Journal of Kerbala University , Vol. 12 No.4 Scientific . 2014

Relative Growth Rate (RGR) and Electrical Conductivity changes in snake cucumber (*Cucumis melo var.flexuoses Naud.*) seeds under Accelerated Ageing conditions

التغيرات في خصائص الانبات والتوصيلية الكهربائية ومعدل النمو النسبي في بذور خيار القثاء تحت ظروف التعمير المعجل

Muhannad.M.Sahib
College of Science, University of Qadesyia

Hussein J. Hussein
College of Science for Women, University of Babylon

Abstract:

Seed ageing is a main problem during storage of seed. Un-suitable storage conditions with high moisture and temperature increases seed ageing. A seed of snake cucumber was subjected to the accelerated ageing conditions at 45C°±1 and 100% relative humidity for various time intervals (0, 3, 7, 12 days), for evaluation of seed vigorisity . However increasing of ageing period caused significant increases in seed moisture content (from 7.53% in control to 21.27%), electrolytic leakage (from 194.73 in control to 783.30 µs/cm/25 seed) whereas germination percentage and seed vigor index was significantly decreased (from 99% at control to 0.0%) and (from 14.29 in control to 0.00) respectively after 12 days of accelerated ageing (seeds losing viability). Seedling length, fresh & dry weight also decreases with increased ageing period.

Key Word: snake cucumber, seed accelerated ageing, vigor index, viability

الخلاصة:

هرم البذور هو المشكلة الرئيسية خلال خزن البذور. الظروف غير الملائمة للخزن مع ارتفاع في درجات الحرارة والرطوبة النسبية تعجل من سرعة هرم البذور. عرضت بذور خيار القثاء الى ظروف الهرم المعجل بدرجة حرارة 45± 1م° ورطوبة نسبية 100% ولمدة 3، 7، 12 يوم لتقييم حيوية البذور. الهرم المعجل لبذور خيار القثاء سبب تاثيرات معنوية لكل مواصفات الانبات ومعدل النمو النسبي. زيادة مدة الهرم سببت حدوث زيادة معنوية في محتوى البذور الرطوبي (من 7.53% عند معاملة السيطرة الى 21.27%) و نضوح الايونات بدلالة التوصيلية الكهربائية (من 194.73 عند معاملة السيطرة الى 783.30 µs /سم /25 بذرة) بينما نسبة انبات البذور انخفضت (من 99% عند معاملة السيطرة الى 0.0%) و دليل حيوية البذور انخفض معنوياً (من 14.29 عند معاملة السيطرة الى 0.0) بعد مرور 12 يوم من التعمير (البذور فقدت حيويتها). طول البادرة والوزن الطري والجاف ايضاً انخفضت مع زيادة مدة التعمير.

Introduction:

Temperature and relative humidity together cause rapid decline in seed quality during storage [1]. The accelerating ageing test, in which seed is incubated for a short period (a few days) under high humidity and high temperature conditions, was first developed by [2] for predicting the storability of seed. [3] Concluded that physiological changes in seeds subjected to accelerated ageing were largely similar to those during natural ageing except the rate at which they occur. During the ageing process, seeds lose their vigor, ability to germinate and ultimately become less viable [4]. Ageing is manifested as reduction in germination percentage and those seeds that do germinate produce weak seedling [5]. [6] Stated that the accelerated ageing (AA) test consistently better than standard germination tests for predicting seed vigor. [7] Suggested that the secondary products of lipid peroxidation, such as malondialdehyde, was likely to be involved in the breakdown of proteins and nucleic acids through the Amadori and Maillard reactions. However, the involvement of lipid peroxidation in seed degradation during storage is still subject to debate [8].

Seed ageing is generally marked by reduction in Vigor [9], viability, rate and capacity of germination [10], increased solute leakage [11] and susceptibility to stresses and reduced tolerance for storage under adverse conditions [12].

Such methods provide information on both putative seed storability and on seed vigor; seeds able to tolerate this treatment are generally of good germinative quality. Therefore, information about the vigor of the seed lots before storage is valuable for producers.

The aims of this work was studying the changes in the germination characteristics of snake cucumber seeds during accelerated ageing conditions and its relation to seed viability, in order to extend.

