Indian J. Pl. Genet. Resources 13(2): 177-182, 2000

EVALUATION OF INDIAN MUSTARD (*Brassica juncea* [L.] Czern & Coss.) GERMPLASM UNDER RAINFED CONDITION

J. S. CHAUHAN, S. K. YADAV, P. R. KUMAR, S. PAREEK, M. K. TYAGI AND M. L. MEENA
National Research Centre on Rapeseed-Mustard, Sewar, Bharatpur-321303 (Rajasthan)

To identify suitable donors for different morpho-agronomic characters, 226 indigenous accessions of Indian mustard (*Brassica juncea* [L.] Czern & Coss.) were evaluated under rainfed agro-ecology. Appreciable range of variation was observed for all the characters except for days to maturity and oil content. Maximum variability was obtained for seed yield (CV 45.6 %) followed by secondary branches/plant (CV 28.8%) and harvest index (CV 26.9%). Seed yield was positively and significantly associated with all the characters studied except oil content, which was found to have positively significant correlation with days to maturity only. A number of useful accessions was identified for different agro-morphological characters and oil content. The accessions with high oil content and harvest index were also characterized.

Key words: Indian mustard, *Brassica juncea*, oilseeds, morpho-agronomic characters

Rapeseed-mustard group is the second important oilseed crop of India after groundnut. Indian mustard is the predominant crop occupying nearly 90 per cent of the total hectarage (7.0 m. ha). Seed and oil yields in Indian mustard is quite low as compared to other brassica species. It is therefore imperative to intensify efforts to improve seed and oil yield in this crop to fulfill ever-increasing demand of edible oil. Nearly 34 per cent of the hecterage of rapeseed mustard is still under rainfed agro-ecology and increase in productivity through breeding efforts in this crop has not been striking in rainfed areas. Consequently, characterization and evaluation of germplasm is necessary in order to search for potential donors (Yadav *et al.*, 1997). The envisaged investigation was therefore undertaken to characterize the genetic resources of Indian mustard maintained at this center to assess their potentiality as suitable donors for utilization in cultivar development programme for rainfed agro-ecology.

MATERIALS AND METHODS

Two hundred and twenty six germplasm lines of Indian mustard (*Brassica juncea* [L.] Czern & Coss.) were grown in augmented design during rabi 1997-98 under rainfed conditions at National Research Center on Rapeseed-Mustard, Bharatpur. Each line was grown in two-row plots of five meter length and plant and row distance were maintained at 10 x 30 cm., respectively. Standard agronomic and plant protection practices for rainfed agro-ecology were followed to raise a good and healthy crop. A basal dose of N : P @ 40 and 20 kg/ha was given just before seeding and the data were collected for days to maturity (row basis, plant height (cm), primary branches per plant, secondary branches per plant, main shoot length (cm), siliquae on main shoot, siliqua length (cm), seeds per siliqua, 1000-seed weight (g), harvest index (%), seed yield (g) and oil content (%) on individual plant basis on randomly selected five plants in each accession. The seed were counted by an electronic seed counter ("L" systems,

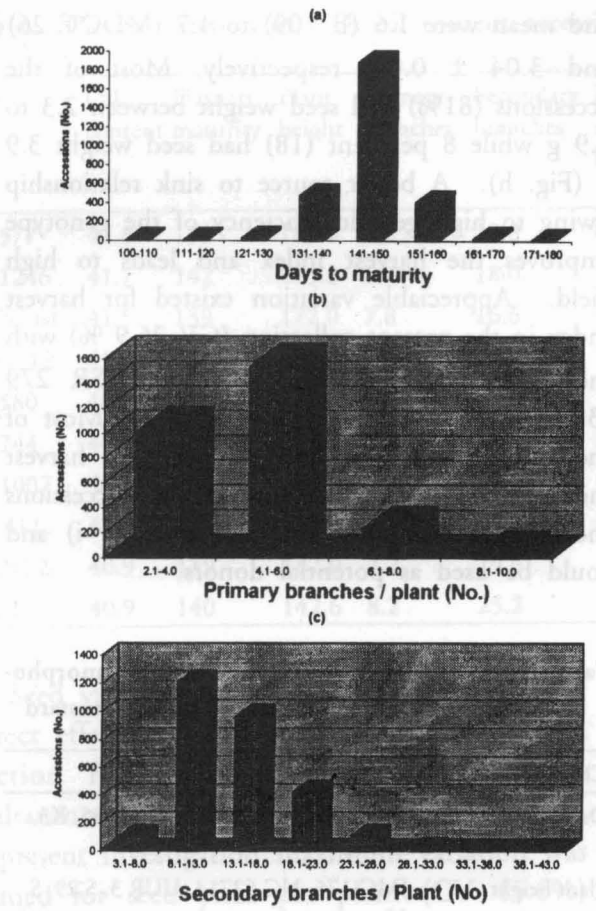
Old mill Co., USA) and the oil content was measured by Nuclear Magnetic Resonance (Oxford 5000). Range, mean, coefficient of variability and simple correlation coefficients were computed using standard statistical methods (Gomez & Gomez, 1984)

