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THE RAPESEED DETERIOTION AT DIFFERENT STORING PACKAGES DURING STORAGE PERIOD

Bita Oskouie and Maryam Divsalar
Seed and Plant Registration and Certification Institute (SPCRI), Karaj, Iran
E-Mail: b_oskouei@yahoo.com

ABSTRACT

The seed quality evaluation as a crop propagation organ and the most important input for crop production has a special position in seed production and certification. This experiment was conducted to study the effect of different packages on rapeseed varieties produced in Qom province- Iran. The studied cultivars were RGS, Talaieh and Okapi and the package types were three - layers paper bag, 4-layer paper bag, propylene bag, propylene + paper and flaxen bag which was studied using factorial experiment on the basis of completely randomized block design at 3 replications. The seed containing bags were stored in the ware house of agricultural and natural resources center of Qom province for 1 year and the standard sampling of each treatment and replication were done at intervals of 3months, 6months, 9 months and one year. Then the germination ability of seeds was tested by standard germination test and also the electrical conductivity test, cold test and accelerated aging test have been conducted for estimating seed vigor, then mean germination time was calculated. As the results showed the seed viability wasn't affected until first stage of sampling (3 months storage) in a way that the germination percent at standard germination test and the vigor tests show that the storing packages have no effect on seed viability during these three months, but the decrease of germination ability at standard germination test was observed after 6 month storage (second sampling stage) and the seed germination ability had more decline within the storage time and this reduction was more evident in propylene and paper + propylene. Also the seed vigor tests indicate more decline of vigor in propylene and paper + propylene bags however the vigor decrease in 3-layers and 4-layers paper bag was less in away that the germination ability of seeds stored in 3-layers and 4-layers paper remained at standard level after one year storage.

Keywords: rapeseed, seed storage, packaging, germination, vigor tests, viability.

INTRODUCTION

In modern agriculture in many countries farmers try to produce high quality and uniform products with minimum costs (Gary, 1983). To achieve this objective fast and uniform seedling establishment is necessary which needs having high quality seeds (Hadavizadeh and Raymond, 1989). Seed vigor is an important factor that affects seedling establishment and crop growth and ultimately production rate. Each biotic or non biotic factor that affect seed vigor and germination during seed's development, subsequently will affect production especially when seeds produced under stress condition (Zakaria, 2009).

The vigor of seeds decreases rapidly by increasing seed storage period. The short terms storage under bad and unfavorable conditions affect seedling vigor more than germination and seed vigor decreases more than germination ability. The storage duration or unfavorable conditions during storage may cause the loss of seed membrane selective property and therefore seed vigor decreases (Abdol-Bakhi and Anderson, 1973). This subject also causes microbial attack increasing. The decrease of seed vigor isn't only due to physical disorder and is more complicated. For example the respiration amount at mitochondria of seedling produced from soybean fresh seeds has significant difference in comparison to old seeds. In plants which produced from fresh seeds the amount of light phosphorylation by each unit of used oxygen were 40-70 percent of plants produced from old seeds. The seedlings resulted from old seeds had fewer mitochondria by weight unit rather to seedlings of fresh seeds (Franklin *et al*., 1985).

It's clear that neither seed vigor nor germination of a seed lot does lost instantly but both of them decreased progressively during the time. Using improper harvest, drying and storage methods have high effect on seed's germination ability and decrease it within the time (gradually) (Kreyger, 1964). In fact seed vigor tests are conducted for estimating the seed emergence at farm (Dyer *et al*., 2000, Elisand Robert,). Bogolepove (1981) reported if the moisture content is under 12 percent the germination ability of vegetables seeds remains well up to 2 years. Yangi (1997) kept the seeds of three vegetable species with moisture content of 5, 10.11 and 12.2 percent in plastic and paper packages and also no packaging for 40 months and found that seeds in paper packages had more germination percentage, germination rate and emergence rate (Yoongyi *et al*., 1987).

Amaral and his colleagues (1987) stored soybean seeds with 11.4% and 13.4% moisture content in linen bags and multi layer bags for 2 months and found there was non significant difference in seed vigor, although vigor decreased after 5 months.

Zhang (2008) stored cotton seeds with 1-2% moisture in bags with nylon fiber and also bags with plastic PV with hole and without hole, for one year and found that the seeds stored in nylon fiber had more change in moisture compare to other storing environments and he didn't found any differences between other packaging environments (Zhang *et al*., 2008).

Agha and his colleagues (2004) reported the best condition for soybean seeds storage at 15-18 degree centigrade, 60% humidity and in bags resistant to moisture permeability.

