

EFFICACY OF COWPEA SEED TREATMENT WITH SOME BIOLOGICAL AND CHEMICAL MATERIALS AS WELL AS STORAGE PERIOD ON SEED INFESTATION WITH "*Callosobruchus maculatus*" AND SEED VIABILITY

EL-Shamma, H.A. and S.A. Doss

* Vegetable crop Dept. Hort. Inst. Agric., Res. center, Dokki – Giza

** Plant Protection Res. Inst. Agric. Res. center, Dokki – Giza

ABSTRACT

Cowpea seeds (*Vigna unguiculata* L.) were treated with twelve seed treatments and nine storage periods at room temperature to study the effect of these treatments on seed infestation with "*Callosobruchus maculatus*" and seed viability starting from October till June in two seasons of (1998/1999) and (1999/2000).

Results revealed that the lowest infestation were resulted from treating seeds with 50°C temperature and malathion powder compared with the untreated seeds.

Moreover, sulphur, 50°C temperature and zanzalaght leaves powder increased germination percentage. However, calcium carbonate increased seedling length. As for storage periods it was found that storing seeds for one month showed the maximum seedling length and seed viability were gradually decreased as the storage periods increased.

Obtained results indicated that cowpea seeds treated with sulphur powder, 50°C temperature, malathion, neem dry seeds wooden ash, black pepper powder and calcium carbonate and storage at one month till four months maximum at least of long period storage conditions. Seed viability was gradually decreased as the storage periods increased.

INTRODUCTION

Cowpea (*Vigna unguiculata*) mature seed is one of the most important vegetable crops in Egypt. Storage conditions are considered the most an important factors, which affect seed longevity.

Temperature, humidity type of packages and mixing seeds with insecticides during storage period are very important to keep cowpea seeds free from *Callosobruchus maculatus* insect infestation. This subject was studied by many investigators. Natural and chemical products such as neem leave or seed powder, neem oil, malathion, powder of black pepper seed, urea wooden ash, sulphur powder and fenugreek straw were mixed-before storage to protect seeds against insects.

Many researches were carried out on grains, rice, maize, pea, beans and cowpea to protect them during storage from pests infestation by *Callosobruchus maculatus* after treated seeds with neem such as Das (1986), Hongo and Karel (1986) and Gupto *et al.* (1988), observed that treated cowpea seeds with extracts of neem seed and neem leaves show less damage and a significantly lower incidence of the pests than untreated lots. As well as neem oils was very effective at 5 till 10 ml/kg. seed against insect pests, without detrimental effect on germination. Besides, Shehata *et al.* (1984) reported that when faba bean were mixed before storage with sand, wood ash and containers were lined with fenugreek straw, infestations

were controlled by the mixture treatments. In addition black pepper which may have an important role on protection during storage from pests infestation by this insects (*C. maculatus*). Seeds treated with black pepper has been studied by many investigators (Su. Hcf, 1984) on wheat and (Juneja and Patel, 1994 and Ivbijaro and Agbaje, 1986) on cowpea. They found that seeds mixed with a powder black pepper at different concentration against (*Callosobruchus analis*) infestation and caused significantly higher mortality of (*Callosobruchus maculatus*) adults within 48 h than when using a powder of *Capsicum annum* or *Capsicum frutesens* were used. On the other hand, none of the treatments adversely affected germination of cowpea seeds.

Concerning the effect of malathion at several concentration and storage periods with seeds treated on seed infestation by (*Callosobruchus maculatus*), numerous workers (Hunje *et al.*, 1990 and Usha *et al.*, 1990) working on cowpea seeds; Bhuiyah *et al.* (1995) on maize seeds and Sinha and Singh (1998) on wheat seeds. They mention that malathion was effective in preventing the emergence of adults and *C.chinesis* from seeds of green gram and very effective in protecting seeds against *sitophilus zeanais* for 6 till g monthes under storage conditions and did not affect seed viability.

On the other hand, Aykroyd (1969) found that deteriorate % was rapidly taken place when exposed to high temperatures, moisture, and insect infestation. Losses and changes in nutritive value are related to conditions of storage. Also he reported that raw whole soybeans in sealed tins stored at room temperature for 404 days showed little deterioration in protein value. Del Rosorico *et al.* (1981) stated that protein content varied from 19.96 to 24.4% of the dry matter on cowpea. While, Satya (1981) screened 24 varieties of cowpea seeds to find out the relative susceptibility to (*Callosobruchus maculatus*) and the results showed that it is not the morphological characters of seeds, seed volume and color of seeds, but the nutritional value of seed which governs the mechanism of resistance in cowpea to the attack of the pest. Further, the varieties with high protein contents for storage purpose should be well protected from the attack of *C.Maculatus* as there is fewer of more damage to the grain.

