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Genetic variability, heritability and genetic advance among Indian mustard (B*rassica juncea*) genotypes

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ABSTRACT

Fifty five germplasm of Indian mustard were evaluated to estimate relationships among yield and some yield components using direct selection parameters like variability, heritability and genetic advance at school of Agricultural Sciences and Engineering IFTM University, Moradabad (U.P.) during 2017-18. Analysis of variance revealed highly significant differences for all the characters. The genotypes showed moderate to high level of genotypic coefficient of variance (GCV) and phenotypic coefficient of variance (PCV). In general, phenotypic coefficient of variance was higher than their genotypic coefficient of variance but the extent was quite small, indicating very less environmental influence on the expression of the characters. Genotypic coefficient of variation was found to be higher forsiliquae per plant (54.04), secondary branches per plant (36.02), seed yield per plant (28.84), siliquae on main shoot (27.51). Genetic advance and heritability are High heritability estimates were observed for plant height, secondary branches per plant, main shoot length, test weight, siliquae per plant, siliquae on main shoot, seed yield per plant. The expected genetic advance as per cent of mean was higher for siliquae per plant, secondary branch per plant, primary branch per plant, seed yield per plant, siliquae on main shoot, main shoot length and test weight, indicating heritability is due to additive gene effects, so selection may be effective and it would be helpful in predicting the gain under selection.

Key Words: Indian mustard, heritability, genetic advance, genotypic variation, phenotypic variation, yield

INTRODUCTION

Indian mustard [*Brassica juncea*L. (Czern & Coss)] is an important oil seed crop of India. It plays a major role in catering to the edible oil demand of the country. In terms of area under oilseeds. The average production of Indian mustard is low in the country; which may be attributed to the lack of high yielding varieties, resistant to diseases and pests, high response to high inputs and other management practices. The assessment of parameters including phenotypic and genotypic coefficients of variation, heritability in broad sense, and genetic advance as % of mean is a pre-requisite for making effective selection. Yield is a complex trait, polygenic in inheritance, more prone to environmental fluctuations than ancillary traits such as branches/ plant, seeds/siliquae, main shoot length, and test weight. Understanding the association between yield and its components is of paramount importance for making the best use of these relationships in selection. The path coefficient analysis helps breeders to explain direct and indirect effects, and hence extensively used in breeding experiments in different crop species (Maurya *et al.*, 2018 and Ray *et al.*, 2019). However, to carry out most effective selection, the information on the available genetic variation among Indian mustard genotypes, the nature of component traits on which selection would be effective and the influence of environmental factors on each trait need to be known. Information on the nature and magnitude of variability and heritability in a population is one of the prerequisite for successful breeding programme in selecting genotypes with desirable characters. It is therefore, of great importance for breeder to know the heritability of the agronomical characters to improve the yield of the crop effectively. Keeping these facts in view, the present investigation was initialled using Indian mustard as test crop.

MATERIALS AND METHODS

A field experiment was conducted in randomized block design at research farm of Department of Agricultural Sciences and Engineering, IFTM University, Moradabad (U.P.) during 2018-19. Fifty five genotypes of Indian

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mustardwere sown with spacing of 0.4 m row to row and 0.3 m. plant to plant. The soil type of experimental site was sandy loam in texture having hhigh Kand low organic carbon, nitrogen and phosphorus. Five competitive plants from each plot were randomly selected for recording observations for all the quantitative characters except days to flowering and maturity, which were recorded on the plot basis. The data were recorded days to maturity, plant height, primary and secondary branches plant^{-1}, length of main raceme, number of siliquae on main raceme, number of seed siliquae^{-1}, seed yield plant^{-1}, test weight, oil content etc. Analysis of variance (ANOVA) in randomized block design for all attributes was done using statistical software (Windostat ver.80). Analysis of variance and the genetic parameters were computed by following standard statistical procedure. The mean data were also subjected to analysis of variance as per standard procedure. The variability present in the population was estimatedby measure mean, phenotypic and genotypic variance andcoefficient of variation. The phenotypic and genotypic variance, genotypic, phenotypic coefficientsof variation and heritability in broad sense were estimated using formula of Burton and de Vane (1953)

