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Viability and Seedling Parameters for Some Barley Cultivars as Influenced by Storage Condition

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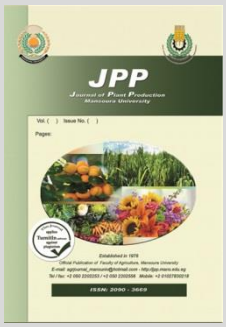

ABSTRACT

This study was conducted to investigate the effect of some storage conditions for different periods (6 and 18 months) after harvest [two kinds of packages were used, high density polyethylene (H.D.P) and jute, with two forms of barley grains (grains and spikes), for five barley cultivars, Giza 123, Giza 126, Giza 127, Giza 128 and Giza 129) on the seed germination%, seedling vigor, seedling vigor index, viability and some seed quality parameters. The results revealed that, there was a significant increase in moisture content, electrical conductivity and acidity% with long storage time for both kinds of package and seeds form. Barley stored in spike form is more resistant than barley stored in grain form against the adverse effects of some storage conditions by decrease its content of moisture, electrical conductivity and acidity %. Barley seeds stored in spike form in both package recorded the highest values differences ($P<0.05$) compared with grain form, H.D.P used for storage barley grain avoid the previous disorders of storage conditions in the present study. Also, results recorded highly significant differences among the tested cultivars for all studied characters. Giza 123 achieved the highest values in all tested characters, while Giza 129 gave the lowest values. The results illustrated that, using (H.D.P) and spikes form would be avoid the adverse effect of increasing storage period up to 18 months of barley on seed viability and seedling parameters.

Keywords: Grain quality, Storage material, Storage period, Storage form, Barley

INTRODUCTION

Barley seeds were generally produced once during the year. For this reason, barley is stored for about a year after harvest or until the next crop is harvested so that it is available during the end of the season or longer. Barley is stored in the form of grain. The ear of barley is the technical name for the head of an herbaceous plant and is the part of the plant where the grain is formed. Thus, storing barley in spike form is a process in which the grain is stored as a whole spike in an attempt to preserve the grain for later use. Storage time, temperature and moisture content of the grain are the most important factors in terms of barley quality Karaoglu *et al*. (2010) and Konopatskaia *et al*. (2016). The spike is the most important part of the wheat plant because grains are formed inside it and this spike consists of a central axis winding along the rotating spike Konopatskaia *et al*. (2016). These spikelets are developed into the spikes at the nodes and contribute to the improvement of flowers and seeds. The seed of wheat crop surrounds the lemma and also the palea of each spikelet Miller (2003) and Kibar (2015). According to that, the spike of wheat could be considered as natural package for seeds. El-Sayed *et al*. (2018) cleared that wheat stored in spike form is more resistant than wheat stored in grain form against adverse storage conditions by lower content of electrical conductivity (E.C), moisture content and acidity percentage.

Quality barley seed has the ability to germinate and can contribute to high initial bearing growth as well as rapid growth thus creating good seedlings. To attend such a high germination rate, the seeds should be stored in the required storage period to maintain their quality. Seed germination percentage, germination rate and seedling establishment are decreased with increased in seed storage was accompanied with the increase mean germination time Basra *et al*. (2003). El-Sayed *et al*. (2018) reported that increasing storage time after harvest until 18 months caused negative effect seed germination percentage, seedling vigor, 1000-grain weight, relative density, protein percentage and viability parameters.

Storage has a big and important role in maintaining the viability and quality of the stored seeds for a long time without any deterioration of seed. Mettananda *et al*. (2001) reported that the seeds should be packaged using a watertight container and stated that the strength of the seeds decreases with the increase of the water content especially in environments with high temperature and high humidity in the air. Proper packing and storage methods are essential for good seed storage stability. Traditionally, jute was used for bulk packing of seed crops. Plastics such as high-density polyethylene, polypropylene, woven bags, multi-layer extruded films, three-layer bags and aluminum foil are very widely used for seed storage due to their excellent barrier to air, moisture, odors and microorganisms

There is no enough information about storage of barley in spike form, however this study was performed to investigate the seed germination percentage, seedling vigor, seedling vigor index, viability and some seed quality parameters of barley grains under different storage conditions and periods.

MATERIALS AND METHODS

Barley spike and grains were investigated at Sakha Agriculture Research Station, ARC, Egypt during a 2018-

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2019 season. Viability parameters, laboratory and field germination, vigor seedling parameters and some chemical analysis were conducted at the Seed Technology Laboratory, Field Crop Research Institute, Sakha during the period from 2019 to 2020 year to investigate the effect of some storage different conditions i.e.

