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Assessment of pattern in seed deterioration during ambient storage in some *Brassica* genotypes

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ABSTRACT

The present investigation was undertaken during 2012-13 and 2013-14 to assess the pattern of seed deterioration in some Brassica genotypes during ambient storage. Decline in germination potential of seeds under ambient storage was slow up to 15 months maintaining more than minimum seed certification standards; though varied among the genotypes. The rate of deterioration was found to be genotype specific as could be evident from its declining trend in germination potential and vigour index. Highest germination was recorded as 96 per cent, which continued from pre-storage stage to nine months of storage when average was made over the genotypes, then declined with increasing rate and it was recorded as lowest on completion of storage duration. Average vigour status of seed was determined as maximum for Jhumka followed by that of Benoy and White Flower, seeds produced after Agrani were of lowest vigour status. Harvest fresh seeds i.e., seeds at pre-storage condition exhibited highest vigour status followed by that after three months' storage with non-significant reduction, when average was made over the genotypes, then reduction was slow up to nine months, faster up to fifteen months and then drastically reduced at eighteen months' storage.

Keywords : Brassica, germination, seed deterioration, storage response, vigour

Inherent pattern towards seed deterioration during ambient storage will help in better understanding on safe seed storage of any crop. Many investigators have reported that the speed of decline in seed quality is largely dependent on storage temperature and conditions, relative humidity, seed moisture content, length of storage, type of seed and initial seed quality. *Brassica* oilseeds are no such exception. Rapeseed and Mustard occupies an area of 6.5 million hectares with the production of 7.8 million tonnes and productivity of 1208 kilograms ha^{-1} in India (Economic Survey, 2013-14). India is one among the leading oil seed producing countries in the world. In India, oilseeds form the second largest agricultural commodity after cereals.

MATERIALS AND METHODS

Harvest fresh seeds of five varieties *viz*., Agrani, Benoy, Jhumka, Tori Local and White flower produced in first year (2012-13) were sundried thoroughly till almost 7 per cent moisture content, packed in cloth bags separately for individual genotypes with three replications and were stored in laboratory under ambient condition. Seeds were subjected to its quality assessment at pre-storage (harvest fresh) condition and three months interval thereafter upto 18 months of storage to record the rate of deterioration in germination and vigour status through germination test in laboratory. Parameters studied for such quality assessment included germination (%), root-shoot length and fresh-dry weight of seedlings, and vigour index. Germination (%) was determined from the laboratory experiment set through petri-plates method and seedling parameters *viz*., root and shoot length, fresh and dry weight were determined from the laboratory experiment set through glass plate method (ISTA, 1976). Observations on storability of seeds in first year were continued till one and half years (18 months) of storage *i.e*., upto the sowing of crops after a gap of one year. Observations on different parameters were recorded as :

Germination percentage

Germination test was done in petri-plates by placing 100 seeds of each genotype in each pair of petri-plates for one replication and each genotype was replicated thrice. Petri-plates were prepared for germination test with cotton and blotting paper, and moistened adequately avoiding excessive water. Germinating seeds were counted on every day after setting till the final count on 7th day on the basis of normal seedlings produced. Germination (%) was calculated as: (Number of seeds germinated and producing normal seedlings/Total number of seeds used) x 100.

Shoot length (cm)

It was measured on individual seedlings from collar region to apex of the apical shoot for randomly selected ten normal seedlings from each glass-plate (*i.e*., for each genotype) per replication on the day of final count and their mean length was recorded as shoot length in centimetres.

Root length (cm)

Root length was measured on single seedling basis between collar region and tip of the primary root for the

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same ten randomly chosen normal seedlings used for shoot length measurement for each glass plate. The mean root length was expressed in centimetres.

Seedling length (cm)

Seedling length was calculated by adding shoot length and root length as measured for each randomly chosen ten normal seedlings from each glass plate. Their mean length was expressed as seedling length in centimetres.

