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Characterization and Evaluation of Asian Mustard (*Brassica tournefortii* Gouan.) – An Endangered Oilseed Crop of Northwestern India

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Asian mustard (*Brassica tournefortii* Gouan.), an endangered oilseed crop, is cultivated in the parts of north-western India. This crop is known to have genes for resistance to biotic and abiotic stresses, therefore, attempts were made to collect, evaluate and conserve its genetic resources for further utilization. A total of 18 accessions were grown consecutively for three crop seasons in randomized block design for characterization and evaluation using twelve minimal morpho-agronomic traits. Promising accessions were identified for different economic traits, which may be useful for developing disease, pest and drought resistant varieties, cytoplasmic male sterile (CMS) lines as well as for developing hybrids. Moreover, Geographical Information System (GIS) tools were also used to understand distribution of diversity/ variability in the collected germplasm.

Key Words: Asian mustard, *Brassica tournefortii*, Characterization, Endangered, Genetic diversity, GIS tools, Under-utilized

Introduction

Asian mustard (*Brassica tournefortii* Gouan.), also known as Saharan mustard, is a member of mustard family Brassicaceae. It is an endangered, underexploited oilseed crop, which has become naturalized under tropical and subtropical regions of Asia, Africa, Australia and USA. In India, it is localized in drier parts of North-western states (Rajasthan, Punjab and Haryana). It is cultivated under rainfed conditions either as a sole or mixed crop on marginal lands and sand dunes as a source of edible oil and forage (Fig. 1a & b). Asian mustard was a common oilseed crop of Indian arid region (Rana and Singh, 1992) but due to low yield, shattering habit and development of high yielding varieties of rapeseed-mustard, its cultivation has declined and gradually it became an endangered oilseed crop in the region. Presently, this crop is confined only to sand dunes of uninhabited remote localities in Haryana and Rajasthan (Duhoon and Koppar, 1998; Kumar *et al.,* 2004; Singh 1996; Singh and Sharma, 2007). It has been observed that its seeds generally grow as weed from the shattered seeds of previous season crop.

Inter-specific hybridization is considered as an important tool for transferring resistance genes from wild to cultivated brassicas in order to improve rapeseed-mustard crop. Asian mustard is known to have resistance genes against biotic and abiotic stresses and, therefore, it can play an important role in development of tolerant lines against *Alternaria* blight, white rust, aphids and drought under changing climatic conditions (Chander *et al.,* 2013; Prakash and Bhat, 2007; Singh *et al.,* 1965). Successful inter-specific hybridization has been reported between *B. tournefortii* and *B. rapa* in India for resistance against diseases and pests (Rawat and Anand, 1979). Its germplasm resource has also been utilized for resistance breeding through development of cytoplasmic male sterile (CMS) restorer lines to generate inter-specific hybrids. Considering the importance of this endangered under-utilized oilseed, attempts have been made to collect, evaluate and conserve the genetic diversity of *B. tournefortii*.

Materials and Methods

A total of 18 accessions of *B. tournefortii* were collected from drier parts of north-western states of India covering Alwar, Jhunjhunu, Sikar, Jodhpur and Bikaner districts of Rajasthan; and Bhiwani, Mahendragarh and Hisar districts of Haryana (Fig. 2). During field survey, information pertaining to areas under cultivation, time of harvesting/ maturity, its uses, and factors responsible for genetic erosion were also recorded, besides passport data. The assembled germplasm was grown in three replications for three consecutive years (2009-10, 2010-11 and 2011-12) at NBPGR, Experimental Farm, New Delhi, in randomized block design (RBD), keeping recommended

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Fig. 1a. *B. tournefortii* on sand dune

Fig. 1b. *B. tournefortii* growing as mixed crop

three rows of 3 m length, row to row distance of 45 cm and plant to plant distance of 10-15 cm. Characterization and evaluation data were recorded on five randomly selected plants using twelve important morpho-agronomic and yield contributing traits. Oil content (%) was estimated using non-destructive Nuclear Magnetic Resonance (NMR) technique. Mean and coefficient of variation were computed for pooled data using standard statistical methods (Gomez and Gomez 1984). DIVA-GIS tool was used for mapping diversity distribution (Semwal *et al.* 2013). For GIS based grid mapping, grid of 0.5^0 x 0.5^0 (55.5 Km) cells and a circular neighborhood method was used in the present study. Variability mapping was done using diversity indices (Shannon and Weaver, 1963). At maturity, the dehydrated seed samples were sealed in airtight three layered aluminium packets for long-term conservation at -18°C in the National Genebank at NBPGR, New Delhi.

