Evaluation of Exotic Germplasm of Indian Mustard (*Brassica juncea*) for Economic Traits

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Genetic diversity in *Brassica* crop is limited as compared to the variability within the species and its relatives including exotic germplasm. The exotic germplasm lines have been found to be reservoir of genetic diversity, especially to several agro-morphological traits and disease resistance which causes severe yield losses in the country. Therefore, one hundred exotic accessions of Indian mustard were evaluated for various agro-morphological, quality traits and disease resistance against two major diseases of this crop, *i.e.,* Alternaria blight (*Alternaria brassicae*) and white rust (*Albugo candida*). Among the traits studied, the highest variability was observed for secondary branches per plant (CV 47.3%) followed by siliqua beak length (CV 43.6%) while the least variability was observed for oil content (CV 4.3%) followed by protein content (CV 6%). All the exotic accessions were small seeded. More than sixty percent of total accessions were late maturing. The accession EC511435 was identified as a useful donor for early flowering, more secondary branches per plant and high seed yield per plant as compared to best check. However, EC511407 and EC511435 were identified as donors for high oil content and high seed yield**.** Seed yield was positively and significantly correlated with main shoot length, siliquae on main shoot, plant height and oil content. Seven aaccessions showed tolerance to Alternaria blight (percent disease severity or PDS < 10), while eleven accessions to white rust (PDS < 1). However, four accessions namely, EC511504, EC511507, EC511472 and EC511513 showed combined tolerance to both the diseases.

Key Words: Accessions, Donors, Evaluation, Variability

Introduction

Rapeseed-mustard is a group of seven cultivated oilseed crops of *Brassica* species. Indian mustard (*Brassica juncea* L. Czern & Coss) is an annual species belonging to family Brassicaceae and amongst the most important species of seven cultivated oilseeds of India. The family Brassicaceae contains about 3500 species and 350 genera and is placed among the 10 most economically important plant families (Warwick *et al.,* 2000). The crop *Brassica* display enormous diversity and are mainly used as sources of oil, vegetables, condiments, and fodder. A wider genetic base assumes priority in breeding research aimed at developing new varieties with desired traits. Germplasm play an important role in crop improvement programme of rapeseed-mustard (Kumar *et al.,* 2004; Kumar and Misra 2007; Misra 2008; Misra and Kumar, 2008). Genetic diversity within elite cultivars of a crop is limited compared to the variability within the species and its relatives including exotic germplasm. Exotic germplasm refers to crop varieties unadapted to a breeder's target environment, and is an underutilized resource for crop improvement (Holland, 2004). This exotic germplasm represent unique alleles for productivity that are absent from elite crop gene pools, and may protect the crop against new biotic and abiotic stresses (Zamir, 2001). Brassica has narrow genetic base thus variability available in present germplasm of rapeseed-mustard is limited to few desired traits (Kumar *et al.,* 2000). There is no resistance source available for Alternaria bight and white rust, in available indigenous germplasm collection, however, few donors are available for some traits but they are location or race specific (Misra, 2004a). The exotic germplasm lines have been found to be reservoir of genetic diversity, especially to several agro-morphological traits and disease resistance which causes severe yield losses in the country. Estimated yield losses due to Alternaria blight varied between 10 to 70% in different species of these crops (Saharan and Chand, 1988; Kolte, 1991). It is evident that many of the exotic lines possess desirable traits which are otherwise not available in cultivated oilseed *Brassicas*. Thus, the exotic germplasm of crop plants are one of the important sources of some of the agronomical and disease resistance traits for the development of improved cultivars.

A number of rapeseed-mustard varieties have been developed by utilization of exotic germplasm (Misra,

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2004b). Some of the exotic lines were characterized and promising donors were also identified in *B. juncea* (Misra *et al.,* 2005a), *B. carinata* and *Eruca sativa* (Misra *et al.,* 2005b).There are limited reports on evaluation and utilization of exotic germplasm in rapeseed-mustard. Therefore, the present study was aimed to evaluate the diversity in exotic accessions of Indian mustard and their reaction to two major diseases of *Brassica* crop.