Seedling fresh and dry weight (g per 10 seedlings)

Those ten normal seedlings, used for measurement of its root and shoot length, were thoroughly surface dried with blotting paper, weighed in a digital balance for recording its fresh weight and then kept in hot air oven for drying at 70^0C for 24 hours till a constant weight is achieved. Dried seedlings were cooled in desiccator for 30 minutes and weighed, its average was determined and expressed in grams per ten seedlings.

Vigour index

For determination of vigour index, average seedling length was multiplied by average germination percentage (Abdul-Baki and Anderson, 1973) for each genotype and replication as-

Seedling vigour index (SVI) = Germination percentage x seedling length (cm)

RESULTS AND DISCUSSION

Significantly highest germination potential (86%) of seeds was recorded for White Flower, when average was made over storage durations, followed by that of Benoy, Jhumka, Tori Local and Agrani, average potential of Jhumka and Benoy were recorded as exactly similar with each other. After averaging over genotypes, highest germination could be noticed as 96 per cent, which continued from pre-storage stage to nine months of storage, then declined with increasing rate and it was recorded as low as 26 per cent on completion of storage duration (Table 1). Differences in potential of individual genotypes could be noticed: germination potential at pre-storage condition was maintained upto six months of storage for Agrani (98%) and Tori Local (96%), after which decline started and the rate of decline was greater in Agrani than that of Tori Local leaving 6 and 28 per cent respectively after 18 months' storage; while maintenance of same higher germination potential (98%) could be noticed for other three genotypes till nine months' storage, rate of declination was greater for Jhumka preceded by that of Benoy and White Flower. Kurdikeri *et al*. (2000) recorded that mustard seeds can be safely stored up to 13 months maintaining minimum prescribed germination in ambient storage. It exceeds by another one month from the present investigation, which may be due to difference in climatic condition during storage.

Average seedling length was highest for Jhumka followed by that of Benoy and White Flower, and it was of shortest type for Agrani (Table 2). When average was made over the genotypes, seedlings with statistically similar length were produced by both harvest fresh seeds and seeds stored upto three months, after which reduction could be noticed with increasing rate with the advancement in storage duration; non-significant change was noticed from 6 to 9 months of storage then declined slowly upto fifteen months after which it was reduced drastically and became only 8.18 cm on completion of 18 months storage. Similar trend with slight variation for individual genotypes, could be noticed when detailed clarification is made for performance of individual genotypes: non-significant reduction in seedling length could be noticed upto nine months' storage for Agrani, Jhumka and Tori Local, then declined slightly with non-significant reduction from nine to twelve months of storage, declined with a slightly higher rate upto fifteen months and then sharply declined at eighteen months' storage with most crippled seedlings for Agrani and Tori Local: statistically similar germination potential was noticed for Benoy from pre-storage to six months storage, then non-significant reduction occurred both at nine and twelve months' storage, after which similar pattern was followed upto eighteen months leaving average seedling length as 9.30 cm; and seedling length of White Flower after three months of storage became statistically at par with that at pre-storage condition, then non-significant reduction could be noticed from six to twelve months of storage, after which it was reduced significantly with a lower rate at fifteen months' and higher rate at eighteen months' storage.

Performance of the genotypes for production of average seedling fresh and dry weight was recorded as best with higher magnitude for Jhumka, followed by White Flower and Benoy for fresh weight, and Benoy, White Flower and Tori Local for dry weight, while it was lowest for Agrani for both the parameters (Table 3, 4). When average was made over the genotypes, non-significant reduction in seedling fresh weight was noticed from pre-storage to three months' storage after which it declined slowly upto nine months with non-significant reduction from three to six months and six to nine months, then significantly reduced with increasing rate with the advancement in storage period; for seedling dry weight, it also remained unchanged from pre-storage to three months' storage, but reduced significantly after six months storage, there was further non-significant change from six to fifteen months, then reduced at eighteen

Table 1: Germination (%) of seeds as influenced by duration under ambient storage condition

