired direction becomes extremely important in any yield improvement programme. The extent of genetic variability in specific breeding population depends upon the genotypes included in it. Heritability and genetics advance are important selection parameters. Heritability estimates along with genetics advanced are normally more helpful in predicting genetics gain under selection than heritable estimates alone (Johnson *et al*.1955).

The correlation coefficient gives an idea about the associations exist between yield and its components. However, it is a well-known fact that correlation mainly does not fulfil the purpose because it does not fulfil the purpose because it does not affect the characters having indiect effects on seeds yield. In such situation path coefficient analysis developed by wright (1921) would give the real importance such characters of partitioning the correlation coefficient in to direct and indirect effects. Genetic divergence helps the breeder, for identifying diverse genotypes for hybridization to exploit heterosis and to get desirable sergeants and considered to be the important tools in quantifying the genetic divergence in different crops.

MATERIALS AND METHODS

The present investigation entitled "**Studies on Genetic Divergence in Indian mustard (*Brassica juncea*L. Czern and Coss)**" were conducted during 2010-2011 at the Research Farm of Janta Vedic College, Baraut, Baghpat (U.P.). The details of the materials and methods are given below:

Experimental materials: The material for this study consisted of 39 genotypes were obtained from the NBPGR, New Delhi.

S.No.	Genotypes	S.No.	Genotypes	S.No.	Genotypes
1	IC9841	14	IC363942	27	IC399857
2	IC10965	15	IC366460	28	IC399853
3	IC10967	16	IC375924	29	IC399854
4	IC10977	17	IC375925	30	IC399877
5	IC11765	18	IC399788	31	IC399878
6	IC320641	19	IC399795	32	IC417020
7	IC320648	20	IC399797	33	IC426336
8	IC329705	21	IC399808	34	IC426357
9	IC335854	22	IC399841	35	IC446900
10	IC347949	23	IC399816	36	IC491257
11	IC360723	24	IC399826	37	IC491283
12	IC360749	25	IC399839	38	IC491313
13	IC360770	26	IC399840	39	IC491330

Experimental details

The thirty nine genotypes of Indian mustard (*Brassica juncea*L. Czern and Coss) were grown during *rabi* season on 2 Nov. 2010 at Research Farm of Janta Vedic College Baraut, Baghpat (U.P.). Experimental farm is situated at the western boundary of Uttar Pradesh 20°, 6N and 77°,15E, 226.80 meters above the mean sea level.

The soil of experimental plot was heavy loam and represent western plains between Ganga and Yamuna rivers, Climate of the area is semi–arid and subtropical during *rabi* season in 2010-2011.

The thirty nine genotypes of Indian mustard (*Brassica juncea* L. Czern and Coss) were shown in a Randomized Block Desing (RBD) with

three replications at the Research Farm of Janta Vedic College Baraut, Baghpat (U.P.). The length of the row kept 2.5 meters and spacing between the rows 45 cm and between plants 15 cm, respectively. Five competitive plants from each plot were randomly selected from all three rows for recording data. Observations of all the characters were recorded on single plant basis except for days to flowering and days to maturity. Average of these selected five plants in respect of different plant characters were used for statistical analysis.

Days to 50% flowering, Days to 80% maturity, Plant height (cm) ,Number of primary branches per plant, Number of secondary branches per plant, Length of siliqua (cm), Number of seeds per siliqua,1000-seed weight (g), Biological yield per plant (g), Harvest index (%),Oil content and Seed yield per plant (g).

3.4.3. Coefficient of variation:
Genotypic and phenotypic coefficients of variation were estimated by the formula suggested by Burton and De Vane (1953). Heritability in broad sense were calculated according to the formula suggested by Allard (1960) and the expected genetic advance were calculated at 5% selection intensity for each character.

Experimental results
The analysis was done in respect of 12 characters including yield and component traits along with flowering and maturity. Their performances in respect of genetics analysis of variance, character association and cluster pattern in relation to all the 12 traits have been judged.

Mean performance
The mean values of various characters are presented in Table 2.

4.2.1 Days to 50% flowering
The mean days to 50% flowering was 73.35 days and its ranged from 50.33 to 87.00 days. Genotypes IC 347947 and IC 375924 required minimum days (50.33) while genotypes IC 399788 took maximum days for flowering (94.00) days.

4.2.2 Days to 75% maturity
The mean days to 75% maturity was 132.60 days and its ranged from 119.00 to 142.00 days. Genotype IC 366460 required minimum days (119.00) while the genotype IC 399826 took maximum days for maturity (142.00).