The effect of seed storage period, has been studied by many investigators. For instance Crocker and Barton (1957) reported that the proteins of such seed and seed meals became less soluble and broke down, showing an increase in amino acids at 30°F and 76°F for various periods. The change was more rapid in open than insealed storage, for meals than for intact seeds and at 76°F than at 30°F. Abu-Shakra (1969) stored various vegetable seeds under natural environmental conditions. The germination capacity of all seeds decreased more rapidly after 3 years. It exhibited only 50% germination or less. Ader (1978) stored lettuce and carrot pelleted seed at room temperature (18-22°C) or at 10C^o in different bags. He observed no loss in germination capacity and a very little reduction in the percentage of seed producing seedlings, when seeds of either species were stored at 10°C in airtight –glass Jars for up to 7 years. Selvara (1988) stored seeds of (*Solanum melongena L.*) for up to 24 months in different types of containers

at ambient temperature. Seed germination and vigor index were generally acceptable up to 18 months, but declined rapidly thereafter, up to 18 months.

Hence, the present work was conducted to study the effect of various natural materials as well as chemical products and storage period on infested seed and viability of cowpea seeds under storage conditions.

MATERIALS AND METHODS

The study was carried out in two seasons i.e. (1998/1999) and (1999/2000) at the laboratory of seed technology Research Department to study the effect of seed treatments with some biological and chemical materials as well as temperature and storage periods of seeds on seed infestation and seed viability. The materials were used

- | | |
|-------------------------------|---|
| 1 - Black pepper seed powder. | 2 - pod hot red capsicum. |
| 3 - Sulphur powder. | 4 - Malathion powder. |
| 5 - Urea. | 6 - Calcium carbonate. |
| 7 - Wooden ash powder. | 8 - Neem dry leaves powder. |
| 9 - Zanzalaght seed powder. | 10- Seeds treated at 50°C
temperature for five min.. |
| 11- Zanzalaght leaves powder. | 12- untreated seed (control). |

Twelve treatments and nine months of storage periods were examined in addition date of tested treatments started from October (1998/1999) and (1999/2000) seasons. The concentration of materials was 1% of seed weight. The variety used was cream 7 cowpea seeds. Treated seeds were packed in cloth bags and stored for nine months at the room temperature ranged from (18 to 35°C) and relative humidity ranged from 60-75%. The stored seeds were tested every month for the two seasons of the experiment (1998/1999) and (1999/2000) seasons.

Experimental design was split plot design with Four replicates where the period of storage was assigned in the main-plot and seed treatments in sub-plot.

Representative sample of 500 gram were taken at random from each treatment for recording the following measurements:

- 1- Seed infestation percentage.
- 2- Seed weight loss percentage.
- 3- Seed protein content percentage that was determined as follows: dry cowpea seeds were grained in a ground mill. A sample of 0.2 grams was taken to determine the total nitrogen (N), using the semi-micro kieldahl method as described by Miller and Ahoghorn (1945) and Howk *et al.* (1947).

The total protein was estimated by multiplying the nitrogen percent by 6.25.

4- Seed Viability **4-a- Germinability**

Germination test experiment was applied on mature extracted seeds was taken from pods. One hundred seeds was taken at randomly to test seed

viability. The germination test of seed took was lasting for 15 days in the incubator with optimum temperature of 25°C. The following data were recorded.

4-a-1. Germination percentage according to the equation.

$$\frac{\text{Number of germinated seed}}{\text{Initial number of seeds}} \times 100$$

4-a-2. Germination rate: was determined according to the equation reported by (Cleland, 1957) as follows:

$$GR = \frac{d_1, n_1, + d_2n_2+.....d_x n_x}{\text{Germination percentage}} = \text{days}$$

Were: $n_1, n_2, n_3,$ and n_x = number of seeds germinated in the first, second, third and x counting.

$d_1, d_2, d_3,$ and $d_x,$ = number of days after planting up to the first, second, third and x counting.