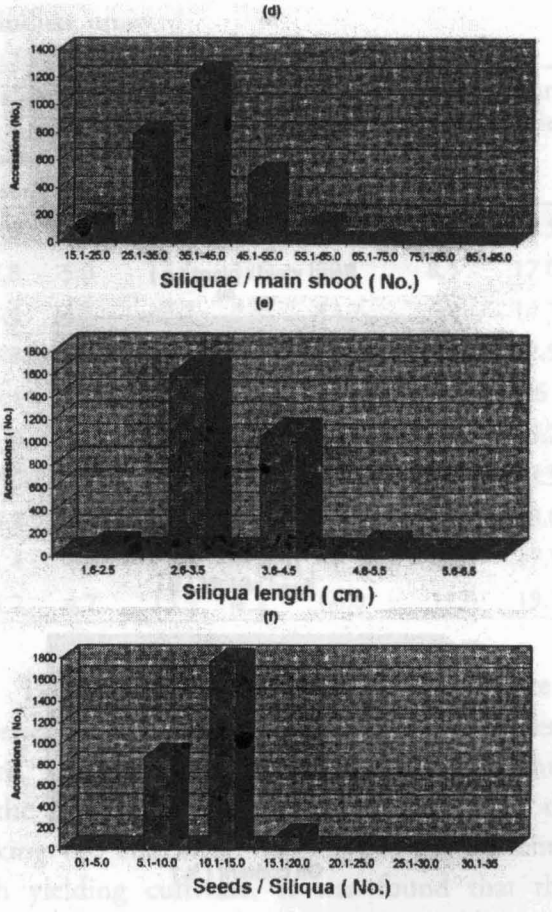
RESULTS AND DISCUSSIONS

The evaluated germplasm had considerable variability as indicated by coefficient of variability CV (Table 1) for all the characters studied except for days to maturity (CV 1.9%) followed by oil content (CV 3.7%) and plant height (CV 8.7%). Early maturity and dwarfness are desirable characters. Early maturity makes a variety suitable for multiple crop rotation. The range for days to maturity and plant height in the present collection was 131 (CSR 1054) to 142 days (JMG 423) and 141 (JMG 176) to 214.4 cm (CSR 1052) respectively. The earliest maturity group i.e. 130-135 days constituted 22.6 per cent of the accessions (Fig. a), whereas most of the accessions (69%) took 135 to 140 days to mature. The mean plant height for most of the accessions (81%) ranged between 160 to 200 cm, yet a few (28 accessions) had short height (160 cm). Only fifteen accessions were recorded to have a mean height of more than 2 m (Fig. b). The observations for mean number of primary branches ranged between 5 and 13 with CSR 741 having minimum and CSR 464 having maximum number of primary branches per plant. Similar results were reported earlier by Yadav *et al.*, 1997 in Indian mustard. The coefficient of variation being 19.2 per cent, the character showed moderate variation. Nineteen accessions had more than ten primary branches per plant (Fig. c). As evident from the CV number of secondary branches/plant showed high variability. The accessions, JMG 190 and JMG 200 flanked the range for this character with a mean value of 45.4 and 7.0 respectively. Approximately 89 per cent of accessions had number of secondary branches between 12-30 (Fig. d), whereas, 13 accessions had 30 secondary branches thus making a good bunch of potential donors for this trait. Correlation analysis also