1- Storage time: Zero time, 6 and 18 months.
2- Storage packages: High density polyethylene (H.D.P) and jute.
3- Storage forms of barley: Spike form and grain form.
4- Cultivars: Five barley cultivars (Giza 123, Giza 126, Giza 127, Giza 128 and Giza 129).

Spike and grains samples were taken immediately after one month from harvesting. The samples were sieved and cleaned from dust, husk or any inert materials and the spike and grains moisture content at 12%. Spike and grains samples of each variety were stored in two types of packages High density polyethylene (H.D.P) and Jute bag. Each package was filled with 1 kg of barley of spikes and grains in three replicates and stored for 6 and 18 months under warehouse condition. Random samples were taken from each package to determine seed viability parameters vigor and some chemical.

- Stander germination percentage (G.P):

Eight replicates of 50 seeds per lot were planted in plastic boxes of 40 x 20 x20 cm dimensions and contained sterilized sand. The boxes were watered and kept at 25 C° in an inculcated chamber and following parameters were evaluated:

Germination percentage (G.P) was calculated by counting only normal seedlings 8 days after planting according to international rules of ISTA. (1999).

$$\textbf{G.P \%} = \frac{Number\ of\ normal\ seedling}{Number\ of\ seed\ tested} \textbf{X100}$$

- Seedling vigor:

Seedling vigor as measured by the length of normal seedling and dry weight which was made on 10 seedlings per replicate at the end of germination test. The seedling was oven dried at 70ºC for 24 hours and weight AOSA. (1991).

- Seedling vigor index (S.V.I):

Seedling vigor index was calculated using the following formula outlined by Ruan *et al*. (2002)

Seedling vigor index = Seedling dry weight × germination%

-Field Emergence (F.E):

This was recorded on the 4th day after planting. It is the percentage of germinated seed 4 days after planting relative to the total number of seeds tested Ruan *et al*. (2002)

-Relative Field Emergence (R.F.E):

Denote to the percentage of viable seeds produced plants in the field/seed germination as determined in the laboratory.

$$\textbf{R.F.E} = \frac{F.E}{G.P} \times \textbf{100}$$

-Field Survival (F.S):

Field Survival was recorded at time intervals until constant [30 days from seed sowing] and the highest figures were used.

-Relative Field Survival (R.F.S):

Denote to the percentage of viable seeds produced plants survival / seed germination as determined in the laboratory

$$\textbf{R.F.S} = \frac{F.S}{G.P} \times \textbf{100}$$

Relative density (R.D)

Relative density of seeds was calculated accorded to Kramer and Twigg (1962) as follows:

$$\textbf{Relative density (g/mm}^3\textbf{)} = \frac{100 - seed\ weight\ (g)}{100 - seed\ volume\ (mm\ 3)}$$

Electrical conductivity test (EC):

Four sub-samples each of 50 seeds were taken from the pure seed portion of each seed grade. Each sub-sample was weighed to the nearest two decimal points after which it was placed in 500 ml conical flask containing 250 ml distilled water. The flasks were covered and then incubated at 25 ± 1ºC for 24-hours period. Conductivity measures were recorded at the end of each test period at 20 ºC using a calibrated conductivity meter.

-Crude protein: -

Known weight of the fine powdered seeds (ca 0.1g) was digested using a micro kjeldahl apparatus. The crude protein was calculated by multiplying the total nitrogen by 5.85 AOAC. (990).

Statistical analysis

Collected data were analyzed according to the factorial completely randomized design with three replicates. Analysis of variance computed according to Sendedcor and Cochran (1982) and treatment means was compared by Duncan Multiple Range Test the treatments were compared at 0.01% level of significance Duncan (1955). Correlation performed according to Singh and Chaudhary (1977). All statistical analyses were performed using analysis of variance technique by "MSTAT-C" (1990) computer software package.