Materials and Methods:

Plant material:

Experiments were performed on a local Iraqi cultivar (*Cucumis melo var.flexuoses Naud.*). The seed materials were obtained directly from the field of Babil governorate in the season of (2012-2013) Seeds were surface sterilized using 5% sodium hypochlorite solution for 5 minutes and rinsed thoroughly in distilled water. The seeds were dried at 25°C for 24 hours in the laboratory. As described for pea by [13]. Seed material was stored in dark plastic containers at 5C° until use.

Accelerated ageing treatment:

Seeds were aged acceleratedly at (45 ±1C°) and 100% relative humidity up-to 12 days. Seeds were aged in glass desiccators containing distilled water. The desiccators were covered and maintained in an incubator at 45±1ºC for 3, 7 and 12 days. Seeds were taken after 3, 7, and12 days of ageing treatments. Moisture content was determined and the seeds were air dried at 25°C until their original moisture content (7.3-8.0%) was restored. The seed material was stored at 4°C under the dark until use [13].

Moisture content:

Moisture content was carried out in an oven at 105±3°C for 72 h using three samples of 4.0 g of seeds for each lot. Results were expressed as mean percentages for each lot (fresh weight basis) [6].

Germination test:

Germination assays were performed in a germination laboratory. Twenty five seeds for each treatment were placed on moistened two-layered germination paper. The papers were watered whenever required. They were considered germinated when their radical length was approximately 2 mm or more. Germination count, seedlings and length were observed after 7th day of sowing [11].

Electrolyte leakage test:

Twenty five seeds were weighed and placed in 100 ml beaker containing 30 ml of distilled water. Beakers were covered and left undisturbed for overnight. The Elute was collected and the final volume was made to 50 mL with distilled water [14].The conductivity measurements were expressed in (µs\cm\25 seed).

The germination speed index (GSI):

The germination speed index (GSI) was calculated as described in the Association of Official Seed Analysts [15] by following formula:

$$GSI=\frac{\text{No.of germinated seed}}{\text{Days of first count}}+\cdots+\cdots+\frac{\text{No.of germinated seed}}{\text{Days of final count}}$$

Seedling vigor index (SVI):

Seedling vigor index (SVI) was calculated following modified formula of Abdul-Baki and Anderson [16]:

SVI = [seedling length (cm) × germination percentage]/100

Growth analysis: (Relative Growth Rate):

Seedlings of snake cucumber cultivar were transplanted into plastic trays filled with clean sawdust .Water was topped after 3 days of planting, seedlings were harvested from trays. Root and shoot were separated, fresh and dry weights were determined [17].

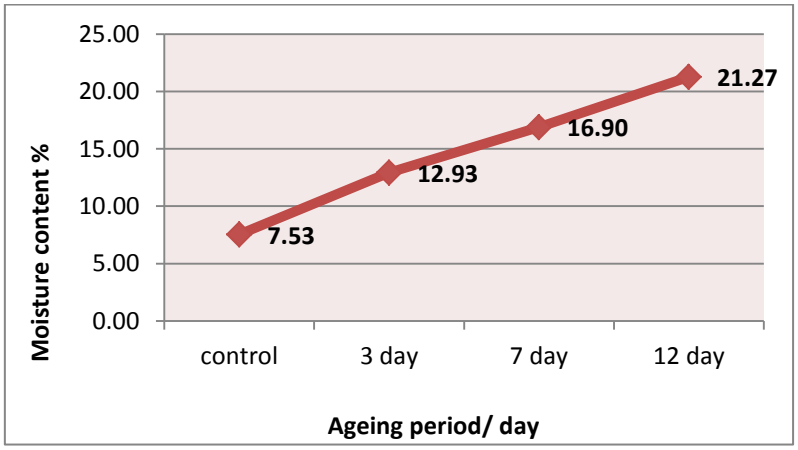
Statistical test:

Data were subjected to an analysis of variance, a completely randomized design and L.S.D (least significant difference) values were calculated at $P \leq 0.05$.

Results and discussion:

Moisture content:

The results in fig (1) shows significant increases in moisture content after subjected to accelerated ageing period from 3 to 12 days compared to control . Moisture content increases from 7.53% at control to 21.27% after 12 days of seeds accelerated ageing time. These results are in agreement with [18] that exposed okra seeds to accelerated ageing, significantly increased moisture content after 3days of ageing period.



Fig(1) Effect of accelerated ageing condition on moisture content (%) for snake cucumber seeds L.S.D$_{0.05}$ = 0.7.