Results and Discussion

B. tournefortii (18 acc.) germplasm accessions were grown for characterization and evaluation for three consecutive years. Evaluation data were recorded on 12 morpho-agronomic traits. Among the traits studied, the highest variability was observed for seed weight per plot (CV=58.57%) followed by beak length (CV=30.73%), main fruiting branch length (CV=17.36%) and number of primary branches (CV= 16.54%) as given in Table 1.

Based on characterization and evaluation of germplasm, promising accessions identified for various morpho-agronomic traits have been given in Table 2 along with source of collection. Maximum promising accessions were identified from Bhiwani district of Haryana and Jodhpur district of Rajasthan. An accession (IC 560703) collected from Alwar (Rajasthan) was found highly tolerant to mustard aphid (*Lipaphis erisimi*) under field condition (Chander *et al.,* 2013).

Among the promising accessions, IC560709 was identified as useful donors for length of main fruiting branch (>50.0 cm) from Jhunjhunu (Rajasthan); RBT2003 for number of siliquae on main fruiting branch (>30) from Jodhpur (Rajasthan); IC560711 for number of

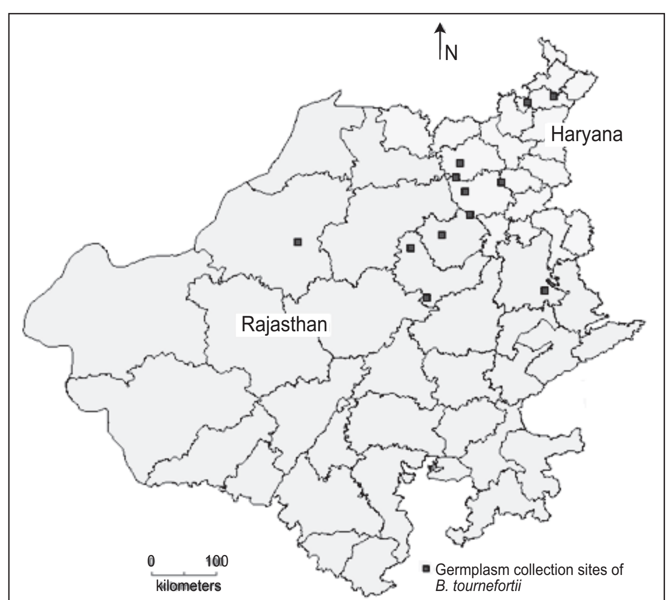

Fig. 2. Germplasm collection sites of *B. tournefortii*

Table 1. Range, mean, standard error (SE) and coefficients of variation (CV) for different agro-morphological traits of *B. tournefortii*

S.No.	Traits/Variables	Code	Minimum	Maximum	Mean	SE	Mean CV (%)
1	Plant height (cm)	PLH	70.6	110.0	88.8	3.20	12.49
2	No. of primary Branches	NPB	8.80	15.6	10.5	0.50	16.54
3	Length of main fruiting branch	LFB	32.0	56.0	40.8	2.04	17.36
4	Pods on main fruiting branch	PFB	15.0	29.2	24.3	1.10	15.64
5	Pod length (cm)	PDL	3.1	4.3	3.6	0.12	11.35
6	Beak length (cm)	BKL	0.7	1.8	1.27	0.11	30.73
7	No. of seeds/pod	NSP	13.0	17.8	15.07	0.49	11.41
8	Days to first flower	DFF	64.0	69.0	66.9	0.48	2.51
9	Days to first maturity	DFM	122.0	127.0	124.58	0.53	1.47
10	Days to mean maturity	DMM	128.0	134.0	130.75	0.55	1.46
11	Oil content (%)	OIL	28.39	31.7	29.5	0.18	3.74
12	Seed weight/plot (g)	SWP	30.0	470.0	252.08	4.30	58.57

seeds per silique (>17.0) from Jodhpur (Rajasthan) and IC560724 for high oil content (31.7%) from district Jodhpur (Rajasthan).

Morpho-agronomic traits were mapped using GIS tools for showing variability distribution in the germplasm accessions. On the basis of areas identified (Table 2) for collection of trait-specific germplasm, area no. 0.97-2.0 and 1.28-2.0 in grid map representing regions with high diversity/variability (Fig. 3) while green areas represent regions with low diversity/variability. Colours of the grids are indicating the extent of diversity in the germplasm accessions. Analysis for richness in oil content using diversity indices method of DIVA-GIS showed that Jodhpur district of Rajasthan is potential area for collection of *B. tournefortii* germplasm with high oil content.

