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Selection parameter analysis for selecting the best cross combinations in Indian mustard (*Brassica Juncea* (L.) Czern & Coss)

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Abstract
The estimates of heritability (narrow sense) coupled with high genetic advance were observed high for all the nine characters. The positive and highly significant correlation was observed for seed yield per plant with days to flowering (0.540), days to maturity (0.550), length of main raceme (0.520), number of siliquae per plant (0.613), oil content (0.440), test weight (0.418), days to flowering significant associate with days to maturity (0.740), plant height (0.640), length of main raceme (0.489), number of siliquae per plant (0.636) and test weight (0.512), days to maturity with plant height (0.757), length of main raceme (0.565), number of siliquae per plant (0.750) and test weight (0.457), plant height associate with number of siliquae per plant (0.592), length of main raceme showed significant positive associate with number of siliquae per plant (0.571), number of siliquae per plant positive and significant showed associate with oil content (0.481) and test weight (0.414), oil content associate with positive and significant associate with test weight (0.544).

Keywords: Brassica, correlation, genetic advance, heritability and selection parameters.

1. Introduction
Rajasthan is the largest producer of rapeseed mustard, followed by Uttar Pradesh, Haryana, Madhya Pradesh, West Bengal, Gujarat and Assam. Other states with minor production are Orissa and Bihar. Rapeseed and mustard crops are also grown in northern and north-east states of the country. There has been a tremendous increase in area and production of rapeseed-mustard during the last two decades mainly in Rajasthan, Haryana, West Bengal and Gujarat. Indian mustard [*Brassica juncea* (L.) Czern & Coss] is the dominant species covering around 85 per cent of area under rapeseed mustard in India. The rest of the area is covered by three ecotypes of *Brassica rapa* variety brown sarson, yellow sarson and toria (Prakash schepra 1996). Among the toria [*Brassica rapa* (L.) spp. Toria] nearly 1.4% area. *Eruca sativa*. *Brassica rapa* L. spp. brown sarson and other occupy nearly 6 percent of the total area.

2. Materials & Methods
The present investigation consisted seven varieties/ genotypes of Indian mustard, [*Brassica juncea* (L.) Czern & Coss] which were selected on the basis of variation for various characters. Using seven diverse genotypes, a diallel set (excluding reciprocals) was made to obtain 21 crosses during *Rabi*, 2009-2010. Plan of layout- All the 28 treatments, (7 parents and 21 F_1s) were grown in randomized complete block design with three replications at Oilseed Research Farm, Kalyanpur, C.S. Azad University of Agriculture and Technology, Kanpur during Rabi 2010-2011. The parents and F_1s were grown in single row of five meter length spaced 45 cm apart. The distance of 20 cm between the plants in a row was maintained by thinning. All the recommended agronomic practices were followed for raising the good crop. The following observations were recorded on 5 randomly taken plants in parents and F_1s in each replication namely, days to 50% flowering, days to maturity, plant height (cm), length of main raceme (cm), number of siliquae per plant, number of secondary branches per plant, oil content (%), test weight (g) and seed yield per plant (g). Diallele neumerical approach was suggested by Griffings in 1956. Oil content is estimated by using NMR Spectro 4000.

3. Results & Discussion
The estimate of heritability (narrow sense) and genetic advance for nine characters in F_1 are presented in Table-1. The estimates of heritability (narrow sense) were observed high for the characters varied from 19.02 per cent for Oil content to 85.26 per cent for days to flowering.

As per classification high heritability were recorded for Days to Flowering (85.26) followed by plant height (82.84), number of siliquae per plant (74.14), days to maturity (61.50), number of secondary branches per plant (54,00), length of main raceme (50.90), test weight (44.11), seed yield per plant (41.77), oil content (19.02). The genetic advance in percent over mean was estimated for all the nine characters which ranged from 2.36 to 21.00 per cent high values were found of Length of main raceme per plant (21.00) followed by days to flowering, (16.39), test weight (15.90), number of siliquae per plant (15.80), seed yield per plant (15.57), number of secondary branches per plant (14.80), plant height (12.28), days to maturity (08.54), and oil content (02.36). The findings are in accordance with the earlier reports of Rao and Gulati (2001) [10], Mahla *et al.* (2003) [7], Rai *et al.* (2005) [9], Akbar *et al.* (2007) [2] and Acharya and Pati (2008) [1].

Table 1: Grand mean, heritability and gain in percent over mean in 9 characters in F_1's diallel generation of Indian mustard.

Character	$\hat{h}^2$ (%)	GA	GA in percent over mean
Days to flowering	85.26	12.36	16.39
Days to maturity	61.50	11.09	08.54
Plant height (cm)	82.84	21.82	12.28
Length of main raceme (cm)	50.90	10.65	21.00
No. siliquae/ plant	74.14	52.13	15.80
No. of secondary branches/plant	54.04	03.48	14.80
Oil content (%)	19.02	0.92	02.36
Test weight (g)	44.11	0.83	15.90
Seed yield / plant (g)	41.77	05.50	15.57

$\hat{h}^2$ (%) = Heritability estimates in percent (ns)
GA = Genetic advance, GA (%) = Genetic advance in percent over mean of the character.