Standard germination test:

Fig (2) shows the germination percentage of snake cucumber seeds had significant decreased with increase accelerated ageing period up to 3 days , the highest value was 99% in control (un aged seeds) compared with 79%, 59% and 0.0 % at 3, 7 and 12 days of accelerated ageing period respectively.

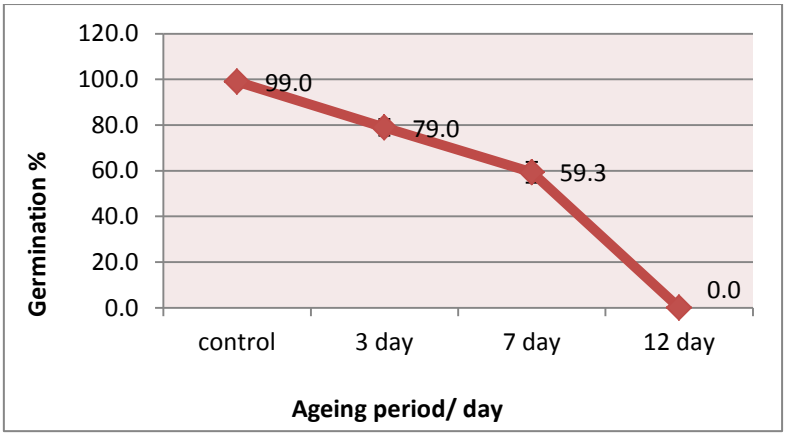


Fig (2) Effect of accelerated ageing conditions on germination percentage (%) for snake cucumber seeds.L.S.D$_{0.05}$ =1.838.

Germination speed index (GSI):

Germination speed is a direct measure of seed vigor. It may be defined as "number of germinated seeds per unit day". Accelerated ageing also decreased the germination speed of seed material. The effects of duration of ageing treatment on seed germination index (GSI) was significantly differ and as shows in the figure Fig(3), germination index reduces by increasing the period of ageing treatments, were the highest value was recorded 46.1 at control compared to 31.77, 18.43 and 0.00 at 3, 7 and 12 days respectively. These results are in agreement with [18] on Okra seeds, [19] on sunflower seeds, they were found that germination percentage and GSI significance decreased with increased ageing time. Reducing seed germinability (fig 2) and (GSI) (fig 3) may be due to lipid peroxidation, mitochondrial dysfunctions and decreased ATP production [7].

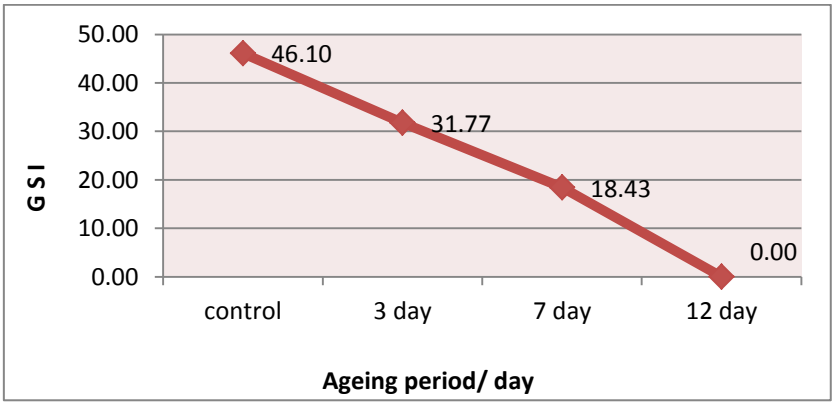


Fig (3) Effect of accelerated ageing conditions on germination speed index (GSI) for snake cucumber seeds.L.S.D$_{0.05}$ = 2.171.

However, [20] suggested that decreasing germination capacity in old alfalfa seeds (natural aged seeds) are because of increasing lipid peroxidation and phenolic materials. And the possible reason of this reduction might be the lowering of biochemical activities in seeds. Ageing have damaging effect on enzymes that are necessary to convert reserve food in the embryo to usable form and ultimately production of normal seedling [21].

Electrolyte Leakage:

The electrical conductivity of seeds increased with increasing ageing time. The ion leakage is increased by each increment of the accelerated ageing treatment and by prolonging of imbibition time.

