

Original Research Article

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Seed Vigour Assessment in Different Varieties of Indian mustard (*Brassica juncea* (L.) Czern. & Coss.)

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ABSTRACT

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The experiment was conducted at the laboratories of the Department of Seed Science and Technology, CCS HAU, Hisar, during 2014-15 and 2015-16 to assess the seed vigour of twenty Indian mustard varieties/genotypes. The freshly harvested seed of all the varieties was assessed for seed vigour parameters viz., test weight (g), germination percentage, seedling length (cm), seedling dry weight (mg), vigour index-I, vigour index-II, electrical conductivity test ($\mu\text{S cm}^{-1}\text{g}^{-1}$), tetrazolium test percentage and dehydrogenase activity test ($\text{OD g}^{-1}\text{ml}^{-1}$). The pooled data of both the years revealed that the highest test weight (6.01) was recorded in the variety RH0406, while the highest germination percentage (96.83), seedling length (14.98), seedling dry weight (2.54), vigour index-I (1450), vigour index-II (245), tetrazolium test percentage (97.91) and dehydrogenase activity (0.847) was recorded in the variety RH30 followed by Kranti and Varuna. The lowest electrical conductivity was also recorded in the variety RH30 (12.567) followed by Kranti (13.500), Varuna (13.567) and NRCD601 (13.822). Among all the twenty Indian mustard varieties, the varieties RH30, Kranti, Varuna and NRCD601 showed superiority for almost all viability and vigour parameters.

Introduction

Indian mustard (*Brassica juncea*) belongs to the Cruciferae (Brassicaceae) family. The family *Brassicaceae*, containing about 350 genera and 3500 species, is one of the ten most economically important plant families with a wide range of agronomic traits. In India, the *Brassica* oilseed is collectively referred to as rapeseed-mustard, which is the most important *Rabi* oilseed crop and occupies an important position in the rain fed agriculture of our country.

Seed is an important component of agricultural production and industry in India

and quality seed is the foundation of a successful crop production programme. The quality seed plays an important role in the agricultural production as well as in national economy. Therefore the good quality seed is necessary to enhance the production and productivity. Seed quality is primarily determined by its genetic and physical purity, germination and vigour. Among these, germination and purity decide its planting value. The seed quality is determined by different factors including seed viability and vigour which imparts inherent capacity to grow under favourable and unfavourable

conditions. Availability of viable and vigorous seed at the planting time is important for achieving targets of agricultural production because good quality seed acts as a catalyst for realizing the full potential of other inputs. Seed vigour is a concept describing several characteristics which include the rate and uniformity of germination and growth, tolerance to environmental stress after sowing and retention of performance after storage. Differences in vigour are only revealed in practice when germination tests fail to indicate emergence differences in the field. There are also many laboratory reports where seed lots having similar germination but large differences in their ability to germinate in field (Matthews, 1980). The establishment of good plant stand is one of the requirement for higher production. It was found that plants from higher quality seed produces 18% higher yield than those obtained from low quality seed (Bishnoi & Delouche 1980).

The advantages of high seed vigour are most apparent in early seedling growth and are often associated with rapid and high rate of emergence and crop stand establishment. Seed which perform well in some or all of these aspects is termed high-vigour seed (Black and Bewely, 2000). Vigour is the first component of seed quality, loss of which is followed by a loss of germination capacity and viability (Trawatha *et al.*, 1995).

Now a days, the seed vigour as a quality attribute has gained significance which is a highly complex character influenced by many parameters. Physiological tests measure some aspects of germination or seedling growth while various biochemical tests based on electrical Conductivity of seed leachate (EC), tetrazolium test (TZ), dehydrogenase activity (DHA) and Peroxidase Enzyme have been used to predict prognosis the seed viability and vigour

Materials and Methods

The freshly harvested Seed of all the twenty Indian mustard varieties were used for the assessment of seed vigour. The experiment was conducted at the laboratories of Department of Seed Science and Technology during the period of 2014-15 and 2015-16. The list of varieties and their source is given below:

The seed of twenty Indian mustard varieties were analyzed in the laboratory for seed quality parameters viz., test weight (g), standard germination (%), seedling length (cm), seedling dry weight (mg), vigour index-I, vigour index-II, electrical conductivity test ($\mu\text{S cm}^{-1}\text{g}^{-1}$), tetrazolium test (%) and dehydrogenase activity test ($\text{OD g}^{-1}\text{ml}^{-1}$).

