Characterization of indigenously collected germplasm of yellow sarson (*B. rapa* L. var. *yellow sarson*) for yield contributing traits

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Abstract

Amongst the seven oilseed *Brassicas, Brassica juncea* Czern & Coss (Indian mustard) and *B. rapa* L are the important cultivated oilseed crop in India. *B. rapa* has three ecotypes, viz. *toria*, *brown sarson* and *yellow sarson* which grown in India. Yellow sarson mainly predominates in the Eastern part of the country. The presence of high oil content and yellow seed coat colour has preference over brown seeded *B. juncea*. The information on the nature and extent of variability in germplasm accessions for yield and other contributing traits is the pre- requisite of effective breeding programme. The seventy indigenously collected accessions of *B rapa* var. *yellow sarson* obtained from National Bureau of Plant Genetic Resources, New Delhi (India), were evaluated for 16 agro-morphological and quality traits, during *Rabi* season 2005-2006 under augmented design in 30 cm×10 cm spacing, with three national checks (NDYS 2, Pusa gold and YST 151) at the National Research Centre on Rapeseed-Mustard, Bharatpur (India). The maximum variability was observed for Seed yield (CV 47.5%) followed by secondary branches per plant (CV 26.7%). The least variability was observed for protein content (CV 2.6%) followed by oil content (CV 3.1%). Promising donors were also identified for various economic traits, for further use in improvement of this crop. Genotype IC 342762 has been found to be one of the useful donors for siliquae on main shoot and main shoot length. Genotype IC 336456 gave maximum seed yield (21.9 g/ plant). The highest 1000 seed weight (5.1 g) and seeds per siliqua (48.9) were recorded in genotype IC 361508 and IC 447740, respectively.

Correlation estimates between seed yield and other characters are useful in selection of desirable plant type and in designing an effective breeding programme. The seed yield had positive and significant correlation with, main shoot length, siliquae on main shoot, primary branches per plant, 1000-seed weight, oil content, harvest index and maturity period. Hence, selection for these traits will be desirable for increased seed yield.

Key words: Accession, correlation, genotype, evaluation, mustard, variability

Introduction

Rapeseed-mustard is a group of seven cultivated oilseed crops of *Brassica* species. *Brassica juncea* Czern & Coss (Indian mustard) and *B. rapa* L are the important oilseed crop in India. The *B rapa* divided into three well defined ecotypes *viz*., *toria*, *brown sarson* and *yellow sarson* which grown in India. Of theses, brown sarson appears to be the oldest in origin and the yellow sarson form is believed to be originated from brown sarson as a result of mutation (Prakash and Hinata 1980). The yellow sarson is a diploid having 20 chromosomes (2n = 20), of which 2 are very long, 8 are long, 6 are medium, 2 are small and 2 are very small (Sikka 1940) and its genomic constitution is regarded as AA (Morinaga 1934).Yellow sarson is self compatible in breeding behavior and is one of the most important members of the family *Brassica*ceae distributed in the Eastern part of the country which including Central and Western districts of Uttar Pradesh, West Bihar and North Bengal. Yellow sarson occupies an important position due to the presence of high oil content (up to 45 %), high seed yield and early maturing (around 100 days) as compared to Indian mustard (130-150 days), furthermore its yellow seed coat colour has preference over brown seeded. The oil mainly used as edible purposes and in addition to this, the yellow sarson is most preferred choice as leafy vegetables among all the cultivated oilseed *brassica*s in India.

Brassica breeding strategy involves assembling or generating variable germplasm for selection of superior genotypes for utilization them in hybridization programme to develop a superior variety. In order to incorporate desirable characters to maximize economic seed yield the information on the nature and extent of variability in the any crop germplasm accessions for yield and other advantageous contributing traits is the prerequisite for breeding programme. The effectiveness of selection for seed yield depends upon both, the genetic variability present in the population as well as the degree of association that exist between seed yield and its components traits. Therefore, the present investigation was undertaken to estimate the magnitude of genetic variability and correlation in the diverse germplasm of yellow sarson and to select superior donors/ genotypes.