4-a-3. Emergency rate index (ERI): according to the equation reported by Bartlett (1937) as follows:

$$ERI = \frac{n_1+ (n_1 + n_2) + (n_1 + n_2+ n_3) +.....n_x}{c (n_1 + n_2+n_x)}$$

Were: $n_1, n_2, n_3, \dots\dots n_x$ = number of germinated seeds at first, second, third and x counting.

c = number of counts.

4-b- Seedling performance:

At 15 days after germination the following measures were under taken.

4-b-1. The length of each of hepocotyle (cm.).

4-b-2. The length of each of misocotyle (cm.).

4-b-3. Seedling length (cm.).

Statistical analysis was carried out by using factorial methods according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

1- Seed infestation percentage:

Data in Table (1) and Fig (1) indicate the existence of significant differences in this character among seed treatments.

In this respect the highest mean values were obtained from untreated seeds in both two seasons. Significant differences were found between the untreated seeds and treating seeds with 50°C temperature, malathion, neem, wooden ash, zanzalaght seeds and sulphur. This treatment gave lower values of infestation compared with the control treatment. In this respect the lowest mean value of infestation were obtained from treated seeds with 50°C temperature. This may be due to the favorable effect of temperature in preventing seed infestation. These results are in agreement with those reported by Das (1986) Hongo and Karel (1986) working with neem powder on pea and bean seeds and Bhuiyah *et al.* (1995) working with malathion powder on maize seeds.

table1

On the other hand the differences in seed infestation were not significant when seed were treated with calcium carbonate, black pepper, zanzalaght leaves and urea compared with the untreated seed.

Concerning the effect of storage periods on seed infestation. Data in Table (1) and Fig (2) showed significant differences between treatments. In this respect the lowest percentage of infestation was detected by storage seeds for one month. Similar finding was reported by Aykroyd (1969) on soybeans. The infestation increased gradually by increasing storage periods.

As for the interaction between seed treatments and storage periods. Data in Table (1) and Fig (1and2) revealed significant differences among treatments. In this respect the lowest infestation were found by treating seeds with temperature and storage for one month.

2- Weight loss percentage:

Data in Table (2) indicate the weight seed loss as affected by seed treatment and storage periods. As for the effect of seed treatment on seed weight loss the highest values were obtained from treating seed with temperature in both two seasons. Similar result was obtained by Aykroyd (1969) he found that high storage temperatures have some direct effect on thiamine content in dry beans when stored since beans seeds at 24C^o for a year lost more thiamine than beans stored at 4.5^oC, but the losses were small in either case. In addition, this could be attributed to the effect of temperature in increasing the loss of seed moisture. However, untreated seeds showed high weight loss without significant difference between it and treating seeds with temperature. While lowest mean values of seed losses were obtained by neem powder for both two seasons.

Concerning, the effect of storage periods on weight losses of seeds. The lowest seed loss was found when seeds were stored for one month while the highest values were obtained from stored for 9 months for both seasons. The increase of seed weight losses due to longer storage period may be attributed to breakdown of seed content by respiration and seed infestation with insect. Similar results were obtained by (Aykroyd, 1969).

As for the interaction between seed treatment and storage periods on seed weight losses. Data in Table (2) revealed that the highest weight losses were obtained when the seeds were treated with temperature and stored for 9 months.

3- Seed protein contents percentage:

Data in Table (3) indicate the seed protein contents as affected by seed treatments and storage periods. It was found that there were insignificant differences among various treatments in this character due to seed treatments.

fig1,2

table2

table3

Concerning the effect of storage periods. Data in Table (3) showed that the differences among treatments in protein content were not pronounced. The opposite results obtained by Crocker and Barton (1953) reported that the proteins of such cowpea seed and seed meals became less soluble and broke down. The change was more rapid in open than in sealed storage, for meals than for intact seed, and at 76°F than at 30°F. Moreover, Del Rosorico *et al.* (1981) stated that protein content varied from 19.96 to 24.4% from the dry matter. Besides, Satya (1981) screened 24 varieties of cowpea seeds to find out the relative susceptibility to *Callosobruchus maculatus*, and the results showed that it is not the morphological characters of seeds, seed volume and color of seed, but the nutritional value of seed which governs the mechanism of resistance in cowpea to the attack of the pest. Further, the varieties with high protein contents for storage purpose should be well protected from the attack of *C. maculatus* as there is fear of more damage to the grain.