4.2.3 Plant height (cm)
The mean plant height was 196.82 cm and its ranged between 142.07 to 230.27. It was lowest in the genotype IC 347947 (142.07 cm) and highest in the genotype IC 399814 (230.27 cm).

4.2.4 Number of primary branches per plant
The mean number of primary branches per plant was 9.84 and its ranged between 6.47 to 12.67. The maximum number of primary branches per plant (12.67) recorded in the genotype IC 399808 and lowest number of primary branches per plant was recorded in IC 347947 (6.47).

4.2.5 Number of secondary branches per plant
It is indicated that genotype IC 399854 produced minimum number of secondary branches per plant (11.27). While for the genotype IC 426336 recorded maximum number of secondary branches per plant (40.60). The mean of this character was 22.71 and ranged between 11.27 to 40.60.

4.2.6 Length of siliqua (cm)
The mean length of siliqua was 4.06 cm and it ranged between 2.39 to 5.86 cm. The maximum length of siliqua 5.86 cm recorded in the genotype IC 491283 and minimum length of siliqua 2.39 cm was recorded on the genotype IC 399826.

4.2.7 Number of seeds per siliqua
The maximum number of seeds per siliqua was recorded from the genotype IC 10965 (23.47), whereas, the minimum number of seeds per siliqua was produced by IC 491257 (11.53). The mean of this character was 14.93 ranged between 11.53 to 23.47 number of seeds per siliqua.

4.2.8 1000- seeds weight (g)
The mean 1000-seeds weight was 2.93 and ranged between 1.07 g to 5.73 g. It is indicated that genotype IC 399854 produced minimum weight of 1000-seeds (1.07g), while genotype IC 375924 recorded maximum weight of 1000-seeds (5.73 g).

4.2.9 Biological yield per plant (g)
With respect to biological yield per plant genotype IC 9841 produced highest biological yield (209.80g) per plant, while the lowest biological yield per plant (31.60 g) per plant by IC 426336. The mean of this character was (77.83g) and ranged between 31.60 g to 209.80 g.

4.2.10 Harvest index (%)
Genotype IC 399878 had maximum harvest index (35.88%) and genotype IC 347947 showed lowest value of harvest index (16.28%). The mean of this character was 25.14% and ranged between 16.28% to 35. 88%.

4.2.11 Oil content (%)
The oil content in Indian mustard varied from 36.30% (IC 339826) to 44.63% (IC 399857). Whereas, mean oil content were recorded 40.01%.

4.2.12 Seed Yield Per Plant (g)
The mean seed yield per plant was 19.85 g and it ranged between 8.67 g to 69.87 g. The genotype IC 9841 exhibited highest seed yield per plant (69.87g), whereas genotype IC 399854 exhibited minimum value of seed yield (8.67g) per plant

Heritability and expected genetic advance
The heritability estimates in broad sense (Table 2) ranged from 86.7 per cent for harvest index to 99.9 per cent for biological yield per plant. The highest value of heritability estimate was also recorded for biological yield per plant (99.9%) followed by plant height (99.8%), 1000-seed weight (99.7%), oil content (99.6%), number of secondary branches per plant (99.2%), day to 50% flowering (98.8%), seed yield per plant (98.8%), length of siliqua (97.6%) and number of seeds per siliqua (96.82). However, moderate value of heritability was observed for days to 75% maturity (95.5%) and number primary branches per plant (91.0%). Lowest value of heritability was observed for harvest index (86.7%).

Expected genetic advance as per cent of mean at 5% selection intensity ranged from 9.38 for day to 75% maturity to 114.40 for seed yield per plant. The higher GA as per cent of mean was recorded for biological yield per plant (91.85), 1000-seed weight (86.17) and number of secondary branches per plant (70.12). While moderate values of expected genetic advance as per cent of mean was observed for length of siliqua (34.67), harvest index (33.68), number of primary branches per plant (33.34), number of seeds per siliqua (32.53), days to 50% flowering (28.65) and plant height (20.24). Low values of expected genetic advance as per cent of mean was observed for day to 75% maturity (9.83) and oil content (9.62).

Heritability and expected genetic advance
The heritability estimates in broad sense (Table 3) ranged from 86.7 per cent for harvest index to 99.9 per cent for biological yield per plant. The highest value of heritability estimate was also recorded for biological yield per plant (99.9%) followed by plant height (99.8%), 1000-seed weight (99.7%), oil content (99.6%), number of secondary branches per plant (99.2%), day to 50% flowering (98.8%), seed yield per plant (98.8%), length of siliqua (97.6%) and number of seeds per siliqua (96.82). However, moderate value of heritability was observed for days to 75% maturity (95.5%) and number primary branches per plant (91.0%). Lowest value of heritability was observed for harvest index (86.7%).