RESULTS AND DISCUSSION

Effect of storage time

Results of seed germination%, seedling parameter (root length, shoot length and S.D.W), S.V.I, E.C and acidity percentage as affected by storage time under study are presented in Table (1).The general effect of time on seed germination%, seedling vigor, seedling vigor index, electrical conductivity and acidity percentage of barley are given in Table (1). Increasing storage time after harvest from 6 to 18 months significantly decreased the mean seed germination% from 96.23 % to 86.72 % and 67.38 %, respectively. The decline in seed germination% with storage time was associated with a decrease in seedling parameter [root length, shoot length and S.D.W) as shown in Table (1). Increasing storage time after harvest to 6 and 18months significantly decreased root length, shoot length and S.D.W from (15.50cm, 14.13cm and 9.99cm), (18.28cm, 16.40 cm and 13.08 cm) and (45.73mg, 40.33mg and 28.57mg), respectively. The decline in seed germination% with storage time was associated with a decrease in seedling vigor index from 4.41to 3.53and 1.96, respectively. Also, the data in this table indicate clearly that the decline in seed germination% with storage time was associated with a decrease in seed viability (by increasing E.C value and acidity %). Increasing storage time after harvest to 6 and 18 months significantly decreased E.C value and acidity percentage from [15.28, 20.23 and 28.87µS m^{-1}] and [3.78 %, 5.62 % and 10.79 %], respectively. These findings are in agreement with obtained by Singh *et al*. (2011). Omar *et al*. (2012), Kibar (2015)

Shahein and Mohamed (2016) who found similar results in different seeds under different storage condition and observed that the long storage time resulted in a decrease in all of those viability parameters associated with a decrease in seed germination%, Badawi *et al*. (2017), El-Sayed *et al*. (2017) and El-Sayed *et al*. (2018).

Table 1. The general effect of storage time and storage packages on seed germination, seedling vigor, seedling vigor index, E.C. and acidity.

Treatment	G.P	Seedling vigor			S.V.I	E.C ($\mu S\ m^{-1}$)	Acidity %
		Root length (cm)	Shoot length (cm)	S.D.W (mg)			
Storage time							
Zero Time	96.23 a	15.50 a	18.28 a	45.73 a	4.41 a	15.28 c	3.78 c
6 months	86.72 b	14.13 b	16.40 b	40.33 b	3.53 b	20.23 b	5.62 b
18 months	67.38 c	9.99 c	13.08 c	28.57 c	1.96 c	28.87 a	10.79 a
F. Test	**	**	**	**	**	**	**
Storage Packages							
H.D.P	86.50 a	13.64 a	16.66 a	39.91 a	3.54 a	20.63 b	6.29 b
Jute	80.39 b	12.77 b	15.18 b	36.51 b	3.06 b	22.29 a	7.16 a
F. Test	**	**	**	**	**	**	**

**** indicated P< 0.01.**

The effect of storage time on field emergence, field survival, relative field emergence, relative field survival, seed index, relative density, moisture content and crude protein percentage are given in Table (2).

Table 2. The general effect of storage time and storage packages on (F.E), (F.S), (R.F.E), (R.F.S), seed index, R.D, moisture content and crude protein

Treatment	F.E%	F.S%	R.F.E	R.F.S	Seed index	R.D	Moisture %	Protein %
Storage time								
Zero Time	86.53 a	83.74 a	89.74 a	86.83 a	95.43 a	1.24 a	11.52 c	11.50 a
6 months	74.73 b	71.81 b	86.06 b	82.56 b	85.31 b	1.14 b	12.15 b	11.32 b
18 months	57.25 c	54.44 c	84.22 c	80.22 c	75.85 c	0.915 c	12.57 a	9.59 c
F. Test	**	**	**	**	**	**	**	**
Storage Packages								
H.D.P	76.69 a	73.87 a	88.24 a	84.86 a	88.17 a	1.14 a	11.73 a	11.08 a
Jute	68.99 b	66.13 b	85.10 b	81.55 b	82.88 b	1.06 b	12.42 b	10.52 b
F. Test	**	**	**	**	**	**	**	**

**** indicated P< 0.01.**

Increasing storage time after harvest from 6 to 18 months significantly decreased the F.E %, F.S %, R.F.E, R.F.S, R.D and crude protein percentage of barley grain. Meanwhile, increasing storage time from zero time to 6 and 18 months significantly increased the moisture content from 11.52 % to 12.15 % and 12.57 %, respectively. Similar results were reported by Singh *et al*. (2011), Shahein and Mohamed (2016), El- Sayed *et al.* (2017) and El- Sayed *et al.* (2018).

Effect of storage packages

The effect of storage packages on the viability and studied viability parameters of barley seed lots are given in Tables (1and 2). There were highly significantly differences among germination percentage, seedling characters, seedling vigor index, E.C. value and acidity percentage as affected by storage packages under study are presented in Table (1). Seed germination% for barley seed within H.D.P was significantly higher than Jute package 86.50 % and 80.39 %, respectively. Meantime, storage with H.D.P. recorded high value of seedling parameter (root length, shoot length and S.D.W) 13.64 cm, 16.66cm and 39.91mg), respectively. Also, H.D.P recorded high of seedling vigor index (S.V.I) 3.54 compared with Jute package 3.06. On the other hand, jute package gave the lowest viability (by increasing EC value and acidity percentage). However, Table (3) indicate that the F.E %, F.S %, R.F.E, R.F.S, seed index, R.D, moisture content and crude protein percentage were highly significantly affected by storage package. H.D.P package recorded high value of F.E%, F.S %, R.F.E, R.F.S, seed index, R.D and crude protein percentage compared with Jute package meantime, jute package recorded higher value of moisture content. These findings agreed with those obtained by Naguib *et al.* (2011), Omar *et al*. (2012), Kandil *et al.* (2013) and El-Sayed *et al.* (2018).