Genotypes	Duration (months)							
	0	**3**	**6**	**9**	**12**	**15**	**18**	**Mean**
Agrani	98 (82.97)	98 (82.97)	98 (82.97)	96 (79.22)	88 (70.18)	82 (65.27)	6 (14.77)	78 (62.38)
Benoy	98 (82.97)	98 (82.97)	98 (82.97)	98 (82.97)	90 (72.05)	86 (68.44)	34 (35.97)	84 (66.82)
Jhumka	98 (82.97)	98 (82.97)	98 (82.97)	98 (82.97)	94 (76.44)	92 (74.11)	22 (28.32)	84 (66.82)
Tori Local	96 (79.22)	96 (79.22)	96 (79.22)	94 (76.44)	92 (74.11)	80 (63.79)	28 (32.27)	81 (64.53)
White Flower	98 (82.97)	98 (82.97)	98 (82.97)	98 (82.97)	92 (74.11)	88 (70.18)	42 (40.69)	86 (68.44)
		V		**S**		**V × S**		
SEm (±)		**0.40**		**0.44**		**0.98**		
LSD (0.05)		**1.13**		**1.24**		**2.76**		

Note: V- Genotype, S- Stage, Figures in parentheses are Arc-sin transformed values

Table 2: Seedling length (cm) as influenced by duration under ambient storage condition

Genotypes	Duration (months)							
	0	**3**	**6**	**9**	**12**	**15**	**18**	**Mean**
Agrani	11.26	11.20	11.02	11.00	10.48	9.14	6.09	10.03
Benoy	16.10	15.98	15.65	15.43	14.89	13.32	9.30	14.38
Jhumka	17.66	17.50	17.23	17.20	16.70	14.27	10.78	15.91
Tori Local	11.82	11.64	11.38	11.30	10.77	9.42	6.47	10.40
White Flower	15.16	14.83	14.53	14.46	14.16	12.27	8.27	13.38
		V		**S**			**V × S**	
SEm (±)		**0.09**		**0.09**			**0.21**	
LSD (0.05)		**0.24**		**0.26**			**0.59**	

Note: V- Genotype, S- Stage

Table 3: Fresh weight (g) of seedlings as influenced by duration under ambient storage condition

Genotypes	Duration (months)							
	0	**3**	**6**	**9**	**12**	**15**	**18**	**Mean**
Agrani	0.125	0.123	0.122	0.120	0.119	0.110	0.102	0.116
Benoy	0.162	0.160	0.158	0.155	0.153	0.149	0.145	0.153
Jhumka	0.195	0.193	0.191	0.187	0.177	0.168	0.156	0.179
Tori Local	0.136	0.133	0.129	0.126	0.120	0.118	0.111	0.123
White Flower	0.177	0.174	0.172	0.169	0.161	0.155	0.147	0.163
		V		**S**			**V ×S**	
SEm (±)		**0.001**		**0.001**			**0.002**	
LSD (0.05)		**0.003**		**0.003**			**0.007**	

Note: V- Genotype, S- Stage

Table 4: Dry weight (g) of seedlings as influenced by duration under ambient storage condition

Genotypes	Duration (months)							
	0	**3**	**6**	**9**	**12**	**15**	**18**	**Mean**
Agrani	0.019	0.018	0.016	0.016	0.016	0.015	0.013	0.016
Benoy	0.023	0.022	0.022	0.021	0.021	0.021	0.020	0.021
Jhumka	0.032	0.030	0.028	0.026	0.026	0.025	0.024	0.026
Tori Local	0.025	0.023	0.020	0.020	0.020	0.019	0.018	0.020
White Flower	0.023	0.021	0.020	0.020	0.020	0.020	0.019	0.020
		V		**S**			**V×S**	
SEm (±)		**0.001**		**0.001**			**0.001**	
LSD (0.05)		**0.003**		**0.001**			**0.001**	

Note: V- Genotype, S- Stage

Table 5: Vigour index of seeds as influenced by duration under ambient storage condition

Genotypes	Duration (months)							
	0	**3**	**6**	**9**	**12**	**15**	**18**	**Mean**
Agrani	1103.48	1097.60	1079.96	1056.00	922.24	749.48	36.54	863.61
Benoy	1577.80	1566.04	1533.70	1512.14	1340.10	1145.52	316.20	1284.50
Jhumka	1730.68	1715.00	1688.54	1685.60	1569.80	1312.84	237.16	1419.95
Tori Local	1134.72	1117.44	1092.48	1062.20	990.84	753.60	181.16	904.63
White Flower	1485.68	1453.34	1423.94	1417.08	1302.72	1079.76	347.34	1215.69
		V		**S**			**V × S**	
SEm (±)		7.068		7.742			17.313	
LSD (0.05)		19.994		21.902			48.975	

Note: V- Genotype, S- Stage

months of storage with unaltered situation from fifteen months' storage.