Test weight (g)

For test weight one thousand seed in three replications from each variety/genotype were counted and weighed and average seed weight of each variety was calculated and expressed in gram.

Standard germination (%)

Three replication with 100 seeds per replication from each variety were placed on the top of filter papers (T.P.) in 18 cm diameter Petri plates containing 15 ml of water. The petri plates were then kept in the germinator at $20 \pm 1^{\circ}\text{C}$. The first counting of normal seedling was made on 5th day and final counting was made on 7th day (ISTA 1985) and normal seedlings were expressed as per cent germination.

Seedling length (cm)

Ten normal seedlings at the time of final count were randomly selected from each replication of all the varieties/genotypes and

their length was measured in cm. Average length of these seedlings was calculated.

Seedling dry weight (mg)

Ten normal seedlings which were used for the measurement of seedling length were also used for seedling dry weight measurement. These were dried in hot air oven at 80°C temperature for 48 h. Then seedlings were removed from oven and allowed to cool in desiccator for 30 minutes before weighing on an electronic balance. The average weight of dried seedlings from each replication was calculated and expressed as dry weight of seedling in milligrams.

Vigour index (I and II)

Seedling vigour indices were calculated by using the formula suggested by (Abdul-Baki and Anderson, 1973) by the formula given below:-

Seedling vigour index-I = Standard germination (%) x seedling length (cm)

Seedling vigour index-II = Standard germination (%) x seedling dry weight (mg)

Electrical conductivity test ($\mu\text{S cm}^{-1}\text{g}^{-1}$)

In each lot, one hundred normal and uninjured seeds in each replication were weighed and put in to 250 ml beakers containing 50 ml of distilled water. Seeds were immersed completely in water and the beakers were covered with foil. Thereafter, these samples were kept in the germinator at 20°C for 24 h. The electrical conductivity of seed leachates was determined by conductivity meter expressed in $\mu\text{S cm}^{-1}\text{g}^{-1}$.

Tetrazolium test (%)

The tetrazolium viability test (Moore, 1973) based on three replication of 100-seeds each

was followed. The seed were moistened for 16 h at room temperature. After peeled off the seed coat, the seeds were stained in 0.5 per cent tetrazolium chloride solution, pH 7.0 for 4-5 at 38°C. The number of seeds stained entirely red were considered as viable seeds and expressed in percentage.

Dehydrogenase activity test ($\text{OD g}^{-1}\text{ml}^{-1}$)

The dehydrogenase activity was assayed by the method suggested by (Kittock and Law 1968) and is described below:

The representative seeds of each lot, replicated thrice were grounded to pass through a 20- mesh screen. The 200 mg flour was soaked in 5 ml of freshly prepared 0.5 per cent, 2, 3, 5 triphenyl tetrazolium chloride solution (pH 7.0) at 35°C for 2 hour in dark. Then it was centrifuged at 10,000 rpm for 3 min. and the supernatant was poured off. The formazon was extracted with 10 ml acetone for 16 hour followed by centrifugation as above. The absorbance of the solution was determined in a Backman DU-64 Spectrophotometer at 570 nm. These observed were recorded at optimal density.

Results and Discussion

In the present study, twenty Indian mustard varieties were evaluated to have substantial information on their vigour parameters. The test weight of 1000 seed of all the twenty Indian mustard varieties was recorded and the maximum test weight was recorded in variety RH0406 (6.01) and lowest (4.42) was observed in NRCHB101. The test weight ranged from 4.42 to 6.01 g with a general mean of 5.54 g (Table 1). Similar observations were recorded by Patra *et al.*, (2006) and Shalini *et al.*, (2000) in Indian mustard. The maximum germination percentage was expressed by the variety RH30 (96.83) followed by Kranti (96.17), Varuna (95.33), NRCDR601 (94.50) and