Yuefeng (2009) stored pepper seeds in aluminum, paper and plastic packages at different times and concluded that the aluminum packaging is the best storage environment (Yuefeng *et al*., 2009).

Oladira and his colleagues (2000) stored newly harvested pepper seeds in three aluminum, and paper packages for 4 week in 30 degree centigrade and 90 percent humidity and observed each three type of packages resulted in decreasing the percent and speed of germination after 4 weeks, but this decline in the polyten package was more than aluminum foil package.

Regarding to the importance of determination the proper rapeseed storage environment conditions for it's quality and hence a few researches have been already done about the effect of packaging type for rapeseed storage ,this research has been done to study the deteriorate of rapeseed in different storage packages during storage period.

MATERIAL AND METHODS

The studied rapeseed cultivars were OKAPI, TALAIEH and RGS and the storing warehouse was in Qoam province-Iran, which has warm and dry weather. After preparation of seeds, the moisture content of them was alternatively measured, when the moisture content of seeds reached below 12 percent the seeds were packed with different packaging materials consist of nylon bag, linen bag, 4-layers paper bag, 3-layers paper bag and paper bag with plastic layer and the bags were placed on the pallets and at end of the storage period ISTA standard sampling was done from each treatment and replication at every stage.

The experiment was conducted as factorial design on the basis of completely randomized block in three replications in 2009 at seed and plant registration and certification institute - Karaj-Iran. The factors were cultivar in three levels and package type in 5 levels.

Laboratory measurements

a) **The Standard Germination:** Three (3) replications of 100 seeds were selected from each sample in laboratory, samples were placed between paper as towel method in germination with 76-86% moisture and 20ºC temperature. After 7 days the number of normal and abnormal seedlings, decayed and un-germinated seeds was counted (ISTA, 2008).

b) **Mean germination time (MGT):** Mean germination time which is considered as germination velocity and acceleration index was obtained from below relation (Scott *et al*., 1984):

$$MGT = \frac{\Sigma (nd)}{\Sigma n}$$

Where

n = number of germinated seed during d days

d = number of days

Σn = total number of germinated seeds

c) **Cold test:** Three (3) replications of 100 seeds from each treatment and replication was counted and was cultured at 5ºC for one week. After 7 days the seeds were transferred to germinator with 25ºC temperature. The days after transferring the number of normal seedlings counted and reported as percent.

d) **Accelerated aging test:** Three (3) replication of 100 seeds from each treatment and replication were counted; the seeds were placed on net which installed on the water containing boxes. The containers were kept at 40ºC for 72 hours then the standard germination test was done and the numbers of normal seedlings were counted (ISTA, 2008).

e) **Electrical conductivity test:** Three (3) replications of 50 seeds with equal weight from each seed lot were counted and submerged in deionized distilled water and kept at 20ºC for 24 hours, then the electrical conductivity of solute which contained seeds was measured at micro siemens on centimeter on gram and finally this value was calculated for each gram of sample.

Data were analyzed by SAS software means were compared by Duncan test in 1% level.

RESULTS AND DISCUSSIONS

Storage after 3 months

The variance analysis results at first stage (three months after storage) shows (Table-1) that none of the measured characters was affected by environmental treatments and also the effect of cultivar, packaging and interaction of cultivar and packaging wasn't significant. As the mean comparisons show (Table-2) the germinate ability in standard germination test was maintained above standard (85% in Iran) in all package types, which indicates seed storage duration (3 month) had no effect on germination ability in specified bags, from the other hand the seed vigor tests also show that all the seed storing packages were placed in same level in all vigor tests, in a way that when the seeds of different treatments were tested by accelerated aging and cold tests maintained their germination ability above standard (Table-1). The mean comparisons show that the electrical conductivity of seeds after three month storage in Qoam province didn't have significant difference in used packages.

Table-1. Mean squares of some measured characters of rapeseed at different packages after 6 months.

S.O.V.	df	Electrical conductivity (µ/cm/g)	Germination ability at standard germination test	Mean time for germination	Germination ability at cold test	Germination ability at accelerated aging test
Cultivar	2	0.13533 ns	2.3111 ns	0.00033778 ns	0.31111 ns	0.31111 ns
Package type	4	0.48181 ns	9.555 ns	0.0007111 ns	1.1111 ns	1.2000 ns
Replication	2	0.44205 ns	13.377 ns	0.0025377 ns	11.91111 ns	0.31111 ns
Package*cultivar	8	4.4582 ns	7.9111 ns	0.0004622 ns	4.3555 ns	1.46666 ns
Error	28	8.11267	68.622	0.01279	127.422	17.6888
Total	44	13.63012	101.777	0.016844	145.1111	20.977
Coefficient of variance		10.361	1.735	2.372	2.3586	0.883

ns = non significant
* significant at 5% level
** significant at 1% level

Table-2. Mean comparison of some measured characters of rapeseed at different packages after 6 months.