Materials and Methods

Seventy accessions of yellow sarson (*Brassica rapa* L. var. *yellow sarson*) were evaluated during *rabi* (winter) season 2005-06 in an Augmented Complete Block Design with three national checks (NDYS 2, Pusa gold and YST 151) at the National Research Centre on Rapeseed–Mustard, Bharatpur, Rajasthan (India). Theses indigenously collected accessions of yellow sarson were acquired from National Bureau of Plant Genetic Resources, New Delhi (India). Each genotype was sown in paired rows of 3m length with 30×10 cm spacing. Recommended standard agronomic package of practices and plants protection measures were adopted.

Randomly tagged five plants were selected at appropriate growth stages to record observations on morphological traits namely, 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 and seeds per siliqua. Post harvest observations include seed yield per plant, 1000- seed weight, harvest index and quality traits such as oil and protein content. The mean value of five plants for each character was considered for computation, except for days to flower initiation, 50 % flowering and days to maturity (which was recorded on whole plot basis). 1000- seed was counted by electronic seed counter (Contador, Germany) and weighed by electronic balance. Further, oil and protein content were analyzed by Near Infrared Reflectance Spectroscopy (NIR), (Dickey- John, Instalab 600). Range, mean, and coefficient of variation were computed using standard statistical methods (Gomez and Gomez 1984).

Results and Discussion

The results of present investigation showed considerable diversity in germplasm as exhibited by wide ranges and moderate to high variability for all the morphological and quality traits as well. The data presented in Table 1 shows mean, ranges, coefficient of variation (CV) and standard error (SEm) with corresponding values of checks. On the basis of CV values, the highest (CV >40 %) was recorded for seed yield per plant, while moderate (CV 20-40 %) were observed for secondary branches per plant, siliquae on main shoot, siliqua beak length, seeds per siliqua, harvest index and 1000- seed weight, and lowest were recorded (CV ⩽20 %) for initiation of flowering, 50% flowering, days to maturity, plant height, primary branches per plant, main shoot length, siliqua length, oil and protein content. Since these characters have wider variability, they can be used to make selection in yellow sarson accessions. Similar trends for genetic variations were reported by various other workers in some of the earlier reports (Varshney and Shankara 1997, Kumar *et al* 2001, Yadav *et al* 2001, Katiyar *et al* 2004, Patel and Patel 2005).

Promising donors were identified for various seed yield contributing traits which to be a useful donors in the variety development programme. Accession IC 361512 was identified as a useful donor for early flowering, high harvest index, more number in primary branches and secondary branches per plant (Table 2). The accessions IC 342762 and IC 334290 were recorded for more number of siliquae on main shoot and long main shoot length compared to the best check. IC 355382 accessions had high oil content and 1000-seed weight, further IC 520748 showed more seeds per siliqua and primary branches per plant. Besides this accession IC 355365 had long siliqua and high harvest index and IC 447818 recorded for short plant height and more number primary branches per plant Highest seed yield per plant (21.9 g), 1000- seed weight (5.1 g) and number of seeds per siliqua (48.9) recorded in accession IC 336456, IC 361508 and IC 447740, respectively.

Correlation estimates between seed yield and other morphological traits are useful in selection of desirable plant type in designing an effective breeding programme. Seed yield is a complex phenomenon, which is encompassing the interactions between many yield-contributing traits. Therefore, selection should be based keeping in view of these traits and their correlation with seed yield. In the present investigation, the seed yield per plant was positively and significantly correlated with main shoot length, siliquae on main shoot, primary branches per plant, oil content, 1000 seed- weight, harvest index and days to maturity, while remaining characters observed non-significant correlations except two character seed per siliqua and protein content which showed negative but significant correlations with this trait (Table 3). Seeds per siliqua showed positive and significant correlations with initiation of flowering, 50% flowering and siliqua length. Significant positive correlations of harvest index with main shoot length, 1000- seed weight and oil content. Similarly significant positive correlations was recorded in siliquae on main shoot with main shoot length and plant height; oil content with 1000- seed weight; plant height with initiation of flowering and 50% flowering; siliqua length with plant height as well as primary branches per plant with initiation of flowering and plant height. Hence, selection for the higher values of these traits will be desirable for increase seed yield. Similar observations for correlations with seed yield were reported in some of the earlier report in *Brassica* species (Kumar *et al* 2001, Yadav *et al* 2001, Katiyar *et al* 2004, Misra *et al* 2004, Patel and Patel 2005). The associations between the yield related attributes reveal the mutual relationship between two or more characters; therefore, it is an important parameter for taking a decision regarding the selection and its further utilization in improvement in the crop.