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Coefficient of varition
The genotypic and phenotypic coefficient of variation for various

characters studies is presented in Table 3. It was observed that the genotypic coefficient of variation (GCV) for seed yield per plant, biological yield per plant, 1000-seed weight, number of secondary branches per plant, harvest index and length of siliqua was high with the value of 55.88, 44.61, 41.95, 34.19, 17.56, and 17.01 per cent, respectively. The lower values of genotypic coefficient of variation were recorded for oil content and days to 75% maturity with the value of 4.68 and 4.66 per cent.

High estimates of phenotypic coefficient of variation (PCV) was observed for seed yield per plant, biological yield per plant, 1000-seed weight, number of secondary branches per plant, having the high values 56.21, 44.62, 42.02, 34.33 per cent respectively. Whereas, moderate phenotypic coefficient of variation was observed for harvest index, number of primary branches per plant, length of siliqua, number of seed per siliqua and days to 50% flowering with the values of 18.86, 17.82, 17.22, 16.34 and 14.08 per cent respectively. The low values of PCV was observed for plant height, day to 75% maturity and oil content with the values of 9.84, 4.77 and 4.69 per cent respectively.

Table No.1. Mean performance for 12 characters of Indian mustard

S. No.	Genotypes	Day of 50%flowering	Day to 75%maturity	Plant height (cm)	No. of primary branches/ plant	No. of secondary branches/ plant	Length of siliqua (cm)	No. of seeds/siliqua	1000 seeds Wt. (g)	Biological yield /plant (g)	Harvest index (%)	Oil content (%)	Seed yield / plant
1	IC9841	74.33	140.33	189.80	11.47	39.00	4.57	16.00	3.23	209.80	33.29	37.25	69.87
2	IC10965	71.00	130.67	186.73	11.55	31.20	4.25	23.47	3.47	108.13	19.30	37.59	20.80
3	IC10967	82.06	139.67	208.07	11.27	21.67	4.61	16.87	3.03	110.00	25.14	41.37	27.53
4	IC10977	83.00	133.67	202.20	11.47	22.00	4.64	13.33	3.20	79.00	19.74	40.71	15.60
5	IC11765	76.33	133.67	218.63	12.30	25.87	3.44	12.93	2.60	102.40	25.14	38.77	25.73
6	IC320641	80.00	133.67	214.33	12.13	39.60	4.72	14.80	1.43	68.13	21.19	42.18	14.73
7	IC320648	54.76	130.33	171.57	10.13	25.20	4.75	15.60	4.10	59.00	21.70	40.60	12.80
8	IC329705	73.67	132.00	219.40	11.40	27.13	4.45	12.87	3.43	126.13	30.07	42.00	38.23
9	IC335854	76.33	128.66	186.93	10.60	36.67	3.17	16.60	1.63	52.67	18.69	40.89	9.87
10	IC347947	50.33	124.67	142.07	6.47	24.33	3.43	13.60	2.53	70.53	16.28	39.69	10.73
11	IC360723	81.67	132.00	208.53	10.27	24.47	3.58	15.07	1.97	71.60	28.21	40.70	20.20
12	IC360749	81.33	134.00	219.27	8.93	20.33	3.83	15.47	1.90	103.53	24.41	38.20	25.27
13	IC360770	72.33	121.67	201.20	9.07	19.33	4.04	17.93	2.10	64.00	28.33	40.50	18.13
14	IC363942	73.00	127.67	175.20	11.93	27.87	4.26	17.40	1.93	78.67	23.01	40.70	18.20
15	IC366460	55.00	119.00	193.07	7.87	25.33	3.29	16.33	2.60	53.73	23.68	40.94	12.20
16	IC375924	50.33	136.00	200.07	7.00	20.60	4.65	13.53	5.73	110.93	26.97	40.70	29.93
17	IC375925	57.00	137.67	179.53	7.73	18.13	4.85	15.80	4.87	80.47	26.68	37.70	20.67