Package type	Electrical conductivity (µ/cm/g)	Germination ability at standard germination test	Mean germination time	Germination ability at cold test	Germination ability at accelerated aging test
Propylene	5.3144 a	89.5556 a	0.896 a	90.333 a	90.111 a
Paper + propylene	5.1967 a	90.111 a	0.90778 a	90.222 a	90.222 a
Linen	5.2833 a	90 a	0.898 a	90.556 a	89.777 a
3-layers paper	5.1600 a	90.889 a	0.8988 a	90.444 a	89.88 a
4-layers paoer	5.0211 a	90.556 a	0.90333 a	90.667 a	89.888 a

Similar letters show non significance at 5% level of Duncan test

Storage after 6 months

The results of variance analysis show if seeds stored six months in Qom warehouse, the type of package has significant effect on electrical conductivity, germination ability at standard germination test and mean germination time of seeds, but the effect of package type on germination ability after cold test and accelerated aging test isn't significant (Table-3). Also the effect of cultivar and interaction of cultivar and package type wasn't significant on any measured characters.

The mean comparisons shows (Table-4) the highest germination ability in standard germination test was for seeds that were kept in 4-layers and 3- layers paper bags (90.666 and 89.777 percent respectively) and

After that the linen bags, paper + propylene bags were placed, respectively. However there wasn't any significant difference between 3 layers paper, linen, paper + propylene and propylene bags in standard germination ability. The seed's electrical conductivity measurement at different packages shows that the highest amount of matter exudation is in propylene package (12.821µs/cm/g) and the lowest amount observed in 4-layers paper and 3-layers paper bags (7.515 and 7.723 µs/cm/g, respectively) which indicates less deterioration of seeds in 3-layers and 4-layers paper package; the results of germination ability at standard germination test confirm it. Also the maximum mean germination time was observed in propylene and paper + propylene package (0.9344 and 0.9377 day) and after that respectively were linen, 3-layers and 4-layers paper (respectively, 0.9266, 0.8911 and 0.8866 day), but only propylene and paper + propylene bags showed significant difference with 3-layers and 4-layers paper (Table-4).

Table-3. Mean squares of some measured characters of rapeseed at different packages after 6 months.

S.O.V.	df	Electrical conductivity (µ/cm/g)	Germination ability at standard germination test	Mean germination time	Germination ability at cold test	Germination ability at accelerated aging test
Cultivar	2	2.03333 ns	1.6444 ns	0.0048133 ns	1.200 ns	2.177 ns
Package type	4	188.5283**	33.4222*	0.021653*	10.5333 ns	15.244 ns
Replication	2	3.30339 ns	32.04444 ns	0.0040533 ns	38.9333 ns	32.5777 ns
Cultivar*package	8	16.45915 ns	23.2444 ns	0.00398667 ns	2.8000 ns	5.1555 ns
Error	28	10.66714	73.9555	0.0458133	77.7333	86.0888
Total	44	220.99036	164.3111	0.080320	131.2000	141.24444
Coefficient of variance		6.46	1.8210	4.419	1.869	1.986

ns = non significant
* significant at 5% level
** significant at 1% level

Table-4. Mean comparison of some measured characters of rapeseed at different packages after 6 months.

Package type	Electrical conductivity (µ/cm/g)	Germination ability at standard germination test	Mean germination time	Germination ability at cold test	Germination ability at accelerated aging test
Propylene	12.8211 a	88.444 b	0.9344 a	88.5556 a	87.44 a
Paper + propylene	10.9786 b	88.444 b	0.9377 a	88.6667 a	88 a
Linen	8.6956 c	88.888 b	0.92667 ab	89.8889 a	89.222 a
3-layers paper	7.7233 d	89.777 ab	0.89111 b	89.222 a	88.333 a
4-p; aper layers	7.5156 d	90.666 a	0.88667 b	89.333 a	88.444 a

Similar letters show non significance at 5% level of Duncan test

Storage after 9 months

The variance analysis results (Table-5) after 9 months storage of different packages in Qom province has shown that the package type effect on electrical conductivity of seeds, germination ability in standard germination test, mean germination time, germination ability after cold test and accelerated aging test was significant at 1% level. But the cultivar effect and also interaction of cultivar and package type had no significant effect on measured characters.