Conclusions

The present investigation revealed that there is an adequate variability for secondary branches, siliquae on main shoot, seeds per siliqua, 1000- seed weight and harvest index in the indigenously collected germplasm of *Brassica rapa* L. var. *yellow sarson*. The promising accessions can be used directly for hybridization and other breeding strategy related to genetic enhancement of yellow sarson. It may be concluded that characters such as seeds per siliqua, siliquae on main shoot, oil content, harvest index, 1000 seed weight and seed yield per plant will help in improving the seed yield directly and indirectly. Therefore these characters should be considered for seed yield improvement in yellow sarson breeding programmes.

References

Gomez KA and AA Gomez (1984) Statistical Procedures for Agricultural Research. (*Wiley Inter-Science Publ.: New York*).

Katiyar RK, R Chamola, HB Singh and S Tickoo (2004) Heterosis and combining ability analysis for seed yield in yellow sarson (*Brassica campestris* Prain. var. *yellow sarson*). *Brassica* **6** (1&2) 23-28.

Kumar A, YS Chauhan, K Kumar and KN Maurya (2001) Genetic variability for seed yield and components traits in newly collected germplasm of yellow sarson (*Brassica rapa* L. var. *yellow sarson*). *Indian J. Pl. Genet. Resour.* **14** (3) 396-397.

Misra AK, S Ratan and A Kumar (2004) Germplasm evaluation of Indian mustard (*B. juncea* (L.) Czern & Coss). *J. Oilseeds Res.* **21** 248-251.

Moringa T (1934) Interspecific hybridization in *Brassica* VI. The cytology of F_1 hybrids of *B juncea* and *B nigra*. *Cytologia* **6** 62-67.

Patel AR, and KM Patel (2005) Genetic variability in Rapeseed (*Brassica rapa* L. var. *yellow* and *brown sarson*). *Brassica* **7** (1&2) 71-72.

Prakash S and K Hinata (1980) Taxonomy, cytogenetics and origin of crop *Brassica*s: A review. *Opera Bot.* **55** 1-57.
Sikka SM (1940) Cytogenetics of *Brassica* hybrids and species. *J. Genet.* **40** 441-509.
Varshney SK and C. Shankara Rao (1997) Combining ability, heterosis and inbreeding depression for yield and yield components in yellow sarson (*Brassica rapa* L. var. *yellow sarson*) *Indian J. Genet* **57** (1) 91-96.
Yadav SK, AK Shukla, JS Chauhan, AK Singh and PR Kumar (2001) Comparative analysis of variability in two ecotypes of Indian rapeseed (*Brassica rapa* L. var. *yellow* and *brown sarson*). *Indian J. Pl. Genet. Resour.* **14** (1) 65-69.

Table 1. Variability in some agro-morphological traits in yellow Sarson

Characters	Range	Mean + SEm	CV (%)	Mean values of checks		
				Pusa Gold	YST 151	NDYS 2
Initiation of flowering (days)	38-55	47.4 + 0.7	11.1	54	51	47
50 % flowering (days)	38-65	53.4 + 0.5	8.8	61	57	53
Plant height (cm)	67-145	97.2 + 2.0	17.8	118	94.5	114.5
Primary branches per plant	2.6-6.4	4.29 + 0.1	18.6	5.4	3.8	4.5
Secondary branches per plant	1.8-5.6	2.9 + 0.1	26.7	3.4	2.9	3.5
Main shoot length (cm)	34.6-69	44.6 + 0.8	15.1	50.5	39.5	48.5
Maturity (days)	100-133	118.1 + 1.3	9.6	122	116.5	118.5
Siliqua beak length (cm)	0.64-2.29	1.4 + 0.1	26.6	1.5	1.3	1.2
Siliqua length (cm)	2.64-4.66	3.75 + 0.1	11.2	4.1	3.6	3.9
Siliquae on main shoot	13.4-41.4	23.5 + 0.7	23.8	27.9	25.7	24.8
1000-seed weight (g)	1.65-5.08	3.2 + 0.1	25.7	2.74	3.04	2.73
Harvest index (%)	7.2-31.56	23.4 + 0.7	24.8	25.1	22.9	24.2
Seeds per siliqua	13.9-48.9	28.6 + 0.9	25.4	26.9	31.5	39
Protein content (%)	18.8-21.1	19.9 + 0.2	2.6	20.3	20.4	21.3
Oil content (%)	38.5-45.5	42.8 + 0.2	3.1	41.5	42.7	41.8
Seed yield per plant	2.96-21.86	9.22 + 0.5	47.5	17.7	15.4	17.1