Table 1: Performance of Indian mustard germplasm for various morpho-agronomic traits

Character	Range	Mean ± SEM	Coefficient of variation
Days to maturity	131.0. (RC 89) - 142.0 (CSR 1054)	137.6 ± 0.2	1.9
Plant height (cm)	141.0 (JMG 176) - 214.4 (CSR464)	178.3 ± 1.0	8.7
Primary branches/plant	5.0 (CSR 741) - 13.0 (CSR 464)	7.7 ± 0.1	19.2
Secondary branches/plant	7.0 (JMG 200) - 45.4 (JMG 190)	20.6 ± 0.4	28.8
Main shoot length (cm)	36.4 (CSR 435) - 81.6 (RH 7839)	58.0 ± 0.6	14.7
Siliquae/main shoot	18.0 (JMG 393) - 64.4 (NC 8258)	40.4 ± 0.5	19.4
Siliqua length (cm)	3.3 (RC 901) - 5.7 (CSR 920)	4.5 ± 0.04	12.3
Seeds/ siliqua	9.7 - (MDOC 30) - 18.4 (CSR 868)	12.8 ± 0.1	9.2
1000 - seed weight (g)	1.6 (B 1090) - 4.7 (MDOC 26)	3.0 ± 0.04	19.7
Harvest index	9.0 (JMG 190) - 38.6 (CSR 279)	16.1 ± 0.3	26.9
Seed yield/ plant (g)	2.5 (CSR 1070) - 32.1 (MDOC 21)	9.1 ± 0.3	45.6
Oil content (%)	34.8 (RW 873) - 41.8 (CSR 577)	38.7 ± 0.1	3.7

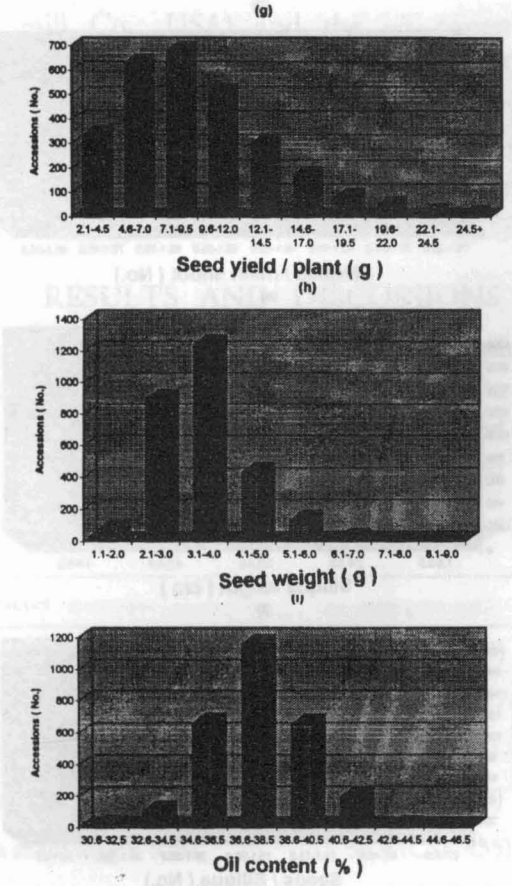




indicated a positive and significant association of primary and secondary branches per plant with seed yield (Table 2). Main shoot length exhibited moderate variation (CV 14.7%) and ranged between maximum and minimum value of 36.4 (CSR 435) to 81.6 cm (RH 7839). Out of the total, 173 (76.5 %) accessions had main shoot length between 50-70cm. Fifteen accessions registered main shoot length above 70 cm (Fig. e) and thus could be used in crossing programme to improve this character. As erdent by coefficient of variation, appreciable variability existed for number of siliquae on main shoot, the lowest and highest was recorded for JMG 393 (18) and NC 8258 (64.4), respectively. The frequency distribution (Fig. f) showed approximately 43 per cent of accessions deviated considerably from the mean. Siliqua length is an important character as longer siliqua accommodate higher number of seeds which in turn increase the yield as depicted by significant value of association between these characters (Table 2). Although the character exhibited moderate variation, yet 34 (14 %) accessions had more than 5 cm siliqua length (Fig. g).