Estimates of genotypic and phenotypic correlation coefficient between all possible pairs of characters involving nine traits in first filial generation were computed. The results are presented in Table-2. In genotypic correlations were higher than their respective phenotypic correlation coefficient. The genotypic correlation coefficients were observed comparatively higher in F_1s than parent. As evident from the Table-2, the significant and positive genotypic correlations were observed for days to flowering with days to maturity (0.863), plant height (0.895), number of secondary branches per plant, days to maturity with plant height (0.974), length of main raceme (0.409), number of siliquae per plant (0.600), number of secondary branches per plant (0.774), seed yield per plant (0.722), plant height with number of siliquae per plant (0.542), number of secondary branches per plant (0.797) and seed yield per plant (0.695), length of main raceme with number of siliquae per plant (0.863), number of secondary branches per plant (0.973), test weight (0.500) and seed yield per plant (0.907), number of siliquae per plant with, number of secondary branches per plant (1.023), test weight (0.687) and seed yield per plant (0.970). Number of secondary branches per plant with oil content (0.566), test weight (0.469) and seed yield per plant (1.221), oil content showed significant and positive correlation with seed yield per plant (0.436), test weight correlation with seed yield per plant (0.796). Positive and highly significant correlation was observed for seed yield per plant with days to flowering (0.540), days to maturity (0.550), length of main raceme (0.520), number of siliquae per plant (0.613), oil content (0.440), test weight (0.418), days to flowering significant associate with days to maturity (0.740), plant height (0.640), length of main raceme (0.489), number of siliquae per plant (0.636) and test weight (0.512), days to maturity with plant height (0.757), length of main raceme (0.565), number of siliquae per plant (0.750) and test weight (0.457), plant height associate with number of siliquae per plant (0.592), length of main raceme showed significant positive associate with number of siliquae per plant (0.571), number of siliquae per plant positive and significant showed associate with oil content (0.481) and test weight (0.414), oil content associate with positive and significant associate with test weight (0.544). These results are in agreement with the findings of Patra *et al.* (2006) [8]. Akbar *et al.* (2007) [2], Sirohi *et al.* (2008) [13] and Verma *et al.* (2008) [15].

Table 2: Genotypic (upper diagonal) and phenotypic (lower diagonal) correlation coefficient among 9 attributes in 7 x 7 parental of a diallel cross in Indian mustard.

Characters	Days to flowering	Days to maturity	Plant height	Length of main raceme	No. of Siliquae/ plant	No. of secondary branches/ plant	Oil content	Test weight	Seed yield/ plant
Days to flowering	ph^{r}g	0.863**	0.895**	0.012	0.253	0.416*	-0.143	0.074	0.311
Days to maturity	0.842**	ph^{r}g	0.974**	0.409*	0.600**	0.774**	-0.005	0.191	0.722**
Plant height	0.849**	0.937**	ph^{r}g	0.334	0.542**	0.797**	0.199	0.192	0.695**
Length of main raceme	-0.002	0.380	0.295	ph^{r}g	0.863**	0.973**	0.297	0.500**	0.907**
No. siliquae/ plant	0.253	0.581**	0.525**	0.832**	ph^{r}g	1.023**	0.204	0.687**	0.970**
No. of secondary branches/plant	0.213	0.550**	0.532**	0.765**	0.729**	ph^{r}g	0.566**	0.469*	1.221**
Oil content	-0.147	0.007	0.220	0.287	0.214	0.423*	ph^{r}g	0.056	0.436*
Test weight	0.080	0.204	0.182	0.492*	0.674**	0.406*	0.079	ph^{r}g	0.796**
Seed yield / plant	0.271	0.526**	0.514**	0.721**	0.752**	0.522**	0.242	0.572**	ph^{r}g

*Significant at P = 0.05; **Significant at P = 0.01

Table 3: Genotypic (upper diagonal) and phenotypic (lower diagonal) correlation coefficient among 9 attributes in F_1s generation of a diallel cross in Indian mustard.

Characters	Days to flowering	Days to maturity	Plant height	Length of main raceme	No. of Siliquae/ plant	No. of secondary branches/ plant	Oil content	Test weight	Seed yield/ plant
Days to flowering	ph^{r}g	0.835**	0.708**	0.575**	0.725**	-0.247	0.318	0.587**	0.719**
Days to maturity	0.740**	ph^{r}g	0.849**	0.639**	0.812**	0.107	0.283	0.521**	0.713**
Plant height	0.640**	0.757**	ph^{r}g	0.437*	0.630**	0.257	0.346	0.419*	0.310
Length of main raceme	0.489**	0.565**	0.357	ph^{r}g	0.624**	-0.302	0.052	0.036	0.715**
No. siliquae/ plant	0.636**	0.750**	0.592**	0.571**	ph^{r}g	0.138	0.537**	0.448*	0.761**
No. of secondary branches/plant	-0.114	-0.005	0.085	-0.118	0.055	ph^{r}g	0.420*	0.621**	-0.058
Oil content	0.311	0.245	0.295	0.058	0.481*	0.299	ph^{r}g	0.629**	0.541**
Test weight	0.512**	0.457*	0.377	0.050	0.414*	0.230	0.544**	ph^{r}g	0.546**
Seed yield / plant	0.540**	0.550**	0.221	0.520**	0.613**	0.007	0.440*	0.418*	ph^{r}g

*Significant at P = 0.05; **Significant at P = 0.01

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