RESULTS AND DISCUSSION

Analysis of variance was carried out for yield contributing characters and presented in Table 1, which showed that treatments differed significantly for all the characters except volumetric seed weight and siliquae length. The mean value of any populations sample provides an idea about the centre of variability of any traits. While, the range of traits provides maximum and minimum limits of that variable genotypes. Mean, range, critical differences, coefficient of variation, heritability and genetic advance are presented in Table 2. The genotypes showed moderate to high level of genotypic coefficient of variance (GCV) and phenotypic coefficient of variance (PCV). In general, phenotypic coefficient of variance was found to be higher than their genotypic coefficient of variance but the extent was quite small, indicating very less environmental influence on the expression of the characters. Genotypic coefficient of variation was found to be higher for siliquae per plant (54.04), secondary branches per plant (36.02), seed yield per plant (28.84), siliquae on main shoot (27.51).

Table 1: Analysis for different quantitative characters of Indian mustard

Traits	Replication MSS	Genotypes MSS	Error MSS
Days to 50% flowering	8.49	24.51**	7.19
Plant height (cm)	15.94	1924.75**	2.46
Days to maturity	13.69	304.01**	8.40
Pr. Braches/plant	22.34	8.91**	0.64
Sr. Branches/plant	41.46	315.63**	0.58
Main shoot length (cm)	27.25	881.26**	2.31
Siliquae on main shoot	106.00	559.52**	6.79
Siliquae/plant	2175.52	558978.88**	2019.31
Siliquae length (cm)	0.00	1.71**	0.07
Seeds per siliquae	0.15	14.04**	0.56
Test weight (g)	0.02	2.52**	0.01
Oil % content	2.42	1.52**	0.20
Fiber content	0.11	2.07**	0.10
Seed yield per plant (g)	4.35	420.07**	5.64

Genetic advance and heritability are important selection parameters. High heritability estimates were observed for plant height (99.87), secondary branches per plant (99.82), main shoot length (99.74), test weight (99.67), siliquae per plant (99.64), siliquae on main shoot (98.79), seed yield per plant (98.66). The expected genetic advance as per cent of mean was higher for some attributes like siliquae per plant (111.31), secondary branch per plant (74.21), primary branch per plant (54.79), seed yield per plant (59.42), siliquae on main shoot (56.67), main shoot length (42.59) and test weight (38.26).The genotypic and phenotypic coefficient of variation were highest for siliquae per plant (185653.19-186326.29), plant height (640.76-641.58), main shoot length (292.98-293.75), followed by siliquae on main shoot (184.24-186.51), seed yield per plant (138.14-140.02), secondary branches per plant (105.02-105.21), days to maturity (98.54-101.34), days to 50% flowering (5.77-8.17) and primary branch per plant (2.79-2.97), while the lower magnitudes were recorded in oil content (0.44-0.51), siliquae length (0.55-0.57), seeds per siliquae (4.49-4.68), fiber content (0.66-0.69) and test weight (0.84-0.84) (Table 2).

Table 2: Estimation of range, mean, coefficients of variation (GCV and PCV), for 14 quantitative characters in Indian mustard

Traits	Mean	Range		Variance (GCV)	Variance (PCV)
		Min	Maximum		
Days to 50% flowering	44.84	34.00	49.33	5.77	8.17
Plant height (cm)	211.56	145.00	280.00	640.76	641.58
Days to maturity	128.12	100.00	141.33	98.54	101.34
Pri. Braches/plant	6.24	3.00	11.00	2.76	2.97
Sr. Branches/plant	28.45	11.67	65.67	105.02	105.21
Main shoot length (cm)	82.79	45.00	112.00	292.98	293.75
Siliquae on main shoot	49.34	22.00	81.33	184.24	186.51
Siliquae/plant	797.39	288.00	2485.33	185653.19	186326.29
Siliquae length (cm)	5.37	3.83	7.17	0.55	0.57
Seeds per siliquae	15.42	11.00	20.67	4.49	4.68
Test weight (g)	4.93	3.15	7.46	0.84	0.84
Oil % content	41.60	39.99	42.91	0.44	0.51
Fiber content	9.12	7.12	11.15	0.66	0.69
Seed yield per plant (g)	40.75	13.17	83.60	138.14	140.02

