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Assessment of seed vigour in different varieties of Indian mustard (*Brassica juncea* (L.) Czern. & Coss.)

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Abstract

An experiment was conducted at the laboratories of the Department of Seed Science and Technology, CSAU, Kanpur, during 2018-19 and 2019-20 to assess the seed vigour of twenty One Indian mustard varieties/genotypes. The freshly harvested seed of all the varieties variety/genotypes 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, Accelerated ageing test, Electrical conductivity test ($\mu\text{S cm}^{-1} \text{ g}^{-1}$), and Tetrazolium test percentage. The pooled data of both the years revealed that the highest test weight (6.73) was recorded in the variety Anmol, Pusa Bold, Bullet, while the highest germination percentage (94.72), seedling length (12.64), seedling dry weight (2.39), vigour index-I (1282.13), vigour index-II (243.84), and tetrazolium test percentage (96.54) was recorded in the Jagay Mani-1(96.54) followed by RH-30 (96.27), Giridhar (95.02), Prerna (94.52) and Dangi (89.36) The lowest electrical conductivity was also recorded in the variety Tanru-M (22.06) followed by Sitaram Rai (20.98), Anmol (20.52), Bathani (20.50) and Purni (18.52). Among all the twenty One Indian mustard varieties, the varieties Jagay Mani-1, RH30, Giridhar, Prerna, PM-25, PM-27, Dangi, and Araak showed superiority for almost all viability and vigour parameters. and Accelerated ageing test was also recorded in the variety The stress condition provided by the artificial ageing for 72 h in accelerated ageing chamber showed that the varieties Jagay Mani-1(78.90), PM-27 (76.44), RH-30 (76.16), PM-25 (74.35) and Kali (74.22) and had higher stress bearing capacity because these showed higher germination percentage even after the artificial ageing. On the contrary, the genotype Potni (62.34), Batani (62.42), Pomi (62.53), Tanru-M (62.94) and Giridhar (69.05) showed reduction in germination percentage after stress. The range varied from 62.34 to 78.90 with a general mean of 71.01 (Table 4.5). The comparison among the mean values showed 13 varieties were superior where as Eight varieties were inferior.

Keywords: Assessment, vigour, varieties, mustard, *Brassica juncea* L.

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 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) [18]. 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) [18]. 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) [27]. 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) and tetrazolium test (TZ) have been used to predict prognosis the seed viability and vigour. Materials and Methods The freshly harvested Seed of all the twenty One 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 2018-19 and 2019-20. 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, Accelerated ageing test, electrical conductivity test ($\mu\text{S cm}^{-1} \text{ g}^{-1}$) and tetrazolium test (%). 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 $20 \pm 10\text{C}$. The first counting of normal seedling was made on 5th day and final counting was made on 7th day (ISTA 1985) [12] 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 Int. J. Curr. Microbiol. App. Sci (2017) 6(10): 1930-1936 1932 their length was measured in cm. Average length of these seedlings was calculated. 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.

Materials and Methods

The freshly harvested Seed of all the twenty Indian mustard varieties/genotypes 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 2018-19 and 2019-20. The list of varieties and their source is given below: The seed of twenty One Indian mustard varieties/genotypes 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 ($\mu\text{S cm}^{-1} \text{ g}^{-1}$) and tetrazolium test (%). 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 $20 \pm 10\text{C}$. The first counting of normal seedling was made on 5th day and final counting was made on 7th day (ISTA 1985) [12] 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 80C 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) [2, 3] 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).

Accelerated ageing test (%)

The stress condition provided by the artificial ageing for 72 h in accelerated ageing chamber and showed that the varieties Jagay Mani-1(79.06), PM-27 (76.21), RH-30 (75.54), Kali (74.22) and PM-25 (74.13) had higher stress bearing capacity because these showed higher germination percentage even after the artificial ageing. On the contrary, the genotype Bathani (62.17), Potni (62.21), Pomi (62.22) Tanru-M (63.04) and Giridhar (69.07) showed reduction in germination percentage after stress. The range varied from 62.17 to 79.06 with a general mean of 70.92 (Table 4.5). The comparison among the mean values showed 16 varieties were superior where as Five varieties were inferior.