Conclusions

Although limited germplasm of Asian mustard is available in India but good variability has been present for plant height, number of primary branches per plant, oil content (%) and number of seeds per siliquae. Most of the promising accessions identified as useful donors were from Alwar and Jodhpur districts of Rajasthan; and Bhiwani district of Haryana mainly for traits like

Table 2. Promising donor genotypes of *B. tournefortii* germplasm identified for important traits

S.No.	Traits	Promising value	Promising donor genotypes		
			Accessions	Value	Source of collection
1	Dwarf plant height	< 80.0 cm	IC560717	78.8	Sikar, Rajasthan
			IC560720	70.6	Hisar, Haryana
			IC560722	76.2	Bhiwani, Haryana
2	Number of primary branches	>12.0	IC560703	15.6	Alwar, Rajasthan
			BT Yellow	13.0	Jodhpur, Rajasthan
			IC342758	13.0	
3	Length of main fruiting branch (cm)	>50.0 cm	IC560709	56.0	Jhunjhunu, Rajasthan
			BT Yellow	53.6	
			IC560703	52.0	Alwar, Rajasthan
4	No of siliquae on main fruiting branch	>30.0	RBT2003	32.0	Jodhpur, Rajasthan
			RBT2001A	31.2	
			BT Yellow	30.8	
5	Siliquae length (cm)	>4.0 cm	IC560709	4.3	Jodhpur, Rajasthan
			RBT2001A	4.1	
6	No. of seeds/siliquae	>17.0	RBT2002	18.6	Jodhpur, Rajasthan
			IC560711	17.8	
			IC560705	17.6	
7	Days to first flowering (early flowering)	< 65	RBT2003	63	Jodhpur, Rajasthan
			IC560722	64	Bhiwani, Haryana
8	Oil content (%)	>31.0	IC560724	31.7	Jodhpur, Rajasthan
9	Seed weight/plot (SWP) g	>12	IC560708	12.5	Mahendragarh, Haryana

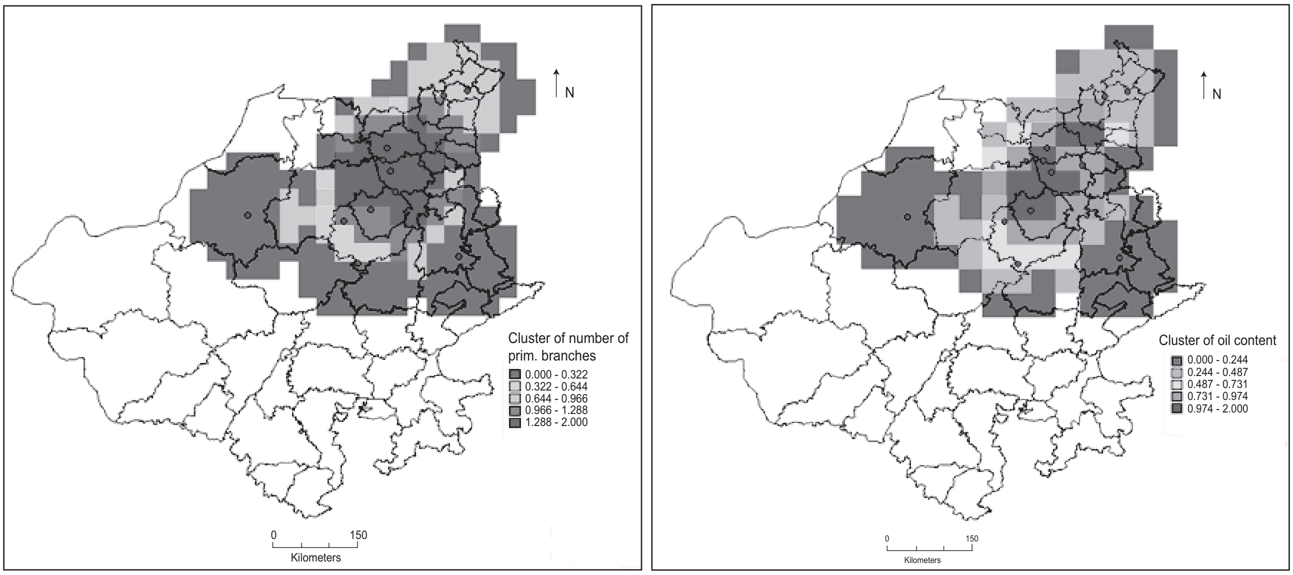

Fig. 3. Grid map showing diversity in number of primary branches and richness value of oil content

dwarf plant height, early maturity, high yield and high oil content. Such pockets need to be surveyed intensively for more number of germplasm to broaden genetic base and to utilize in breeding programmes of the crop. The development of improved cultivars through hybridization combining with high seed yield potential and specific fatty acid composition, disease, pest and drought resistance as well as low levels of glucosinolates would allow expanded production of spring grown *Brassica rapa* will be improved using *B. tournefortii* as oilseed crop across the northwestern parts of India.

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