As for the interaction between seed treatments and storage periods. Data indicate insignificant differences in this character.

4- Seed Viability

4-a- Germinability

4-a-1. Germination percentage:

Data presented in Table (4) and Fig (3) indicate the effect of treating seeds with natural and chemical materials as well as temperature, The results showed significant difference between the treated seeds and the untreated control. The most effective treatments were detected from treating seeds with sulphur, zanzalaght leaves powder and 50°C temperature without significant differences among them. The highest value of germination percentage was obtained by sulphur in both two seasons. This could be attributed to the influence of sulphur in inhibiting the infestation with the insect and protecting seeds during germination against fungal infection. Similar results were obtained by (Aykroyd, 1969) with bean seed treating by temperature.

As for the effect of seed storage periods on germination percentage presented in table (4) and Fig (4). It could be noticed that the highest value of this character was noticed when seeds were stored for one month in both seasons. The germination percentage significantly decreased as the seed storage period increased. Similar results were reported by Abu-Shakra (1969) on different vegetable seeds and Selvara (1988) on eggplant seeds.

Concerning, the effect of interaction between seed treatments and seed storage periods. It was found that there were significant differences among treatments. The highest values in this character were obtained from treating seeds with sulphur when stored to one month in both seasons. This high percentage of germination could be attributed to the favorable effect of sulphur in controlling the insect and short storage period of seeds which resulted in low infestation with the insect Table (1)

table4

fig3,4

4-a-2. Germination rate in days:

Data presented in Table (5) and Fig (5) showed significant differences in germination rate as affected by seed treatments and storage periods.

Concerning, the effect of seed treatments on this character. Data indicate that the highest values were obtained when seeds were treated with wooden ashes followed by black pepper powder without significant differences between them. This could be attributed to the high seed viability in both treatments. Similar results were reported on cowpea treated with pepper powder by several investigators such as SU. Hcf (1984), Ivbijaro and Agbaja (1986) and Juneja and Patel (1994). However, on field crops Hunje *et al.* (1990) and Usha *et al.* (1990), Bhuiyah *et al.* (1995) on maize grains and Sinha and Singh (1998) on wheat grains treated with malathion and Gupta *et al.* (1988) on wheat grains treated with neem powder and Shehata *et al.* (1984) on faba bean seeds treated with sand and wood ash. They observed that seed treatment with this materials gave a good protection while germination was not effected.

In this connection the highest values were obtained when seeds were stored for one month. These values were decreased gradually as the storage periods increased with significant differences. These results presented in Table (5) and Fig (6) clearly showed that the germination rate was evidently affected with different seed storage period.

Concerning the interaction between seed treatments and storage periods. Data showed significant differences. The highest values were obtained by treating seeds with wooden ashes when stored to one month. Similar results were observed from treating seeds with black pepper without significant differences between this treatment and that of wooden ashes.

4-a-3. Emergency rate index:

Data presented in Table (6) showed the effect of seed treatments and storage periods on this character.

It could be noticed that various seed treatments had no significant effect on this character.

Concerning, the effect of storage periods on these character significant differences was observed among periods. The highest values were detected from storing seeds to one month. These values gradually decreased by increasing storage periods. This could be due to the bad effect of storage periods on seed viability.

As for the interaction between seed treatment and storage periods the differences were not significant.

4-b- Seedling performance:

4-b-1. Hepocotyl length (cm.)

Data in Table (7) showed no significant differences in this character due to seed treatment.

Concerning the effect of storage periods on this character the highest values were recorded when

seeds were stored for one month. These results are partially in line with those reported by Ader (1978) on lettuce and carrot seeds.

As for the interaction between seed treatments and storage periods the differences were not significant. The highest mean values of this character were obtained from the untreated seeds (control) when stored for one month.

4-b-2. Misocotyl length (cm.)

Data presented in Table (8) indicate significant differences among seed treatment. The highest values were detected from treating seeds with calcium carbonate and wooden ash without significant differences between them. Shehata *et al.* (1984) reported that when beans were roasted before storage admixed with sand, wood ash and containers were lined with fenugreek straw, infestations were controlled by the admixture treatments.

As for the effect of storage periods in this character, the best results were observed when seeds were stored for one month. The mean values of this character decreased gradually as the storage periods increased. Ader (1978) worked on lettuce and carrot found that storage period affected on seedling growth.

