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EFFECT OF SEED AGEING ON SEED GERMINATION BEHAVIOR AND SEEDLING GROWTH OF TURNIP MUSTARD (*BRASSICA CAMPESTRIS* L.)#

*Nikita S. Hinge[1] and S. N. Malode**

Abstract

Seeds are generally stored in physiological conditions in which they gradually lose their viability and vigor depending on storage conditions, storage time and genotype. Prolongation of ageing led to the deterioration of both germinability and seed viability. Our goal was to examine the effects on seed storage on seed germination, seedling growth of mustard (*Brassica campestris*). The present study was carried out in five mustard *(Brassica campestris*) varieties viz. Control, GPTA8R4, GPT3, APM1 and Bilobed leaf for analyzing the varietals differences during seed deterioration by subjected them to different storage material with respect to different temperature (Room temperature, Deepfreeze i.e. -20^{0}C, Refrigerator i.e. 8^{0}C) for storage period 6, 12, 18 and 24 months and new crop seeds were referred as control. Different level of seed vigor were obtained with different varieties and duration of seed storage. In present investigation it is observed that among all seed storage material and condition the aluminium bag is the best storage material with temperature -20^{0}C. The study conclude that seed storage conditions showed effect on seed germination and seed quality of all the varieties of *Brassica campestris* (L.)

Keywords: Seed ageing, germination, storage period, storage condition, *Brassica campestris*

#Research Article
Cytology and Genetics laboratory, P. G. Dept. of Botany, Government Vidarbha Institute of Science and Humanities, Amravati - 444604 (M.S.) India
E-mail: satishmalode17@gmail.com

Introduction

Storage conditions and duration are important factors affecting germination parameters. Seed vigor is used as a measure of accumulated damage in seed as viability declines. Preservation of seed viability depended on storage condition and duration (Balesevic Tubic SM *et al.*, 2010). Changes that occur in seed during aging are significant in terms of seed quality, the feature that, among other things, also implies seed longevity (Milošević and Malešević, 2004). Progress of the technology and industrialization of agricultural production has increased opportunities for long term storage of seed (Lekić, 2003). The purpose of storage is to maintain harvest quality of product, not to improve it (Sisman and Delibas, 2004). The rate at which the seed aging process takes place depends on the ability of seed to resist degradation changes by protection mechanisms which are specific for each plant species (Balešević-Tubić, 2001). Kept under the same storage conditions, seeds of different plant species lose viability to a various degree. Degradation and inactivation of enzymes due to changes in their macromolecular structures is one of the most important hypotheses proposed regarding causes of ageing in seeds (Bailly, 2004; Basavarajappa *et al.,* 1991; Basra and Malik, 1994; Goel *et al.*, 2002; Kalpana and Rao, 1993; Lehner *et al.*, 2008; McDonald, 2004; Salama and Pearce, 1993).

Oil seeds are very sensitive to the harsh environmental conditions. It is hypothesized that their oil content readily oxidizes, which deteriorate the seed health in storage (Kausar *et al.*, 2009). Brassica occupy third position among the various oilseed species due to its considerable economic and nutritional value. Various brassica species are popular for their considerable nutritional and economic value they are mainly grown for oil, condiments, vegetables or fodder. Brassica species grown predominantly for commercial purposes are rape seeds (*Brassica campestris* L. and *B. napus* L.), mustards (*B. juncea* L. [Czern &Coss.] and *B. carinal* (Ashraf and McNeilly,2004). Brassica contains about 100 including cabbage, cauliflower, broccoli, turnip, Brussels sprouts, various mustard and weeds (Gomez Campo,1999). This genus is remarkably known for having more important agricultural and horticultural crops than any other genus.

Some researchers believe that survival of plants in adverse field conditions can be reliably predicted on the basis of laboratory germination tests. Others maintain that small differences in germination percentage can sometimes overshadow large differences existing in seed damage rate (Milošević and Ćirović, 1994). The same authors suggested that under adverse conditions such as the temperature above 30°C and relative air humidity from 80 to 90% the variation in seed germination rate can be high. It seems that temperature, moisture and storage duration are the most important individual factors which affect on stored product quality and quantity (Sisman, 2005). The objective of this research was to determine the effects of storage period, storage conditions and materials on seed germination parameters of different mustard cultivars.