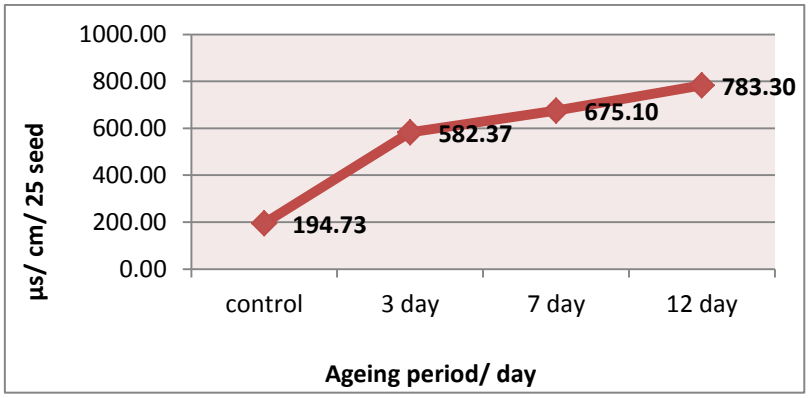


Fig (4) Effect of accelerated ageing conditions on membrane permeability in term electrical conductivity (µs\cm\25 seed) for Snake cucumber seeds.L.S.D$_{0.05}$ =29.898.

After 24 h of soaking seed leachates of control treatments were (194.73 µs/cm/25 seed) and these were increased (582.37 , 675.10 and 783.30 µs/cm/25 seed) in 3, 7 and 12 days of ageing treatments respectively Fig. (4). Effects of seeds ageing on electrolyte leakage have been reviewed by several researchers who found that as the ageing period increased, leachate conductivity also increased [18] on Okra seeds [19] on sunflower seeds. The increased seed leakage is believed to be associated with ageing induced changes in cellular membranes of imbibed seeds. [22] Suggesting that membrane integrity had declined. Many biochemical investigations have proven that lipid per oxidation and fat acidity (free fatty acid percentage) is a major cause of seed deterioration, including cellular membrane disruption.

Seedling vigor index (SVI):

The accelerated ageing treatment showed that the seedling vigor index (SVI) was significantly decreased with increasing ageing period Fig (5). The highest (SVI) value 14.29 was found at control, while the lowest value was recorded 0.00 after 12 days of accelerated ageing (seeds lossing viability).

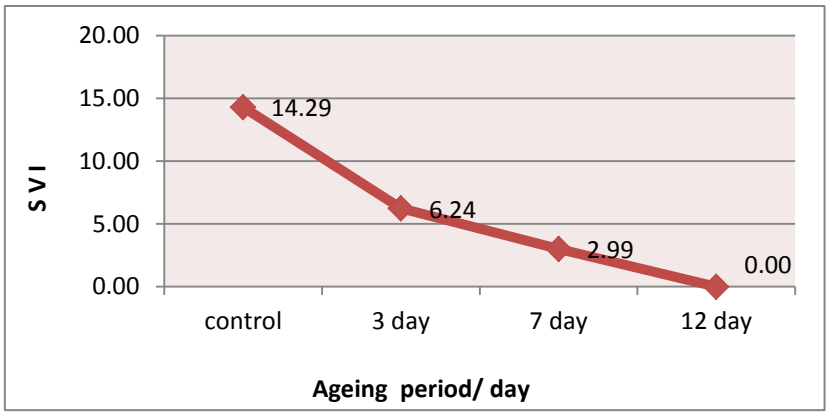


Fig (5) Effect of accelerated ageing conditions on seedling vigor index for snake cucumber seeds L.S.D$_{0.05}$ = 0.577.

Seedling length:

Seedling length significantly decreased with increasing accelerated ageing period, the highest value recorded 14.43 cm in control, and the lowest value recorded in 7 day was 5.03 and completely inhibited 0.0 cm at 12 day. Similar results were reported in sunflower and Okra seeds [19], [18].