As the results of variance analysis show (Table-6) the maximum germination ability at standard germination test was observed in 4-layers and 3-layers paper (89.888 and 88.555 percent, respectively) and then the linen bags (84.556 percent), paper + propylene and propylene were placed (83.111 and83.222 percent, respectively) (Table-6).

The mean comparison of mean germination time at different packages show that the maximum mean germination time was in propylene (1.866 day) and paper + propylene packages (1.8255 day) and then linen package (1.5358 day), the minimum mean time was in 4-layers paper (0.890 day) and 3-layers paper bags (0.892 day) (Table-6).

The values of electrical conductivity of seeds at different storing packages have shown (Table-6) that the highest amount of electrical conductivity was in propylene package (16.232 µs/cm/g) and after that paper + propylene (13.96 µs/cm/g), linen (11.913 µs/cm/g), 3-layers paper (11.056 µs/cm/g) and 4-layers paper (10.7044 µs/cm/g) packages were placed at same level.

The seed germination ability after cold test and accelerated aging test indicates 3-layers and 4-layers paper had the maximum germination amount and the packages of propylene and paper + propylene had minimum germination (Table-6).

Table-5. Mean squares of some measured characters of rapeseed at different packages after 9 months.

S.O.V.	df	Electrical conductivity (µ/cm/g)	Germination ability at standard germination test	Mean germination time (day)	Germination ability at cold test	Germination ability at accelerated aging test
Cultivar	2	0.3543 ns	3.333 ns	0.17773 ns	1.6444 ns	2.1333 ns
Package type	4	192.1693**	357.422**	8.416520**	86.222**	86.0888**
Replication	2	0.513631 ns	12.933 ns	0.0289200 ns	0.5777 ns	0.1333 ns
Cultivar*package	8	1.3683 ns	5.111 ns	0.0477600 ns	2.5777 ns	3.6444 ns
Error	28	10.2131	112.4000	0.42634	32.0888	25.2000
Tptal	44	204.6187	491.2000	8.93732	123.1111	117.2000
Coefficient of variance		4.727	2.3	8.8	1.281	1.149

ns = non significant
* significant at 5% level
** significant at 1% level

Table-6. Mean comparison of some measured characters of rapeseed at different packages after 9 months.

S.O.V.	df	Electrical conductivity (µ/cm/g)	Germination ability at standard germination test	Mean germination time	Germination ability at cold test	Germination ability at accelerated aging test
Cultivar	2	2.03333 ns	1.6444 ns	0.0048133 ns	1.200 ns	2.177 ns
Package type	4	188.5283**	33.4222*	0.021653*	10.5333 ns	15.244 ns
Replication	2	3.30339 ns	32.04444 ns	0.0040533 ns	38.9333 ns	32.5777 ns
Cultivar*package	8	16.45915 ns	23.2444 ns	0.00398667 ns	2.8000 ns	5.1555 ns
Error	28	10.66714	73.9555	0.0458133	77.7333	86.0888
Total	44	220.99036	164.3111	0.080320	131.2000	141.24444
Coefficient of variance		6.46	1.8210	4.419	1.869	1.986

ns = non significant
* significant at 5% level
** significant at 1% level

Storage after one year

The results of variance analysis (Table-7) indicate significant effect of package on germination ability at standard germination test, mean germination time, electrical conductivity of seeds, germination ability after cold test and accelerated aging test, although cultivar effect and interaction of cultivar and packaging type wasn't significant (Table-7). The mean comparison of germination ability at standard germination test shows that the maximum germination ability observed in 3-layers paper (86.556%) and 4-layers paper (87 percent) bags and the minimum was in paper + propylene (79.33%) and propylene (77.33%). Also the mean germination time showed that the maximum time for germination was in propylene bag (2.478 day) and then there were paper + propylene (2.3144 day) and linen (2.0577 day) and after that 3-layers paper (1.0800 day) and 4-layers paper (1.0911 day) bags were at the same level (Table-8).

The mean comparison shows the maximum amount of electrical conductivity was observed in propylene package (18.071µ⁄cm⁄g) and then paper + propylene and linen (16.22 and 13.945 µ⁄cm⁄g, respectively) and 4-layers and 3-layers paper (12.987 and 13.1955 µ⁄cm⁄g, respectively) showed the minimum amount of electrical conductivity.

Table-7. Mean squares of some measured characters of rapeseed at different packages after 1 year.