RH819 (93.83). Whereas the minimum was observed in NRCHB101 (85.33) followed by RB50 (85.67), RH0119 (86.67), RH0406 (87.67) and RH8113 (88.17). The standard germination among all the varieties ranged from 85.33 to 96.83 per cent with overall mean values as 90.88 per cent. The results are in conformity with findings of (Christiansen and Rowland, 1981) in cotton, (Pallavi *et al.*, 2003) in sunflower and Gupta *et al.*, (2005) in pearl millet. The variety RH30 showed maximum (14.98) seedling length followed by Kranti (14.61) whereas the variety NRCHB101 (8.94) showed minimum seedling length. Among the twenty varieties, only seven varieties showed maximum seedling length and thirteen showed minimum Seedling length (Table 1). The results are in conformity with findings of (Dharmalingam and Basu, 1978; Khan *et al.*, 1998; Basra *et al.*, 2003) in cotton, (Maity *et al.*, 2000) in mung bean, (Verma *et al.*, 2003) in mustard, (Pallavi *et al.*, 2003) and Khan *et al.*, (2003) in sunflower, The varieties RH30 (2.54), Kranti (2.42), Varuna (2.39), NRCDR601 (2.29) and RH819 (2.25) showed higher seedling dry weight while the varieties NRCHB101 (1.68), RB50 (1.74), RH0119 (1.85), RH0406 (1.83) and RH8113 (1.90) showed lower seedling dry weight. The range of seedling dry weight (mg) accumulation

varied from 1.68 to 2.54(mg) with the overall mean value of 2.07. Similar observations were recorded by Paul and Ramaswamy (1979) in cowpea

The seed vigour index-1 was calculated by multiplying the standard germination percentage with seedling length (cm). The comparison among the mean values of varieties showed that out of twenty varieties, six were having mean value above the general mean and fourteen varieties were having values below the general mean. The variety RH30 (1450.58), observed higher vigour index- I whereas NRCHB101 (763.11) observed lower vigour index- I. The results are in conformity with findings of Abdul-Baki and Anderson (1973a, 1973b) in soyabean, Verma *et al.*, (2003) in mustard, Pallavi *et al.*, (2003) in sunflower Gupta *et al.*, (2005) in pearl millet. Seed vigour index-II was calculated by multiplying standard germination percentage with seedling dry weight (mg). The data revealed that the variety RH30 showed maximum vigour index value of 245.55 whereas NRCHB101 recorded minimum value of 143.40. The range of vigour index II varied from 143.00 to 245.55 with a general mean of 188.98 (Table 1). Similar findings were reported by Basu *et al.*, (2004) in maize

Source of Seed: Seed of 20 Indian mustard varieties

Variety	Source	Variety	Source	Variety	Source
RH30	CCSHAU, Hisar	RH0119	CCSHAU, Hisar	NRCDR601	DRMR Bharatpur
RH8812	CCSHAU, Hisar	RH9304	CCSHAU, Hisar	NRCHB101	DRMR Bharatpur
RH8113	CCSHAU, Hisar	RH9801	CCSHAU, Hisar	DRMRIJ31	DRMR Bharatpur
RH0749	CCSHAU, Hisar	RH819	CCSHAU, Hisar	NPJ112	IARI, New Delhi
RB50	CCSHAU, Hisar	RH781	CCSHAU, Hisar	RGN73	RAU, Sriganganagar
RH0406	CCSHAU, Hisar	Varuna	CSAUA&T Kanpur	Kranti	GBPUA&T, Pantnagar
RB24	CCSHAU, Hisar	NRCDR02	DRMR Bharatpur		

Table.1 Mean performance of different seed vigour parameters in twenty varieties of Indian mustard (Pooled mean)