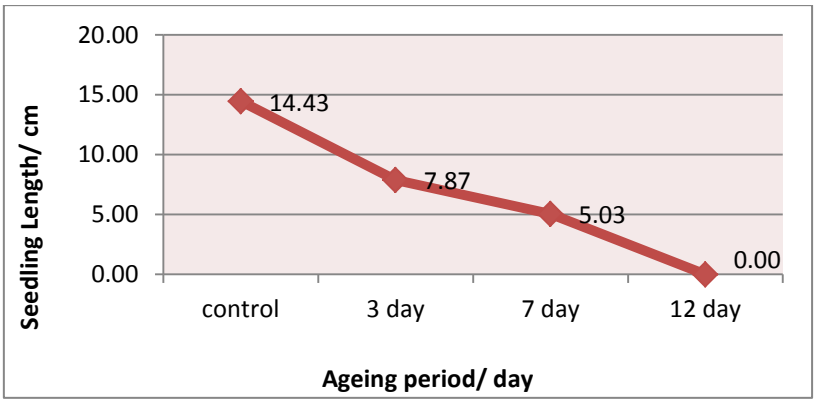


Fig (6) Effect of accelerated ageing conditions on snake cucumber seedling length (cm\plant) 7 days old.L.S.D$_{0.05}$ = 0.545.

The decline seedling vigor index (fig 5) and seedling length (fig 6) might be attributed to DNA degradation with ageing which leads to impaired transcription causing incomplete or faulty enzyme synthesis essential for earlier stages of germination [23].

Growth analysis (Relative Growth Rate):

The results were showed significant decreased of shoot length with increasing ageing period , the maximum shoot length was recorded for un-accelerated ageing seed (control) 8 cm, after 3 days of accelerated ageing decreased shoot length; it was 0.0 cm at 12 day of treatment because preventing germination.

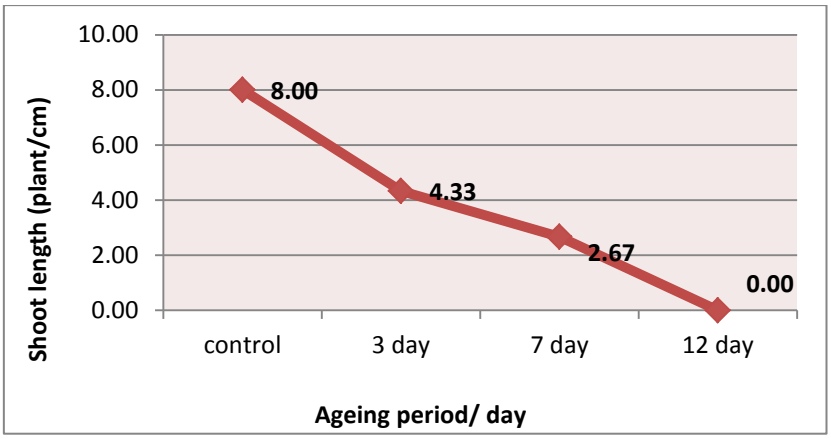


Fig (7) Effect of accelerated ageing conditions on snake cucumber shoot length (plant/cm) 7 days old.L.S.D$_{0.05}$ = 0.512.

Root length was greatly reduced with the increase in ageing time. Largest average root length was observed in control 6.43 cm and it was reduced with the ageing period up to 2.37 and 0.0 cm after 7 and 12days of ageing period respectively.

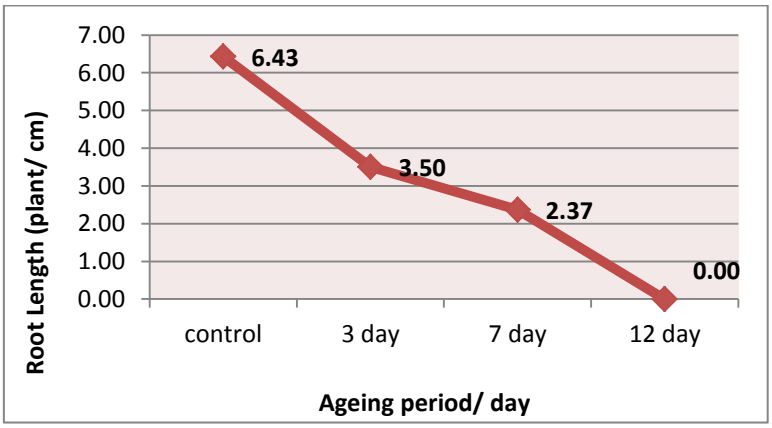


Fig (8) Effect of accelerated ageing conditions on snake cucumber root length (plant/cm) 7 days old.L.S.D$_{0.05}$ = 0.351.