Comparatively low variability existed for number of seeds per siliqua in the evaluated germplasm (CV 9.2%) and ranged from 9.7 (MDOC 30) to 18.4 (CSR 868) with a mean value of 12.8 + 0. 1. Ten accessions were found to have more than 15 seeds per siliqua and could be used in a hybridization to improve yield as this character had positive and significant association with seed yield (Table 2).

Increased seed weight augments the yield, furthermore, bold seeded varieties fetch higher price hence identification of suitable donors is



vital for cultivar development programme in Brassicas. Moderate variability was observed in the present collection (CV 19.7%). The range and mean were 1.6 (B 109) to 4.7 (MDOC 26) and 3.04 ± 0.04, respectively. Most of the accessions (81%) had seed weight between 2.3 to 3.9 g while 8 per cent (18) had seed weight 3.9 g (Fig. h). A better source to sink relationship owing to high genetic efficiency of the genotype improves the harvest index and leads to high yield. Appreciable variation existed for harvest index in the present collection (CV 26.9 %) with mean 16.1 ± 10.3. The accession, CSR 279 (38.6%) ahd the highest harvest index. Most of the accessions (95%) had 24 per cent harvest index under rainfed conditions, yet three accessions showed harvest index 32 per cent (Fig. i) and could be used as potential donors.

Table 2: Association of different characters with seed yield and oil content.

Characters	Seed yield	Oil content
Days to maturity	0.056	0.299**
Plant height	0.137	0.092
Primary branches/plant	0.207**	-0.015
Secondary branches/ plant	0.344**	-0.274**
Main shoot length	0.249**	-0. 159*
Siliquae on main shoot	0. 152*	-0.213**
Siliqua length	-0.009	0.117
Seeds/siliqua	0.193	-0.126
Seed weight	0.134	0.110
Harvest index	0.507**	-0.002
Seed yield	1.000	-0.184**

Table 3: Potential donors for various morpho-agronomic characters in Indian mustard

Characters	Accessions
Days to maturity	CSR 1054, NC 59787, JMG 385, K3, NC 6365
Plant height	JMG 176, NC 62713, UUR 3, S 29, S 35
Primary branches/plant	CSR 464, CSR 395, JMG 190, CSR 301, RC 80
Secondary branches/plant	JMG 190, B 145, MDOC 27, CSR 816, R-17-26
Main shoot length	RH 7839, IB 1705, JMG 400, UUR 3, CSR 498
Siliquae/main shoot	NC 8258, RC 290, CSR 743, STM 191, CSR 577
Siliqua length	CSR 920, JMG 193, CSR 377, CSR 607, CSR 313
Seeds/siliqua	CSR 868, PRG 942, RC 1023, CSR 313, PR 17
1000 - seed weight	MDOC 26, IB 1699, RC 413, RC 1124, CSR 691
Harvest index	CSR 279, RC-17-26, RC 817, CSR 154, MDOC 26
Seed yield	MDOC 21, MDOC3 ,CSR 305, CSR 1312, MDOC 13
Oil content	CSR 577, CSR 1246, MDOC 61, NC 58112, UUR 3