Materials and Methods

Procurement of Germplasm

In the present investigation 5 different varieties /genotypes of *Brassica campestris* was developed in research field, department of botany, Government Vidarbha Institute of

Science and Humanities, Amravati and were multiplied in order to study seed ageing process. Five different genotypes of *Brassica campestris* were selected for the research work were Control, GPTA8R4, GPT3, APM1 and Bilobed leaf. All these varieties / variants were sown in experimental field in Department of Botany, Govt. Vidarbha Institute of Science and Humanities, Amravati. All the experiment was carried in triplicates. As the flowering initiated every plot had covered with net in order to control pollen flow and generate pure (Self) seeds. All the self-seeds were collected in cotton bags and were kept in adequate condition and set up seed ageing study under following varying conditions as per storage materials and storage conditions as follows:

Storage Materials

i) Paper bags
ii) Cotton bags
iii) Aluminum foil

Storage Conditions

a) Temperature
b) Humidity

Four seed storage periods, i.e. 6, 12, 18 and 24 months and Every six months, from a total 24 months of storage, germination characters were evaluated.

Seed Germination and Seed Viability Study

Germination is a fascinating process. The first sign of germination is the absorption of water. This activates an enzyme, respiration increases and plant cells are duplicated. Soon the embryo becomes too large, the seed coat bursts open and the growing plant emerges. The tip of root is the first thing to emerge. For the study of germination percentage, 25 seeds were kept in Petri dish lined with moist blotting paper for germination count. Germination counts were taken from 25 seeds after 48 hrs. from the time of treatment. Actively emerging radicals were taken as the criteria for germination. Seeds did not germinate were consider as dead.

Results and Discussion

The result in (Table 1) showed that final germination percentage was decreased as storage periods were increased**.** The interaction between varieties and storage material was statistically non-significant up to 6 months from seed storage. The effect of different conditions, storage material and storage period on germination percentage was highly significant after 12 months. While after 24 months from storage recorded lowest final germination percentage. It could be concluded that increasing storage periods from 6, 12, 18 and 24 months decreased final germination percentage compared with final germination percentage of pre-storage seeds.

Table: 1. Mean of Germination Percentage (%) of *Brassica campestris* Cultivars as Affected by Storage Periods, Storage Conditions, Storage Materials and Their Interactions

Storage period	Mean of Seed Germination Percentage (%)										
	Variety	Control	Paper			Aluminium			Cotton		
			Deep Freeze (-20^oC)	Freeze (8^oC)	Room Temp. ($24 - 45^oC$)	Deep Freeze (-20^oC)	Freeze (8^oC)	Room Temp. ($24 - 45^oC$)	Deep Freeze (-20^oC)	Freeze (8^oC)	Room Temp. ($24 - 45^oC$)
6 Months	CONTROL	100	90.6	92	85.3	97.3	94.6	94.6	89.3	92	90.6
	GPTA8R4	100	92	94.6	88	94.6	94.6	90.6	90.6	88	86.6
	GPT3	100	93.3	89.3	86.6	96	92	93.3	92	93	88
	APM1	100	89.3	89.3	89.3	94.6	90.6	88	89.3	90	89.3
	BILOBED LEAF	100	92	92.6	88	97.3	94.6	92	88	85.3	92
12 Months	CONTROL	100	90.6	89.3	89.3	93.3	89.3	93.3	88	89.3	69.3
	GPTA8R4	100	93.3	90.6	84	96	88	90.6	90.6	88	74.6
	GPT3	100	86.3	93.3	81.3	94.6	90.6	94.6	89.3	82.6	81.3
	APM1	100	90.6	85.3	84	96	89.3	90.6	90.6	88	77.3
	BILOBED LEAF	100	89.3	90.6	88	94.6	93.3	89.3	86.6	89.3	73.3
18 Months	CONTROL	100	82.6	84	64	93.3	86.6	80	90.6	80	80
	GPTA8R4	100	85.3	78.6	53.3	94.6	88	81.3	88	72	81.3
	GPT3	100	85.3	82.6	61.3	93.3	86.6	82.6	85.3	78.6	82.6
	APM1	100	78.6	78.6	65.3	94.6	89.3	73.3	89.3	84	73.3
	BILOBED LEAF	100	88	76	70.6	96	90.6	80	89.3	84	80
24 Months	CONTROL	100	87.6	61.3	38.6	92	74.6	45	78.6	61.3	18.6
	GPTA8R4	100	78.6	66.6	41.3	88	78.6	40	77.3	66.6	29.3
	GPT3	100	81.3	64	46.6	92	66.6	44	80	69.3	22.6
	APM1	100	78.6	62.6	41.3	93.3	70.6	48	78.6	66.6	18.6
	BILOBED LEAF	100	68	70.6	44	90.6	68	48	77.3	61.3	25.3

Table: 2. Summary of One Way Analysis of Variance for the Data on Seed Germination of Different Conditions Using Different Material Bags With Respect to Time Interval