Materials and Methods

Seeds of one hundred exotic germplasm accessions of Indian mustard (*Brassica juncea* L. Czern & Coss) were evaluated for 15 agro-morphological, quality traits and disease resistance for two major diseases of the crop i.e. Alternaria blight (*Alternaria brassicae*) and white rust (*Albugo candida*). These exotic accessions of *B. juncea* were acquired from Canada through National Bureau of Plant Genetic Resources (Indian Council of Agricultural Research), New Delhi (India). The experiment was conducted during *rabi* season (post-rainy) of 2007-2008, under Augmented complete Block Design in 30 cm x 10 cm spacing, with three national checks (BIO 902, PCR 7 and RH 30) at the Directorate of Rapeseed-Mustard Research (formerly National Research Centre on Rapeseed–Mustard) Bharatpur, Rajasthan. Recommended standard agronomic package of practices were adopted as and when required to raise a healthy crop. The observations were recorded on randomly tagged five plants for different traits at appropriate growth stages for initiation of flowering, 50% flowering, maturity, plant height, primary branches and secondary branches per plant, main shoot length, siliquae on main shoot, siliqua length, siliqua beak length, seeds per siliqua and seed yield per plant. 1000 seeds were counted by electronic seed counter (Contador, Germany) and weighed by electronic balance. Further, protein and oil content were analyzed by Near Infrared Reflectance Spectroscopy (Dickey- John, Instalab 600). While, Alternaria blight and white rust severity recorded on leaves and pods after 90 days sowing using standard pictorial scale of Conn *et al.* (1990). Range, mean, and coefficient of variation were computed using standard statistical methods (Gomez and Gomez 1984).

Results and Discussion

A range of variability observed in all the agro-morphological traits. Among the traits studied, the highest variability was observed (Table 1) for secondary branches per plant (CV 47.3%) followed by siliqua beak length (CV 43.6%) and the least variability was observed for oil content (CV 4.4\%) followed by protein content (CV 6%). The over all mean value of initiation of flowering was 72.5 and ranged between 41 to 116 days, the accessions EC511435 was earliest in flowering followed by EC511615, EC537892 and EC537896. The mean value of days to 50% flowering was 89.2 and ranged 53-123 days, the accession EC511504 was earliest for this trait which followed by EC511640 and EC537894. The plant height ranged from 100 cm to 320 cm with mean value of 188.6 cm. Siliquae on main shoot ranged 8-64 and accession EC511663 had highest number of siliquae. Seed yield per plant ranged 0.39-58.8 and accession EC511435 gave highest seed yield. The accession EC511435 was identified as a useful donor for early flowering, more secondary branches per plant and high seed yield per plant as compared to the best check. There

Table 1. Range, mean and coefficient of variation (CV) for different traits in exotic accessions of Indian mustard

Traits	Range	Mean ± SEm	CV (%)	Mean values of checks		
				BIO 902	PCR 7	RH30
Initial flowering (days)	41-116	72.5 ± 1.6	23.3	59	52	51
50% flowering (days)	53-123	89.2 ± 1.3	15.3	65	64	58
Plant height (cm)	100-320	188.6 ± 3.3	21.3	169.3	167.5	223.5
Primary branches per plant	4-15	7.3 ± 0.2	30.5	7.6	6	7.5
Secondary branches per plant	2-22	8.5 ± 0.3	47.3	11.3	8	9
Main shoot length (cm)	10-65	34.8 ± 1.0	33.9	47.6	54.5	66.5
Siliquae on main shoot	8-64	31.9 ± 0.9	34.1	39.3	40	43
Maturity (days)	118-163	144.6 ± 0.8	6.3	136	126	130.5
Siliqua beak length (cm)	0.1-1.2	0.4 ± 0.02	43.6	0.94	0.98	0.96
Siliqua length (cm)	1.1-4.7	2.0 ± 0.1	39.5	3.7	4.65	4.65
Seed yield per plant (g)	1.4-38.8	7.4 ± 0.9	30.4	11.2	7.58	21
1000-seed weight (g)	1.1-4.2	2.3 ± 0.1	24.5	3.58	5.72	4.78
Seeds per siliqua	2.3-19	10.6 ± 0.3	28.7	13.95	17.28	12.48
Protein content (%)	19.2-26.2	23.1 ± 0.1	6.0	23.1	21.5	21.05
Oil content (%)	33.1-41.8	38.9 ± 0.2	4.3	37.6	39.1	39.08

has been a wide variability for seed yield contributing traits such as primary and secondary branches per plant, seed yield per plant, siliquae on main shoot and seeds per siliqua. EC511407 and EC511435 were identified as useful donors for high oil content and seed yield**.** Promising donors were identified (Table 2) for various economic traits which can be further used for future breeding programme. However, exotic lines were not found superior for some economic traits such as, 1000-seed weight, main shoot length, siliqua length and siliqua beak length among the tested accessions.

Accessions EC511472, EC511478, EC511504, EC511507, EC511513, EC511732, EC537897 and EC537898 showed tolerance to Alternaria blight (Per cent Disease Severity or PDS < 10), while accessions EC511472, EC511488, EC511489, EC511490, EC511504, EC511507, EC511513, EC511516, EC511517, EC511518 and EC511718 to white rust (PDS < 1). However, accessions EC511504, EC511507, EC511472 and EC511513 showed combined tolerance to both the diseases (Table 3). Tolerance to the two diseases has also been reported by earlier workers (Chattopadhyay and Séguin-Swartz, 2004; Misra *et al.,* 2005a).