Table 4: Characterization of high oil content accessions of Indian mustard

Entry	Oil content	Days to maturity	Plant height	Primary branches	Secondary branches	Main shoot length	Siliquae on main shoot	Siliqua length	Seeds/ siliqua	1000-Seed weight	Biological yield/ plant	Seed yield/ plant	Harvest index
CSR 577	41.8	138	189.0	6.8	12.8	64.6	55.0	4.8	11.4	3.4	45.1	8.8	19.5
CSR 1246	41.7	142	175.0	7.4	18.0	55.0	27.8	5.0	14.1	3.0	50.1	8.5	17.0
MDOC 61	41.5	139	172.0	7.8	16.6	54.0	41.4	4.3	13.2	2.4	42.2	6.2	14.7
NC 58112	41.4	134	185.0	8.0	20.0	52.2	29.8	4.9	12.8	3.4	50.5	6.5	12.9
CSR 580	40.9	133	170.6	6.6	20.4	59.8	33.4	4.6	13.0	2.1	39.7	3.8	9.6
CSR 744	40.9	139	211.0	8.8	21.6	60.6	54.0	4.7	12.2	3.2	66.9	10.5	15.7
CSR 1007	40.9	136	205.4	7.4	21.0	61.8	37.6	5.2	13.2	2.4	29.6	3.7	12.5
JMG 411	40.9	137	171.2	7.2	14.8	55.0	44.8	4.2	12.6	2.8	38.6	5.0	13.0
MDOC 2	40.9	139	182.0	7.2	19.6	48.8	31.4	4.3	12.4	3.0	47.3	8.1	17.1
UUR 3	40.9	140	142.6	8.2	25.2	78.4	44.2	4.7	13.5	4.2	66.0	12.6	19.1

Seed yield is the end product of direct and indirect effects of yield associated attributes and selection for high yield accompanies with simultaneous improvement of related traits. In the present investigation maximum variation was obtained for seed yield per plant (CV 45.6%) with accessions ranging from 2.5 (CSR 1070) to 32.1 g yield (MDOC 21). Only two accessions yielded 24.9 per plant (Fig. 11). These results are in agreement with the results of Yadav *et al.*, (1997) in Indian mustard.

The oil content, has high significance as varieties with greater oil content are preferred more. This objective gains rather more weightage in the face of edible oil deficits being faced thus making the endeavour to improve oil content of high yielding cuftivars. It was found that there existed little variation for oil content in the germplasm (CV 3.7%) with overall mean 38.71 0.1%. Thirty-eight accessions had oil content 40%. Maximum oil content was observed in the line CSR 577 (41.8%). The association of oil

Table 5: Characteristics of promising Indian mustard strains having high harvest index

Strain	Plant height (Cm)	Primary branches /plant	Secondary branches/ plant	Main shoot length (cm)	Siliquae on main shoot	Siliqua length (cm)	Seeds/ siliqua	1000-Seed weight (g)	Oil content (%)	Seed yield/ plant(g)	Dry matter/ plant (g)	Harvest index (%)
CSR 279	193.2	7.6	23.4	60.8	43.4	4.2	12.9	2.5	38.7	8.8	22.8	38.7
R 17-26	174.6	10.8	34.6	54.2	50.8	4.6	12.4	2.3	38.6	10.6	28.8	36.7
CSR 817	204.2	10.8	32.2	56.4	34.6	4.5	14.0	3.0	40.5	17.3	48.3	35.9
CSR 154	177.6	9.0	23.2	58.0	42.0	3.4	12.3	2.7	39.5	16.4	53.4	30.6
MDOC 26	166.2	7.2	22.0	62.2	48.0	4.4	15.0	4.7	36.2	14.4	51.6	27.9
CSR 1227	177.0	10.4	30.6	42.0	30.0	5.1	15.0	2.3	38.8	12.8	47.3	27.2
MDOC 21	180.8	7.0	22.6	62.6	45.6	4.0	10.7	2.5	38.2	32.1	122.0	26.3
CSR 968	201.8	8.8	23.6	60.0	38.0	4.9	15.0	3.8	36.2	12.6	48.2	26.1
CSR 960	186.0	7.2	17.4	44.0	32.8	5.0	13.7	3.0	39.8	12.5	49.9	25.1

content was positive and significant, only with days to maturity but in fact further studies are advocated as there can be a shift in the direction of correlation due to impact of environment on the character. Ten high oil yielding accessions with their agro-morphological traits have been listed in the Table 3.

It can be concluded that the present collection proved to be a good source of genetic variability, which could be harnessed to develop improved high yielding genotypes for rainfed agro-ecology. Potential donors for different morpho-agronomic traits have been identified (Table 3). The accessions having more than 25 per cent harvest index were also characterized (Table 5).

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