In general noted phenotypic coefficient of variation was higher than genotypic coefficient of variation.The result indicated that breeders have opportunity for selection of desirable plants through the attributes having higher magnitudes of PCV/GCV. Similar results were reported byVerma *et al.* (2017) and Ray *et al.* (2019) in Indian mustard.Number of secondary branches per plant, seed yield per plant and seeds per siliquae indicated that the character were predominantly governed by additive gene action and may be exploited directly in selection.

Table 3: Estimation of heritability, genetic advance and coefficients of variation (GCV and PCV) for 14 quantitative characters in Indian mustard

Traits	Heritability (h^2b)	Genetic Advance	Genetic Advance (% of mean)	PCV (%)	GCV (%)
Days to 50% flowering	70.66	4.95	11.04	6.37	5.36
Plant height (cm)	99.87	52.15	24.65	11.97	11.96
Days to maturity	97.24	20.45	15.96	7.86	7.75
Pri. Braches/plant	92.83	3.42	54.79	27.60	26.60
Sr. Branches/plant	99.82	21.11	74.21	36.06	36.02
Main shoot length (cm)	99.74	35.26	42.59	20.70	20.68
Siliquae on main shoot	98.79	27.96	56.67	27.68	27.51
Siliquae/plant	99.64	887.60	111.31	54.13	54.04
Siliquae length (cm)	95.94	1.52	28.35	14.05	13.76
Seeds per siliquae	96.00	4.37	28.31	14.03	13.74
Test weight (g)	99.67	1.89	38.26	18.60	18.57
Oil % content	87.17	1.37	3.29	1.71	1.60
Fiber content	95.18	1.67	18.32	9.12	8.89
Seed yield per plant (g)	98.66	24.21	59.42	29.04	28.84

The results of present study indicated conformity with the previous investigations on Indian mustard (Akabari and Niranjana 2015).
High heritability was coupled with high genetic advance in per cent of mean. The data on siliquae per plant, secondary branches per plant, biological yield per plant, plant height, main shoot length, test weight, siliquae on main shoot, seeds per siliquae, fiber content and siliquae length indicated that these characters were predominantly governed by additive gene action and may be exploited directly in selection (Table 3). These investigations were consistent with the findings of Akabari and Niranjana (2015) and Singh *et al.,* (2018) in Indian mustard genotypes. The fundamental requirement of selection is the heritable variation of genotypes. The characters which are more heritable and yield contributing can ameliorate the yield potential by their few cyclic selections. The present study revealed that estimates of broad sense heritability were high for all the traits. The expected genetic advance is a prediction of breeders that is up to which extant, a character can be improved in coming generation after 9-10% of better heritable individual selection. The characters having high heritability with high genetic advance generally indicated that heritability is more due to the additive gene effect and advocate the use of high estimates of heritability along with high magnitude of genetic advance for genetic improvement in any trait through selection. Heritability estimates together with genetic advance are generally regarded to be more useful in predicting the grain through selection.
it may be concluded that there was sufficient genetic variability for most of the economic traits and a combinating of various traits contributes to seed yield. Number of siliquae per plant, plant height, main shoot length, seed yield per plant and days to maturity showed maximum potential for effectiveness of selection. Because these traits showed high genotypic and phenotypic coefficient of variation, heritability and genetic advance. This would help us in designing the selection methodology which can further be utilized in the breeding programme for improvement of seed yield in Indian mustard.

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