Characterization and evaluation of germplasm is the primary step in any plant breeding programme. Earlier most of the studies were on indigenous accessions (Yadav *et al.,* 1997; Meena *et al.,* 2000; Misra *et al.,* 2004). In the present investigation, evaluation was done on exotic accessions for 15 agro-morphological, quality traits and disease resistance for two major diseases of the crop, *i.e.*, Alternaria blight (*Alternaria brassicae*) and white rust (*Albugo candida*) and several useful accessions were identified (Tables 2 and 3).

All the accessions were small seeded (light weight) and short siliqua. The exotic germplasm were very tall (>75%) and were late maturing (>60%). In general these had short main shoot length (>70%) with few siliquae (around 80%) and few seeds in each siliqua (>70%). In addition, these lines also had medium range of oil per cent. Therefore, the exotic germplasm might be a very useful source as one of the parent material for improvement of crop *per se*.

Correlation among different traits is one of the practical means in understanding the behaviour of the accessions and might be useful in selecting desirable clones in a breeding programme. Computation of correlation between seed yield contributing characters and yield are of considerable importance in plant selection. There is significant difference for the characters studied among the genotypes, which demonstrated adequate variability among them. Seed yield was positively and significantly correlated with main shoot length, siliquae on main shoot, plant height and oil content. Seed yield showed negative but significant correlation with initiation of flowering, 50% flowering and protein content. Some of the component characters also showed positive and significant correlation among themselves like 1000-seed weight with plant height, oil content and seed yield per plant, siliquae on main shoot with plant height and main shoot length (Table 4). This indicates that simultaneous

Table 2. List of promising genotypes identified

Traits	Name of genotypes
Initiation of flowering (days)	≤ 51 :EC511435, EC537896, EC537892, EC511615
50 % flowering (days)	≤ 58:EC511435, EC511615, EC537896
Plant height (cm)	≤ 167.5 :EC511504, EC537894, EC511640
Primary branches per plant	e” 7.6 :EC511734, EC511436, EC537892, EC537897
Secondary branches per plant	e” 11.3 :EC511436, EC537892, EC537899, EC511458, EC511435
Siliquae on main shoot	e” 43:EC511663, EC511419, EC511657
Seed yield per plant (g)	e”21:EC511435, EC511608, EC511604
Seeds per siliqua	e” 17.3 :EC511436, EC511632, EC537896
Days to maturity (days)	≤ 126 :EC537892, EC537896, EC511433
Protein content (%)	e” 23.1:EC511493, EC511440, EC511429
Oil content (%)	e” 39.1:EC511407, EC511679, EC511601

Table 3. Exotic accessions showing tolerance to various diseases

Alternaria blight tolerant genotypes	White rust tolerant genotypes
EC511472, EC511478 EC511504, EC511507, EC511513, EC511732, EC537897 and EC537898	EC511472, EC511488,EC511489, EC511490, EC511504, EC511507, EC511513, EC511516,EC511517, EC511518 and EC511718

Table 4. Correlation among different traits of exotic accessions

Traits	Initial flowering	50% flowering	Maturity	Plant height	Primary branches	Secondary branches	Main shoot length	Siliquae on main shoot	Protein content	Oil content	Seed yield/ plant	1000 seed weight	Siliqua beak length	Siliqua length
50% Flowering	0.79*													
Primary branches	-0.07	-0.15	0.04	0.03										
Secondary branches	-0.08	-0.16	0.24*	0.26*	0.69*									
Main shoot length	-0.40*	-0.36*	-0.28*	0.07	0.01	0.10								
Siliquae on main shoot	-0.40*	-0.24*	-0.13	0.28*	-0.02	0.14	0.69*							
Protein content	0.20*	0.33*	0.28*	0.05	0.04	0.07	-0.22*	-0.15						
Oil content	0.02	0.12	-0.03	0.23*	-0.36*	-0.26*	0.04	0.14	-0.46*					
Seed yield/ plant	-0.39*	-0.47*	-0.03	0.19*	-0.04	-0.04	0.24*	0.22*	-0.41*	0.29*				
1000 seed weight	-0.19*	-0.28*	-0.05	0.18*	-0.22*	-0.03	0.17	0.16	-0.29*	0.19*	0.32*			
Siliqua beak length	-0.27*	-0.43*	-0.32*	-0.25*	0.19*	0.04	0.26*	0.17	-0.30*	-0.11	0.29*	0.37*		
Siliqua length	-0.28*	-0.42*	-0.25*	-0.18*	0.20*	0.09	0.23*	0.19*	-0.35*	-0.07	0.29*	0.38*	0.89*	
Seeds/ siliqua	0.02	0.05	0.12	0.14	0.03	0.16	0.13	0.14	0.08	0.03	0.00	0.11	0.04	0.11

* Significant at 5%

improvement for these components is possible in exotic lines of mustard. Similar trend for these traits have conformity with the some of the earlier reports in brassicas (Yadav *et al.,* 1997; Meena *et al.,* 2000; Misra *et al.,* 2004, 2005b).

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