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 20C 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) [19] based on three replication of 100-seeds each Jagay Mani-1(96.54). Whereas the minimum was observed in Purni (81.39) followed by Bathani (81.55), Sitaram Rai (82.02), Tanru-M (82.04) and Lotni Gol (83.30). The standard germination

among all the varieties ranged from 85.15 to 94.72 per cent with overall mean values as 88.52 per cent. The results are in conformity with findings of (Christiansen and Rowland, 1981) in cotton, (Pallavi *et al.*, 2003) [21] in sunflower and Gupta *et al.*, (2005) [11] in pearl millet. The variety Jagay Mani-1 showed maximum (12.64) seedling length followed by RH-30 (12.57) whereas the variety Purni (3.36) showed minimum seedling length. Among the twenty One varieties, only eleven varieties showed maximum seedling length and ten 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) [10, 13, 4] in cotton, (Maity *et al.*, 2000) [17] in mung bean, (Verma *et al.*, 2003) [28] in mustard, (Pallavi *et al.*, 2003) [21] and Khan *et al.*, (2003) [14] in sunflower, The varieties Jagay Mani-1 (2.39), followed by RH-30 (2.34), Pomi (1.58), Sitaram Rai (1.51) and PM-25 (1.48) showed higher seedling dry weight while the varieties while the varieties Kali (1.19), Araak (1.21), Potni (1.22), Purni (1.25) and Prerna (1.26) showed lower seedling dry weight.. The range of seedling dry weight (mg) accumulation 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.

Results and Discussion

In the present study, twenty One Indian mustard varieties were evaluated to have substantial information on their vigour parameters. The test weight of 1000 seed of all the twenty One Indian mustard varieties was recorded and the maximum test weight was recorded in variety Anmol (6.73) and lowest (4.42) was observed in Bathani. The test weight ranged from 3.60 to 6.73 g with a general mean of 4.12 g (Table 1). Similar observations were recorded by Patra *et al.*, (2006) and Shalini *et al.*, (2000) [25] in Indian mustard. The maximum germination percentage was expressed by the variety Jagay Mani-1 (94.72) followed by RH-30 (93.02), Prerna (92.81), Giridhar (92.81) and Dangi (90.64), Potni (90.65), Araak (90.61) and Tejan (88.63), Whereas the minimum was observed in followed by Lotni Gol (85.15), Purni (85.18), Tanru-M (85.22), Anmol (85.45), Bathani (85.50) and Sita ram Rai (85.54). and varied from 85.15 to 94.72 per cent with

overall mean values as 88.52 per cent. Similar observations were recorded by Paul and Ramaswamy (1979) [23] in cowpea. Bony *et al.*, (2017)- After seed treatment, the seeds were sown in the field with four replications adopting randomized block design in order to find out the effect of seed treatments on field emergence, plant biometrics *viz.*, plant height, disease incidence at different stages (25 DAS, 50 DAS and 75 DAS), 100 seed weight, number of pods per plant and yield per hectare under field conditions were recorded. Jitender *et al.*, (2018)- germination, seedling length, seed weight, seed density, vigour index-I, vigour index-II, accelerated ageing test, electrical conductivity, tetrazolium test, dehydrogenase activity test, field emergence index and seedling establishment in summer and kharif season to assess the association among different seed quality parameters. Mishra *et al.*, (2017)- It was found that all the priming method showed significant difference with the control and the highest per centage germination, seedling length, weight and germination index were observed for PEG priming for 14 hours.

The seed vigour index-I 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 One varieties, nine were having mean value above the general mean and twelve varieties were having values below the general mean. The variety Giridhar (1282.13), observed higher vigour index- I whereas Bathani (721.37) observed lower vigour index- I. The results are in conformity with findings of AbdulBaki and Anderson (1973a, 1973b) [2, 3] in soyabean, Verma *et al.*, (2003) [28] in mustard, Pallavi *et al.*, (2003) [21] in sunflower Gupta *et al.*, (2005) [11] 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 243.84 whereas Bathani recorded minimum value of 112.09. The range of vigour index II varied from 112.09 to 243.84 with a general mean of 171.75 (Table 1). Similar findings were reported by Basu *et al.*, (2004) [6] in maize. Meena *et al.*, (2017)- The results of the study revealed that the seed quality parameters *viz.*, germination per cent, root length, shoot length, seedling vigour index and seedling dry weight decreased with an advancement of storage period but the electrical conductivity values were increased with advancement in storage period.

Table 1: Seed Source of 21 Different Indian Mustard Varieties/Genotypes.