18	IC399788	94.00	136.33	196.80	8.60	16.60	3.39	14.27	1.47	51.33	18.19	40.89	9.33
19	IC399795	80.33	126.00	204.86	7.33	12.47	3.70	11.67	3.03	47.93	22.33	39.54	10.73
20	IC399797	83.00	132.33	219.87	11.67	24.53	3.50	13.80	3.00	79.20	21.62	37.00	17.13
21	IC399808	82.67	139.00	203.17	12.67	16.60	4.21	17.66	3.77	50.13	25.93	42.10	13.00
22	IC399841	81.67	136.33	230.27	9.40	20.20	3.91	12.60	2.57	91.20	25.81	41.47	23.67
23	IC399816	72.00	141.00	230.00	9.73	16.93	3.33	12.53	3.07	100.60	22.37	39.98	22.40
24	IC399826	87.00	142.00	169.27	9.33	20.27	2.39	13.53	1.47	32.20	30.62	36.30	9.87
25	IC399839	82.00	136.67	174.47	7.93	14.20	3.68	12.60	3.00	57.53	20.63	40.80	11.87
26	IC399840	69.00	140.00	195.00	7.73	16.20	4.18	14.80	4.17	69.87	30.53	37.65	21.33
27	IC399857	82.67	137.00	214.80	8.60	19.60	4.25	15.80	3.03	140.47	22.54	44.63	31.60
28	IC399853	85.00	127.67	189.80	10.47	11.80	4.03	17.33	1.27	39.93	24.69	39.70	9.87
29	IC399854	81.67	139.60	184.87	7.60	11.27	4.10	13.13	1.07	40.60	21.35	39.04	8.67
30	IC399877	65.00	139.00	203.07	11.80	18.73	4.85	13.47	4.33	60.07	27.27	39.73	16.80
31	IC399878	62.67	127.27	185.67	10.60	24.80	4.43	12.73	5.70	80.73	35.88	37.36	29.00
32	IC417020	69.33	127.00	186.73	9.20	14.47	3.46	17.60	1.37	31.80	28.35	39.60	9.00
33	IC426336	69.00	121.33	161.07	10.27	40.60	2.45	13.47	1.27	31.60	35.24	37.34	11.13
34	IC426357	71.33	123.23	197.80	9.67	13.80	4.47	15.27	3.47	72.13	28.36	39.03	19.87
35	IC446900	73.67	122.66	182.47	10.27	19.13	4.11	18.87	1.43	49.40	21.87	41.58	12.40
36	IC491257	69.06	134.60	219.47	10.27	25.87	4.49	11.53	4.70	90.60	24.28	42.20	22.00
37	IC491283	67.33	138.67	217.13	11.53	16.40	5.86	13.93	3.77	77.67	27.22	40.60	21.10
38	IC491313	74.67	134.00	187.73	10.60	36.67	4.13	18.67	3.77	120.47	26.61	39.80	32.10
39	IC491330	65.67	136.33	205.40	7.0	25.27	5.11	15.13	4.03	71.60	28.00	43.60	20.20
	Mean	**73.35**	**132.60**	**196.82**	**9.84**	**22.71**	**4.06**	**14.93**	**2.93**	**77.83**	**25.14**	**40.01**	**19.85**
	SEm+-	0.93	1.09	0.64	0.42	0.58	0.09	0.35	0.05	0.78	1.40	0.09	0.99
	Range	50.33	119.00	142.07	6.47	11.27	2.39	11.53	1.07	31.60	16.28	36.30	8.67
		87.00	142.42	230.27	12.67	40.60	5.86	23.47	5.73	209.80	35.88	44.63	69.87
	CDat 5%	1.82	2.13	1.25	0.82	1.13	0.17	0.68	0.09	1.52	2.74	0.17	1.94

Table No.2.Heritability, genetic advance, GCV and PCV in Indian mustard

S.N.	Characters	Heritability (%)	Genetic advance	Genetic advance as per cent of mean	Genotypic coefficient variation	Phenotypic coefficient Variation
1	Day of 50%flowering	98.8	21.02	28.65	13.99	14.08
2	Day to 75%maturity	95.5	12.44	9.38	4.66	4.77
3	Plant height (cm)	99.8	39.84	20.24	9.84	9.84
4	No. of primary branches/ Plant	91.0	3.29	33.43	17.00	17.82
5	No. of secondary branches/ Plant	99.2	15.93	70.12	34.19	34.33
6	Length of siliqua (cm)	97.6	1.41	34.67	17.01	17.22
7	No. of seeds/siliqua	96.8	4.86	32.53	16.08	16.34
8	1000-seed weight. (g)	99.7	2.53	86.17	41.95	42.02
9	Biological yield / plant(g)	99.9	71.49	91.85	44.61	44.62

10	Harvest index (%)	86.7	8.47	33.68	17.56	18.86
11	Oil content (%)	99.6	3.85	9.62	4.68	4.69
12	Seed yield / plant	98.8	22.71	114.40	55.88	56.21

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