Concerning the interaction between seed treatments and storage periods on this character significant differences were observed. The highest values were detected from treating seeds with calcium carbonate when seeds were stored for one month.

4-b-3. Seedling length (cm.)

Data in Table (9) indicate the existence of significant differences among seed treatments in this character. In this connection the highest seedling length was detected when seeds were treated with calcium carbonate. This may be due to the favorable effect of this treatment in supplying the seedling with calcium necessary for cell wall formation.

Data in Table (9) also show significant differences in this character due to storage periods. The highest value was detected when seeds were stored for one month and gradually decreased as the storage periods increased. Similar results were found by Ader (1978) on lettuce and carrot seeds.

Concerning, the interaction between seed treatments and storage periods. Data also indicate that the highest mean value was observed when seeds treated with calcium carbonate and stored for one month.

REFERENCES

- Abu-Shakra, S.; G. Aki and S.Saad (1969). Seed longevity of field and vegetable crops under natural conditions of storage in Lebanon. (Publ.) Fac. Agric. Sci., Amer. Univ. Beirut, 39, pp. 19.
- Ader,F.(1978). Moisture content and storage conditions of pelleted vegetable seeds and their influence on germination and plant growth. *Seed science and Technology*, 6(4): 1033-1051.
- Aykroyd, W.R. (1969). Legumes in human nutrition F.A.O Nutritional studies.

- Bartlett. M.S. (1937). some examples of statistical methods of research in agriculture and applied. *Siol.J.Roy. Soc.*,4: 2.
- Bhuiyah, I.M.; N. Islam; A. Ahmed and A. Uddin (1995). Chemical control of corn weevil, *Sitophilus Zeamais* Motschulsky infesting maize seeds in storage. *Bangladesh J. of zoology*.23: 2,209-214, 6 Ref. (C.F.CAB Abstr. (1996-1998). /07
- Cleland,K.W. (1957). Permeability of isolated rate heartsarcosmes. *Nature*, 176:497-499.
- Crocker,W. and L.V. Barton (1953). Protein changes in seeds during storage physiology of seeds PP 36, illus. Watham Mass.
- Das, G. P. (1986). Pesticidal efficacy of some indigenous plant oils against the pulse beetle., *Callosobruchus chinensis* linn. (Coleoptera = Bruchidae). *Bangladesh J. of zoology*. 14:1,15-18,7 Ref (C.F.CAB Abstr. (1984-1986).
- Del Rosorico, R.R.; Y. Lozono and M.G. Noel (1981). The chemical and biochemical composition of legume seeds. 2. Cowpea. *Philipp. Agric.*, 64(1): 49-57.
- Gupta H.C.; J.P. Verma; S.S. Bareth and B.N. Mather (1988). Evaluation of some non edible oils as grain Protectant in wheat and their subsequent effect on germination. *Indian J. of Entomology*, 50(2):147-150; 8 Ref. (C.F.CAB Abst. (1990-1991).
- Hongo, H. and A.K.Karel (1986) Effect of plant extracts on insect pests of common beans. *Journal of Applied Entomology* 102(2):164-169.En.,Sum. En., De., 18 Ref. (Sokoine univ. of Agric., Dept. of crop, Sci., p.o. Box 3005, Morogoro, Tanzania). (c.F.Abst. on field Beans (*phaseolus vulgaris* L.) vol. X1X No.2, Aug.1989,33198).
- Howk, F.P.;L. Oser and W.h.Summeron (1947). *Microk Jeldahl method*. Practical chemistry, 12 th Edition, J. and Churchill. Landault and Guiochen. 1964, separation of amines by gas liquid chromatography using Teflon support. *J. Chromatog*, 13:562-567.
- Hunje R.V.; G.N., Kalkarni; S.D., Shashidhara and Vyakarnahal, B.S. (1990). Effect of insecticide and fungicide treatment on cowpea seed quality. *Seed Research*. 18, (1) 90-92. (C.F CAB Abst. (1990-1991).
- Juneja, R.P. and J.R., Patal (1994). Botanical materials as protectant of green gram, (*Vigna radiata* L.) Wilczek against pulse beetle, *Callosobruchus analis* Fabricus. *J. Gujarat Agricultural. Univ. Resea. J.* 20: (1) 84-87; 5 Ref. (C.F. CAB Abst. 1996-1998).
- Ivbijaro, M.F. and M. Agbaje (1986). Insecticial activities of piper guineensc Schum and Thonn, and capsicum species on the cowpea bruchid, *Callosobruchus maculatus* F. *Insect science and its Application*, 7: 4, 521-524, 7 Ref. (C.F. CAB Abst. 1987-1989).
- Miller.I. and J.Ahoghorn. (1945). Modification keldah L.J. *Biol. Chemistry*, 159:373.
- Satya VIR, (1981). Note on the relative susceptibility of different varieties of cowpea to *Callosobruchus maculatus* Fabricius. *Indian J. Agric. Sci.*, 51(11): 813-815.
- Selvara, J.A. (1988). Studies on storage of brinjal (*Solanum melongena* L.) Seeds, 1-Biocide treatments and containers for storage. *South Indian*