Seedling fresh and dry weight was significantly affected by different ageing period (fig 9, 10), decreased in seedling fresh and dry weight was observed with the increase in ageing period, the highest value recorded 0.54, 0.0188 g in control for fresh and dry weight respectively, whilst the lowest value recorded 0.20, 0.0079 g and 0.0 g in 7 and 12 days of ageing period for fresh and dry weight respectively.

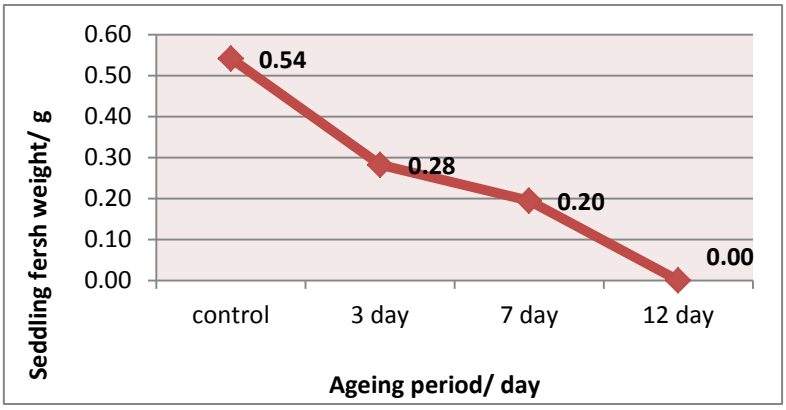


Fig (9) Effect of accelerated ageing conditions on snake cucumber seedling fresh weight /g 7 days old.L.S.D$_{0.05}$ = 0.0715.

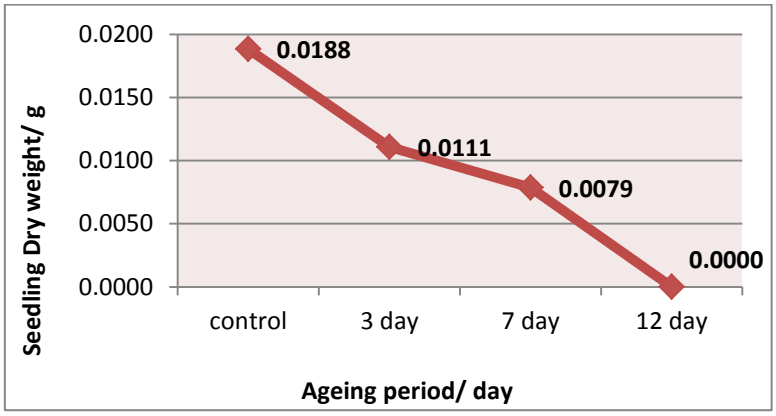


Fig (10) Effect of accelerated ageing conditions on snake cucumber seedling dry weight /g 7 days old.L.S.D$_{0.05}$ = 0.0001.

The decrease in shoot and root length, seedling fresh and dry weight under accelerated ageing conditions may be a result of progressive loss of seed viability and vigor, which was evident in the results of this study [24]. These results are in agreement with most of the previous reports [25], on rice seeds [26].

Reference:

1- Vashisth .A & Nagarajan .S. 2009. Germination Characteristics of Seeds of Maize (*Zea mays* L.) Exposed to Magnetic Fields under Accelerated Ageing Condition**.** J. Agri. Physics. 9: 50-58.
2- Delouche, J.C. & Baskin, C.C. 1973. Accelerated ageing techniques for predicting the relative storability of seed lots. *Seed Science and Technology*, 1: 427-452.
3- Likhlatchev, A.C., Zelensky, G.V., Kiashko, G.Y. & Schevchenko, Z.N. 1984. Modeling of seed ageing. *Seed Science and Technology*, 12: 385-393.
4- Maity, S.; Banerjee, G.; Roy, M.; Pal, C.; Pal, B.; Chakrabarti, D.& Bhattacharjee, A .2000. Chemical induced prolongation of seed viability and stress tolerance capacity of mung bean seedlings. Seed Sci Technol 28: 155-162.
5- Veselova, T.V & Veselovasky, V.A .2003. Innvestigation of atypical germination change during accelerated ageing of pea seeds. Seed Science and Technology.31: 517-530.
6- Woltz, J.M & Tekrony, D. M .2000. Accelerated ageing test for corn seed. Seed Technology. 32: 21-34.
7- McDonald, M.B. 1999. Seed deterioration physiology, repair and assessment. Seed Sci. and Technol. 27:177-237.