Variety	Source	Variety	Source	Variety	Source
RH30	Seed was procured from DUS Test unit, CSAUAT, Kanpur	JAGAY MANI-1	Seed was procured from DUS Test unit, CSAUAT, Kanpur	KALI	Seed was procured from DUS Test unit, CSAUAT, Kanpur
PUSA MUSTARD-27	Seed was procured from DUST estunit, CSAUAT, Kanpur	PURNI	Seed was procured from DUS Test unit, CSAUAT, Kanpur	DANGI	Seed was procured from DUS Test unit, CSAUAT, Kanpur
PUSA MUSTARD-25	Seed was procured from DUS Test unit, CSAUAT, Kanpur	ANMOL	Seed was procured from DUS Test unit, CSAUAT, Kanpur	ARAK	Seed was procured from DUS Test unit, CSAUAT, Kanpur
PUSA BOLD	Seed was procured from DUS Test unit, CSAUAT, Kanpur	BULLET	Seed was procured from DUS Test unit, CSAUAT, Kanpur	PRERNA	Seed was procured from DUS Test unit, CSAUAT, Kanpur
POMI	Seed was procured from DUS Test unit, CSAUAT, Kanpur	SITARAM RAI	Seed was procured from DUS Test unit, CSAUAT, Kanpur	BOORI	Seed was procured from DUS Test unit, CSAUAT, Kanpur
BATHNI	Seed was procured from DUS Test unit, CSAUAT, Kanpur	TEJAN	Seed was procured from DUS Test unit, CSAUAT, Kanpur	GIRIDHAR	Seed was procured from DUS Test unit, CSAUAT, Kanpur
POTNI	Seed was procured from DUS Test unit, CSAUAT, Kanpur	LOTNI GOL	Seed was procured from DUS Test unit, CSAUAT, Kanpur	TANRU-M	Seed was procured from DUS Test unit, CSAUAT, Kanpur

Table 2: Seed vigour assessment in different varieties of Indian mustard (Pooled mean)

S. No.	Varieties	TW	SG	SL	SDW	VI-I	VI-II
1	Anmol	6.73	85.45(67.78)	8.42	1.46	829.780	158.645
2	RH30	3.93	93.35(75.18)	12.57	2.34	1128.770	243.845
3	PM-27	3.93	87.95(69.69)	8.80	1.42	919.150	176.995
4	PM-25	3.93	86.86(68.71)	7.73	1.48	815.830	166.865
5	Pusa Bold	6.73	86.70(68.61)	7.56	1.45	781.030	157.960
6	Pomi	3.93	86.67(68.59)	9.52	1.58	865.820	184.735
7	Bathani	3.60	85.50(67.62)	6.49	1.40	721.370	112.095
8	Potni	3.60	90.65(72.20)	8.67	1.22	848.605	178.895
9	Jagay Mani-1	3.60	94.72(76.71)	12.64	2.39	1270.275	208.210
10	Purni	3.60	85.18(67.42)	3.36	1.25	737.040	113.295
11	Bullet	6.73	86.83(68.71)	8.75	1.30	917.970	120.270
12	Sitaram Rai	3.93	85.54(67.65)	7.38	1.51	780.560	146.745
13	Tejan	3.93	88.63(70.30)	8.52	1.31	969.660	189.720
14	Lotni Gol	3.93	85.15(67.68)	7.40	1.43	798.930	158.790
15	Kali	3.93	88.15(69.87)	7.71	1.19	743.110	120.065
16	Dangi	3.93	92.52(74.13)	11.44	1.32	1220.585	208.490
17	Araak	3.93	90.61(72.16)	8.41	1.21	941.795	185.920
18	Prerna	3.93	92.81(74.44)	11.43	1.26	1163.385	226.005
19	Boori	3.93	87.75(69.52)	9.37	1.38	1012.985	193.265
20	Giridhar	3.93	92.81(74.44)	11.61	1.30	1282.130	213.830
21	Tanru-M	3.60	85.22(67.39)	7.54	1.36	762.455	142.150
	Mean	4.12	88.52	8.49	1.45	929.10	171.75
	Range	3.60-6.73	85.15-94.72	3.36-12.64	1.19-2.39	721.37-1,282.13	112.09-243.84
	SE(m)	0.16	0.67	0.20	0.03	10.28	2.47
	C.D.	0.46	1.88	0.58	0.09	28.91	6.92

TW- Test weight(g), SG- Standard germination (%), SL- Seedling length(cm), SDW- Seedling dry weight(mg), VI- vigour indices-I, VI-vigour indices-II.

*Values in parenthesis are transformed value.