- Horticulture 36 (6) 313-317 (En, 10 Ref.) Tamil Nadu Agric. Univ., Coimbatore 641 003, India (Hort. Abst. 60:8140,1990).
- Shehata, A.M.E.T.; A.S. Messallam; A.A. El-Banna; M.M. Youssef and M.M. El-Rouby (1984). The effects of storage under different conditions on cooking quality, viability and bruchid infestation of faba beans (*Vicia faba* L.). Tropical stored product information, No 49,9-18; 1 Fig. 13 Ref. (C.F. CAB Abst. 1984-1986).
- Sinha S.N. and P.B. Singh (1998). Effect of containers and joint action of insecticides and fungicide on insect infestation and viability of wheat seed. Crop Research Hisar. 16:3,382-388 7 Ref. (C.F. CAB Abst. 1998-2000).
- Snedecor, G.W. and W.G. Cochran (1967). Statical methods 6 th ed. Iowa state Univ. press Ames Iowa. U.S.A.
- SU. HCF (1984). Comparative toxicity of three pepper corn extracts to four species of stored product insects under laboratory conditions. J. of the Georgia Entomological society. 19:2, 190-199; 15 Ref. (C.F.CAB Abst. 1984-1986).
- Usha, H;Z. Javare – Gowda and H.Ramaiah (1990). Influence of containers, chemical and bio-products treatment on storability of cowpea (*Vigna unguiculata*) and horsegram (*Dolichos biflorus*) seeds. Department of seed technology, U.S.A., Bangalore 65, India, Legume Research. 13:1,13-16; 6 Ref.

تأثير معاملة بذور اللوبيا ببعض المواد الحيوية والكيميائية وفترة التخزين على

تسويس البذور وحيويتها بخنفساء اللوبيا

هانى الفونس الشماع * - صفوت عزمى دوس **

* معهد بحوث البساتين أقسام بحوث الخضر بالدقى – جيزة مركز البحوث الزراعية

** معهد بحوث وقاية النباتات بالدقى – جيزة مركز البحوث الزراعية

عوملت بذور اللوبيا بأثنى عشر معاملة بمواد مختلفة وخزنت تسع أشهر في درجة حرارة الغرفة لدراسة تأثير هذه المعاملات على تسويس البذرة وحيويتها نتيجة الإصابة بخنفساء اللوبيا خلال موسمي (١٩٩٩ ، ٢٠٠٠ / ٩٩).

وقد أوضحت النتائج ما يلي :

- أقل نسبة من التسويس تحصل عليها بمعاملة البذور بدرجة حرارة ٥٠ م⁰ وكذلك معاملة البذور بمسحوق الملاثيون وذلك بالمقارنة بالبذور الغير معاملة.
 - علاوة على ذلك أدت المعاملة بمسحوق الكبريت ومسحوق أوراق الزنزلخت ألي زيادة نسبة الإنبات. كما أدت المعاملة بكربونات الكالسيوم ألي زيادة طول البادرة.
 - كذلك كان لتخزين البذور خلال شهر واحد الحصول على أعلى نمو للبادرة وأعلى حيوية للبذور والتي تقل تدريجياً بزيادة فترة التخزين.
- ولقد أوضحت النتائج المتحصل عليها إن معاملة البذور بمسحوق الكبريت ودرجة الحرارة ٥٠م ومسحوق الملاثيون ومسحوق بذور النيم ورماد الفرن ومسحوق الفلفل وكربونات الكالسيوم كانت أنسب المعاملات من خلال التخزين لمدة شهر واحد حتى ٤ أشهر على أكثر حد تحت ظروف التخزين. وتقل حيوية البذور تدريجياً بزيادة فترة التخزين.