S. No.	Varieties	TW	SG	SL	SDW	VI-I	VI-II	EC	TZ	DHA
1	RH30	5.95	96.83(79.72)	14.98	2.54	1,450.58	245.55	12.567	97.91(81.82)	0.847
2	RH8812	5.12	90.50(72.18)	10.62	1.97	960.44	178.23	14.987	90.27(72.10)	0.702
3	RH8113	5.29	88.17(69.91)	9.62	1.90	848.70	167.67	20.802	86.47(68.43)	0.677
4	RH0749	5.41	88.50(70.18)	11.45	2.10	1,013.38	185.81	15.04	86.83(68.77)	0.707
5	RB50	5.30	85.67(67.76)	9.15	1.74	782.10	148.60	22.333	83.77(66.29)	0.570
6	RH0406	6.01	87.67(69.51)	9.47	1.83	831.11	160.25	21.333	85.72(67.80)	0.647
7	RB24	5.74	90.50(72.05)	10.73	2.12	971.50	191.63	14.667	88.29(70.00)	0.698
8	RH0119	5.87	86.67(68.69)	9.29	1.85	805.33	160.91	21.983	84.96(67.22)	0.598
9	RH9304	5.89	91.67(73.48)	10.69	1.99	979.41	181.93	14.667	87.28(69.21)	0.702
10	RH9801	5.95	89.83(71.41)	9.97	2.00	894.12	179.88	15.033	87.44(69.28)	0.705
11	RH819	5.82	93.83(75.79)	13.03	2.25	1,221.88	210.96	14.33	95.86(78.31)	0.753
12	RH781	5.73	92.50(74.33)	10.24	2.03	945.44	187.62	15.035	88.04(69.88)	0.713
13	Varuna	5.58	95.33(77.55)	13.75	2.39	1,310.19	227.72	13.567	96.88(79.95)	0.807
14	NRCDR02	5.67	91.00(72.57)	11.15	2.14	1,015.42	194.58	15.083	89.58(71.28)	0.695
15	NRCDR601	5.84	94.50(76.64)	13.58	2.29	1,283.14	216.10	13.5	96.46(79.15)	0.773
16	NRCHB101	4.42	85.33(67.57)	8.94	1.68	763.11	143.40	22.667	83.33(65.89)	0.555
17	DRMRIJ31	5.98	91.67(73.43)	11.05	2.20	1,012.84	201.73	14.847	88.99(70.68)	0.717
18	NPJ112	4.84	92.50(74.10)	11.54	1.95	1,068.26	180.53	15	88.85(70.51)	0.720
19	RGN73	5.72	88.83(70.52)	10.92	2.07	969.90	183.80	14.945	87.61(69.42)	0.703
20	Kranti	4.77	96.17(79.02)	14.61	2.42	1,404.20	232.64	13.822	97.88(82.00)	0.837
	Mean	5.54	90.88	11.24	2.07	1026.55	188.98	16.310	89.62	0.706
	Range	4.42-6.01	85.33-96.83	8.94-14.98	1.68-2.54	763.00-1,450.58	143.00-245.55	12.567-22.667	83.33-97.91	0.555-0.847
	SE(m)	0.02	1.51	0.28	0.09	28.55	9.81	0.823	1.40	0.010
	C.D.	0.06	4.32	0.80	0.25	81.92	28.15	2.36	4.02	0.029

TW- Test weight(g), SG- Standard germination(%), SL- Seedling length(cm), SDW- Seedling dry weight(mg),VI- vigour indices-I, VI-vigour indices-II, EC- Electrical conductivity, TZ- Tetrazolium test, DHA- Dehydrogenase activity.

In electrical conductivity test variety NRCHB101 recorded maximum value (22.667), while the variety RH30 showed minimum value (12.567). Here maximum value for electrical conductivity means that the variety is poor for storage and lower value means variety have good storability and process of seed ageing is low. The results are in close conformity with findings of Onyilagha *et al.*, (2011) in *Brassica napus*, Ramanadance and Ponnuswamy (2004) in rice.

The tetrazolium test percentage and dehydrogenase activity was higher in the variety RH30 (97.91) followed by Kranti (97.88) and varuna (96.88) whereas the variety NRCHB101 (83.33), showed minimum viability percentage as well as minimum dehydrogenase activity (Table 1). Similar results were also reported by Steiner *et al.*, (1989) in wheat and Krishnappa *et al.*, (1999) in groundnut.

Among the twenty Indian mustard varieties, RH30, kranti, varuna and RH819 were found to be superior in viability and vigour as compared to the rest of varieties.

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