S.O.V.	df	Electrical conductivity (µ/cm/g)	Germination ability at standard germination test	Mean germination time	Germination ability at cold test	Germination ability at accelerated aging test
cultivar	2	1.4883 ns	10.1777 ns	0.014524 ns	9.3777 ns	10.8444 ns
Packaging type	4	173.6421**	669.555**	16.31535**	639.8666**	575.11**
replication	2	1.9567 ns	24.577 ns	0.0114977 ns	17.91111 ns	16.0444 ns
Cultivar*packag	8	14.3587 ns	18.711 ns	0.060164 ns	9.7333 ns	10.4888 ns
error	28	11.6538	142.75	0.53856	144.7555	157.9555
total	44	203.0996	865.777	16.94011	821.644	770.444
Coefficient of variance		4.333	2.72	7.68	2.796	2.96

ns = non significant
* significant at 5% level
** significant at 1% level

Table-8. The mean comparison of some measured characters of rapeseed at different packages after 1 year storage.

Package type	Electrical conductivity (µ/cm/g)	Germination ability at standard germination test	Mean germination time (day)	Germination ability at cold test	Germination ability at accelerated aging test
Propylene	18.071 a	77.33 c	2.47889 a	76.444 c	75.333 c
Paper+ propylene	16.2289 b	79.33 c	2.31444 b	77.667 c	76.667 c
Linen	13.945 c	83.667 b	2.05778 c	81.667 b	80.778 b
3-layers paper	13.1956 d	86.556 a	1.08000 d	84.778 a	83.556 a
4-layers paper	12.9878 d	87 a	1.09111 d	86.000 a	84.222 a

Similar letters show non significance at 5% level of Duncan test

DISCUSSIONS

The seed deterioration is a flexible and irreversible process and low quality seeds never change to high quality seeds, unless inducing some default mechanisms for seeds to provide conditions for good performance of seeds without changing physiological quality of seeds, so a large amount of seeds deteriorate and loose their vigor annually due to improper storage (Copeland and MC Donald, 2001).

As the results showed seed deterioration hasn't been affected until first sampling stage (3 months after storage) as the mean of standard germination and vigor tests indicates the storing packages didn't affect seed viability during this period (3 months) but the decline of germination ability at standard germination test was observed after 6 months storage (second stage of sampling) as there was a significant difference between 4-layers and propylene bags. However all the bags could retain their germination percentage above standard level (85%). At the third stage of sampling (9 months storage) only 3-layers and 4-layers paper bags could store their germination ability above standard ability above standard level but the seed's germination ability in propylene, paper + propylene and linen packages didn't reach the standard level (85%) which shows propylene, paper + propylene and linen bags detriment germination ability of seeds more than other type of bags. The standard sampling of seed lot after one year storage in Qom region, shows the high decline of seed's standard germination ability in propylene, paper + propylene and linen bags in away that the germination of the seeds which stored in these bags considerably differ from the standard germination of rapeseed. Along with germination ability at standard germination test the mean germination time at the first stage of sampling wasn't different between packages but within a time the differences were observed between various storing packages as at the fourth stage the packing type could classified the mean germination time in 4 groups which the maximum time was in propylene, paper + propylene and linen bags and the minimum time was in 3-layers and 4-layers paper.

Ellis and Roberts (1981) confirmed the seeds with higher germination ability; normally have lower mean germination time. Oladiran and his colleagues

(2000) also confirmed that the seeds which stored in paper bags had relatively good ventilation and so had a higher germination percentage.

Since the seeds with low vigor caused from seed's deterioration at improper storage conditions or mechanical damage have lower membrane integrity so during uptake, their cytoplasm soluble matters exudates to outer, therefore it's concluded if seeds store in propylene bags for one year their cytoplasm membrane destruction and therefore matters exudation will be more. The detrimental effect propylene and paper + propylene bags maybe referred to the temperature increasing effects and the relation of temperature and relative humidity at storage period. Oladiran and his Colleagues (2000) verified this opinion.

Hence the high temperatures cause increasing the velocity of some enzyme and hydraulic reactions and accelerate seed deterioration and considering that the temperature increased up to 45ºC and relative humidity increased to 85 percent at some months in Qom warehouse so the effect of temperature and humidity was more at propylene and paper + propylene bags and probably caused increasing the temperature and respiration in bags and affected seed vigor. Agha and his colleagues also verified this opinion and declared whatever the storage temperature and humidity effects on packed seed be more will cause increasing deterioration probability, although these effects were less in linen bags. The best storage conditions for seeds were 3-layers and 4-layers paper bags.

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