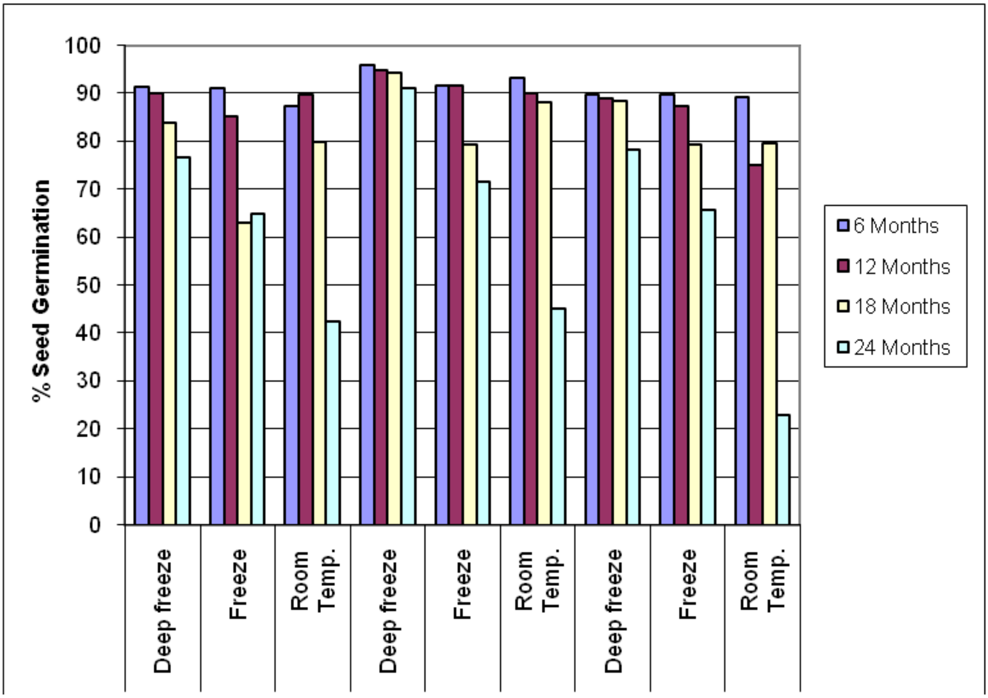
Duration	Bag Material	Mean of Seed Germination Percentage (%)				
		Control	Deep freeze (-20°C)	Freeze (8°C)	Room Temp. (24 - 45°C)	'F' Ratio
6 Months	Paper	100.00	91.44	91.16	87.45	58.845*
	Aluminium	100.00	95.96	91.70	93.28	22.297*
	Cotton	100.00	89.84	89.66	89.30	32.995*
12 Months	Paper	100.00	90.02	85.32	89.86	30.494*
	Aluminium	100.00	94.90	91.68	90.10	37.731*
	Cotton	100.00	89.02	87.44	75.16	67.067*
18 Months	Paper	100.00	83.96	62.90	79.96	73.078*
	Aluminium	100.00	94.36	79.44	88.22	89.984*
	Cotton	100.00	88.50	79.44	79.72	45.332*
24 Months	Paper	100.00	76.62	65.02	42.42	238.014*
	Aluminium	100.00	91.18	71.68	45.00	302.322*
	Cotton	100.00	78.36	65.82	22.88	584.359*

*Significant at 0.05 Tabulated $F_{0.05\ (3,\ 16)} = 3.24$

The result clearly showed significant interaction between storage periods, *Brassica campestris* varieties, storage materials and storage conditions on seed germination percentage in (Table 2). The result of seed viability (germination percentage) in unaged i.e. control seeds of all the 5 varieties shows high germination percentage (Table 2). Accelerated ageing treatment of brassica campestris L. varieties resulted in significant declined in germination percentage with passage of ageing time in all varieties. Thus, the highest germination percentage were recorded after 24 months in seeds stored at deep freeze (-20^{0}C) in aluminium bag material than the paper bags and cotton bags and the lowest germination percentage recorded after 24 months of storage period in cotton bag material at Room temperature (Table 2). That stored seeds got damaged by insects attached and most of the seeds get destroyed in cotton bag material. The result clearly indicated that seed germination percentage significantly differed due to the interaction between storage conditions and storage materials (Graph .1). The graph plotted on the basis of summary of One Way Analysis of Variance for the Data on Seed Germination of Different Conditions using different material bags with respect to time interval i.e. Table no.2. The graph shows the effect of accelerating ageing on germination percentage (%) of five *Brassica campestris* L. varieties.

Conclusion

The study was conducted in five different varieties of *Brassica campestris* L. namely CONTROL, GPTA8R4, GPT3, APM1 and BILOBED LEAF in order to investigate the physiological changes during seed deterioration. The investigation based on results of all the parameters concluded that among all the experimental conditions deep freeze (-20^{0}C) with aluminium bag as storage material are highly suitable condition and material for seed storage of Brassica cultivars and cotton bag at Room temperature condition are least suitable for seed storage.



Graph: 1. Effect of Accelerating Ageing on Germination Percentage (%) of Five *Brassica campestris* L. Varieties with Respect to Storage Duration, Storage Materials and Storage Conditions

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