Table 2. Promising accessions of yellow Sarson

Characters	Promising Accessions
Initiation of flowering (Days)	⩽ 47: IC 331817, IC 342766, IC 361510, IC 361512
50 % flowering (Days)	⩽ 53: IC 331817, IC 334283, IC 334291, IC 520823
Plant height (cm)	> 118: IC 447818, IC 447822, IC 520757, IC 521379
Primary branches per plant	> 5.4: IC 361512, IC 447818, IC 520748, IC 520749
Secondary branches per plant	> 3.5: IC 355391, IC 355397, IC 361512, IC 520748
Main shoot length (cm)	> 50.5: IC 334290, IC 336456, IC 342762, IC 342768
Siliquae on main shoot	> 28.0: IC 336456, IC 342760, IC 342762, IC 361506
Siliqua length (cm)	> 4.1: IC 342766, IC 355365, IC 520755, IC 520771
Seeds per siliqua	> 39.0: IC 447740, IC 447824, IC 520315, IC 520748
1000-seed weight (g)	> 3.04: IC 355412, IC 355368, IC 355382, IC 361508
Seed yield per plant (g)	> 17.7: IC 336456, IC 520771
Harvested index (%)	> 25.1: IC 334200, IC 334290, IC 355365, IC 361512
Oil content (%)	> 42.7: IC 342283, IC 355307, IC 355312, IC 355368, IC 355378, IC 355382

Table 3. Correlations among the different agro-morphological traits in yellow sarson

Characters	Initiation of flowering	50 % flowering	Plant height	Primary branches per plant	Secondary branches per plant	Main shoot length	Siliquae on main shoot	Siliqua length	Siliqua Beak length	Seeds per Siliqua	1000seed weight	Protein content	Oil content	Harvest Index	Maturity Period
50 % flowering	0.89*														
Plant height	0.54*	0.33*													
Primary per branches	0.25*	-0.06	0.40*												
Secondary per branches	0.06	0.04	0.24*	0.46*											
Main shoot length	0.01	0.12	0.30*	0.15	0.10										
Siliquae on main shoot	0.10	0.12	0.39*	0.13	0.19	0.68*									
Siliqua length	0.10	0.08	0.27*	-0.05	-0.07	-0.10	-0.05								
Siliqua beak length	-0.11	0.16	-0.23	-0.37*	-0.22*	0.29*	0.09	-0.08							
Seeds per siliqua	0.38*	0.43*	0.03	-0.13	-0.13	-0.20	-0.20	0.28*	0.04						
1000-seed weight	-0.52*	-0.18	-0.62*	-0.37*	-0.23	0.15	-0.02	-0.14	0.43*	-0.14					
Protein content	0.10	0.09	0.19	0.02	0.20	-0.01	0.15	-0.27*	-0.01	0.15	-0.29*				
Oil content	-0.40*	-0.11	-0.55*	-0.26*	-0.28*	-0.02	-0.19	0.08	0.13	-0.18	0.68*	-0.61*			
Harvest index	-0.33*	-0.14	-0.28*	0.10	0.11	0.22*	0.15	-0.01	-0.02	-0.20	0.50*	-0.29*	0.63*		
Days to maturity	-0.59*	-0.18	-0.67*	-0.36*	-0.20	0.27*	0.09	-0.29*	0.46*	-0.29*	0.83*	-0.30*	0.61*	0.49*	
Seed yield per plant	0.00	0.06	0.10	0.27*	0.17	0.51*	0.38*	0.01	0.13	-0.33*	0.31*	-0.33*	0.38*	0.61*	0.32*

*significant at 5 % level