Genotypic response for expression of both of these parameters varied. For fresh weight of seedlings, no significant reduction from pre-storage condition could be noticed upto twelve months' storage for Agrani with slight reduction at fifteen months' storage, then remained statistically similar at final stage *i.e*., eighteen months storage; it was significantly similar upto nine months for Benoy, then reduced slowly upto fifteen months with non-significant change from nine months' storage and reduced at eighteen months storage with significantly similar magnitude with that at fifteen months storage; while non-significant reduction upto six months' storage from pre-storage condition could be noticed for other three genotypes, then it was reduced at nine months of storage with non-significant manner from that of six months then significantly reduced upto the final stage excepting Tori Local, for which the magnitude at two consecutive stages were statistically similar. Trend in change of seedling dry weight varied with the genotypes: significant reduction at three months of storage from its initial status *i.e*., pre-storage condition could be noticed excepting for Agrani and Benoy; no change could be noticed upto fifteen months storage for White Flower; it was reduced significantly upto six months' storage for Tori Local and then exhibited similar performance upto fifteen months' storage; significantly reduced upto nine months for Jhumka and remained unchanged upto fifteen months' storage; while no significant change could be noticed upto three and six months for Agrani and Benoy respectively, after which it remained similar upto fifteen months for Agrani and eighteen months for Benoy. Change in both these parameters with the progress in storage period did not follow any definite pattern among the genotypes indicating its uniqueness for expression of these two parameters. Though computation of vigour index here has been made as joint function of germination (%) and average seedling length, reflection of rank of genotypes for the second factor could be noticed for vigour index. Germination (%), root length, seedling dry matter and vigour index remained high upto ten

months and decreased with further increase in storage period in sunflower was observed by Balamurugan *et al.* (1989).

Average vigour status of seed was found to be as maximum as 1419.95 for Jhumka followed by that of Benoy and White Flower, seeds produced after Agrani were of lowest vigour status (Table 5). It was of highest magnitude naturally for harvest fresh seeds *i.e*., at pre-storage condition followed by that after three months' storage with non-significant reduction, when average was made over the genotypes; then reduced at increasing rate with advancement in storage period and it was reduced drastically at eighteen months' storage. Response of individual genotypes towards ambient storage upto eighteen months somehow varied: though slow reduction in magnitude could be noticed upto nine months, it was non-significant for Agrani and Jhumka, after which it declined at increasing rate with the advancement of storage; non-significant reduction upto six months could be noticed for Benoy and Tori Local, then exhibiting similar trend in reduction till completion of eighteen months' storage with a non-significant reduction from six to nine months' storage: and it was statistically similar for pre-storage and three months' stored seeds of White flower after which non-significant reduction could be noticed from three to nine months, then the similar trend of reduction was followed. Vigour status of seed was found to be maximum for Jhumka followed by that of Benoy, White Flower, Tori Local and Agrani at pre-storage condition; while it was of highest vigour status as recorded for White Flower followed by that of Benoy, Jhumka, Tori Local and Agrani on completion of eighteen months storage. Reduction could be noticed with greatest extent for Agrani (96.69%) followed by that of Jhumka (86.30%), Tori Local (84.03%), Benoy (79.96%) and White Flower (76.62%) which could be utilized in a better way for explanation of genotype-specific response towards ambient storage of mustard seeds. Significant variation among the varieties and storage periods for seed storability with regard to germinability and vigour index of rape and mustard under ambient condition was recorded by Singh and Singh (2002) and they observed that minimum germination standard for certification continued up to the next sowing season which strictly confirms the findings of the present investigation.

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