8- Narayana Murthy, U.M & Sun, W.Q. 2000. Protein modification by Amadori and Maillard reactions during seed storage: roles of sugar hydrolysis and lipid peroxidation. J. Exp. Bot. 51, 1228-1228.
9- Gupta, A. & Aneja, K.R. 2004. Seed deterioration in soybean varieties during storage-physiological attributes. Seed Res. 32: 26-32.
10- Arefi, H.M. & Abdi, N. 2003. Study of variation and seed deterioration of Festuca ovina germplasm in natural resources genebank. Iranian J. Rangelands and Forests Plant Breeding and Genetic Res. 11: 105-125.
11- Basra,S.M.A;Ahmad,N.;Khan,M.M.;Iqbal,N.&Cheema,M.A.2003.Assessment of cotton seed deterioration during accelerated aging. Seed. Sci. Technol. 31: 531-540.
12- Duffus, C.M. & Slaughter, J.C. 1980. Seed and their uses. J. Wiley and Sons. New York.
13- Khan, M.M; M.J. Iqbal; M. Abbas &M. Usman. 2003. Effect of accelerated aging on viability, vigor and chromosomal damage in pea (*Pisum sativum* L.) seeds. Pakistan J. Agri. Sci.,40**:** 50-4.
14- Simon,E.W&R.M.Rajaharun.1972.Leakage during seed imbibition.J.Exp. Bot. 23**:** 1076-1085.
15- Association of Official Seed Analysts (AOSA).1983. Seed vigor testing handbook. Contribution 32, Handbook on Seed Testing, AOSA, Lincoln, NE, USA.
16- Abdul Baki, A.A. & Anderson, J.D. 1973. Vigor determinations in soybean seed multiple criteria. Crop Sci. 13**:** 630-633.
17- Al-Maskri, A; M.M. Khan; O. Al-Manthery & K. Al-Habsi .2002. Effect of accelerated aging on lipid peroxidation, leakage and seedling vigor (RGR) in cucumber (*Cucumis sativus* L.) seeds. Pakistan J. Agri. Sci., 39: 330–337.
18- Sahib, M.M.2014. Changes in Viability, Vigor and Relative Growth Rate (RGR), in Okra (*Abelmoschus esculentus* L.) seeds during accelerated Ageing Technique. Magazin, Al-Kufa, boil. 6(1):100-110.
19- Hussein, J. H; Abdulla. I.S. & Oda .M.Y. 2011. Effect of Accelerated Aging Conditions on Viability of Sunflower (*Helianthus annus* L.) Seeds. Euphrates .J. of Agri. Sci.3 (3): 1-9.
20- Cakmak, T.; Atici, O.; Agar, G. and Sunar, S. 2010. Natural aging- related biochemical changes in alfalfa seeds stored for 42 years. Int. Res. J. Plant Sci. 1(1): 1-6.
21- Iqbal, N; A., Shahzad M; Basra & Khalil, R .2002. Evaluation of Vigor and Oil Quality in Cotton seed during Accelerated Aging. Int. J. Agri. Biol. 4(3): 318-322.
22- Mumtaz, K. M.; Javed, I.M.; Abbas, M.; Raza, H.; Waseem, R. & Ali, A .2004. Loss of vigour and viability in aged onion (*Allium cepa* L.) seeds. Inter. J. agri. and Biol .6:708-711.
23- Kapoor, N.; Arya, A.; Siddiqui, M. A.; kumar, H. & Amir, A. 2010. Seed deterioration in chickpea (*Cicer arietinum* L.) under accelerated aging. Asian J. Plant Sci. 9 (3): 158-162.
24- Jain, N.; Koopar, R. & Saxena, S .2006. Effect accelerated ageing on seed of Radish (*Raphanus Sativu* L.). Asian J. of plant Sci. 5(3):461-464.
25- Goel, A.; Goel, A.K. & Sheoran, I.S .2003. Changes in oxidative stress enzymes during artificial ageing in cotton (*Gossypium hirsutum* L.) seeds. J. Plant Physiol 160:1093-1100.
26- Gholami, T. H. & Golpayegani, A. 2011. Effect of seed ageing on physiological and biochemical changes in rice seed (*Oryza sativa* L.). Inter. J. Agri.Sci. Vol. 1(3): 138-143.