Table 3: Seed viability and vigour parameters of different varieties of Indian mustard

S.NO	Varieties	AA	EC	Tz	EI	MET	SE
1	Anmol	72.77(58.18)	20.52	84.09(68.05)	7.07	9.12	57.58 (49.08)
2	RH-30	76.16(60.42)	11.98	96.27(79.05)	10.21	6.43	82.25 (65.20)
3	PM-27	76.44(60.80)	3.75	88.61 (70.00)	7.90	8.29	66.45 (54.40)
4	PM-25	74.35(59.45)	4.72	84.61 (67.13)	7.13	9.06	58.64 (49.80)
5	Pusa Bold	73.51(58.69)	5.58	84.60 (67.15)	7.14	9.13	58.05 (49.66)
6	Pomi	62.53(52.06)	3.55	85.57 (67.62)	7.97	8.24	60.25 (51.06)
7	Bathani	62.42(52.03)	20.50	81.55 (64.58)	5.99	9.50	47.25 (43.28)
8	Potni	62.34(52.05)	3.59	87.13(69.10)	7.81	8.23	64.66 (53.37)
9	Jagay Mani-1	78.90(62.80)	4.09	96.54(79.06)	6.01	8.82	49.25 (44.71)
10	Purni	73.58(59.34)	18.52	81.39(64.45)	7.81	8.23	64.08 (53.12)
11	Bullet	72.77(58.05)	14.16	85.49(67.70)	7.10	9.14	59.24 (50.36)
12	Sitaram Rai	71.01(58.18)	20.98	82.02 (65.27)	7.96	8.27	66.33 (54.39)
13	Tejan	70.10(57.04)	12.58	86.41 (67.70)	7.41	9.30	64.25 (53.19)
14	Lotni Gol	70.95(57.42)	5.57	83.30 (66.19)	7.81	8.41	69.00 (55.73)
15	Kali	74.26(59.47)	13.46	85.47 (67.62)	8.47	7.31	63.08 (52.59)
16	Dangi	70.15(57.10)	11.44	89.36 (67.05)	7.83	8.40	70.83 (57.48)
17	Araak	72.25(58.05)	13.44	85.51 (67.54)	9.44	6.16	63.75 (52.83)
18	Prerna	73.29(58.76)	11.34	94.52 (76.31)	7.79	8.20	62.91 (52.48)
19	Boori	71.59(57.61)	13.27	88.06 (70.00)	9.23	7.41	67.08 (55.12)
20	Giridhar	69.01(56.23)	12.08	95.02 (78.17)	7.53	8.20	49.25 (44.66)
21	Tanru-M	62.94(53.00)	22.06	82.04 (65.27)	5.97	8.25	69.66 (56.48)
	Mean	71.01	11.77	87.02	7.69	8.29	62.56
	Range	62.34-78.90	3.55-22.06	81.39-96.54	5.97-10.21	6.16-9.50	47.25-82.25
	SE(m)	0.31	0.32	0.31	0.18	0.19	0.60
	C.D.	0.89	0.90	0.89	0.50	0.51	1.70

AA- Accelerated ageing test (%), EC- Electrical conductivity($\text{cm}^{-1}\text{gm}^{-1}$), Tz- Tetrazolium test(%), EI- Emergence index, MET- Mean emergence time, SE- Seedling establishment(%).

* Values in parenthesis are transformed value.

In electrical conductivity test variety Tanru-M recorded maximum value (22.06), while the variety Pomi showed minimum value (3.55). 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) ^[20] in Brassica napus, Raman dance and Ponnuswamy (2004) ^[24] in rice. The

tetrazolium test percentage was higher in the variety Jagay Mani-1(96.54) followed by RH-30 (96.27), Giridhar (95.02), Prerna (94.52) and Dangi (89.36) whereas the variety Bathani (81.25), showed minimum viability percentage (Table 1). Similar results were also reported by Steiner *et al.*, (1989)^[26] in wheat and Krishnappa *et al.*, (1999)^[16] in groundnut. Among the twenty One Indian mustard varieties, RH30, Jagay Mani, Prerna and Giridhar were found to be superior in viability and vigour as compared to the rest of varieties. Lofti *et al.*, (2018)- Lentil (*Lens culinaris* Medic.) Many seed tests have been proposed to evaluation of seed vigor, such as standard germination test, cold test, electrical conductivity test, hiltner test, tetrazolium test, controlled deterioration test, accelerated aging test, osmotic stress test, etc. To osmotic stress test, the seeds germinate at a specific osmotic potential.

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