Effect of storage forms

Mean seed germination%, seedling parameter and studied viability parameters of barley seed lots as affected by forms (seed and spike) are given in Tables (3 and 4). Seed germination percentage, seedling parameter (root length, shoot length and seedling dry weight) and seedling vigor index of barley stored in spike form 85.17% (13.50cm, 16.17cm and 39.18smg) and 3.44 were significantly higher than those of barley stored seed form 81.72%, (12.91 cm, 15.67 cm and 37.24mg), 3.17, respectively. Meantime, barley stored spike form recorded the highest viability (by decreasing EC value and acidity %). In Spite of, moisture content of barley stored in spike form were significantly lower than those of barley stored in seed form. Similar results were reported by Karaoglu *et al.* (2010) recorded that storage in spike form had generally better preserving effect on hectoliter weight than storage in grain form at all storage time and temperature. El-Sayed *et al.* (2018) who reported that storage in spike form had generally better preserving effect on the viability and studied viability parameters of barley than storage in seed form at all storage time.

Effect of cultivars

Tables (3 and 4) indicated that the seed germination%, seedling parameter (root length, shoot length and S.D.W), SVI, E.C, acidity percentage, F.E%, F.S%, R.F.E, R.F.S, seed index, R.D, moisture content and crude protein percentage of barley seeds were significantly

affected by cultivars. Giza 123 was significantly higher in seed germination %, root length, S.D.W, seedling vigor index 88.58 %, 14.07 cm, 47.44 mg, and 4.27, respectively. In the meantime, Giza 123 was significantly higher viability [by decreasing EC value and acidity percentage]. Also, Giza 123 was significantly higher in F.E %, F.S %, R.F.E, R.F.S, seed index and R.D 79.69 %, 77.75 %, 90.09, 87.67, 106.45 gm. and 1.21, respectively. On the other hand, Giza 129 was significantly lower in seed germination%, viability (by increasing EC value and acidity percentage), F.E %, F.S %, R.F.E, R.F.S, seed index and R.D 77.78 %, 27.89 value and 7.73% 64.53%, 61.14%, 81.81, 78.01, 66.09 gm. and 1.02, respectively. In spite of Giza 129 was significantly higher in moisture content and crude protein %.

Table 3. The general effect of storage forms and cultivars on seed germination, seedling vigor, seedling vigor index, E.C. and acidity%

Treatment	G.P	Seedling vigor			(S.V.I)	E.C ($\mu S\ m^{-1}$)	Acidity %
		Root length (cm)	Shoot length (cm)	S.D.W (mg)			
			Storage forms				
Spike	85.17 a	13.50 a	16.17 a	39.18 a	3.44 a	21.04 b	6.49 b
Grains	81.72 b	12.91 b	15.67 b	37.24 b	3.17 b	21.88 a	6.97 a
F. Test	**	**	**	**	**	**	**
			Cultivars				
G.123	88.58 a	14.07 a	16.34 b	47.44 a	4.27 a	14.84 e	5.74 e
G.126	86.81 b	13.47 b	16.99 a	42.11 b	3.75 b	17.03 d	6.13 d
G.127	84.00 c	13.16 c	15.79 c	37.44 c	3.22 c	20.98 c	6.71 c
G.128	80.06 d	12.33 d	15.22 d	29.47 e	2.46 e	26.56 b	7.34 b
G.129	77.78 e	12.99 c	15.25 d	34.58 d	2.81 d	27.89 a	7.73 a
F.Test	**	**	**	**	**	**	**

**** indicated P< 0.01.**

Table 4. The general effect of storage forms and cultivars on (F.E), (F.S), (R.F.E), (R.F.S), seed index, R.D, moisture content and crude protein

Treatment	F.E %	F.S %	R.F.E	R.F.S	Seed index	R.D	Moisture %	Protein %
				Storage forms				
Spike	74.53 a	71.68 a	86.84 a	83.45 a	86.82 a	1.12 a	11.97 b	10.91 a
Grains	71.14 b	68.32 b	86.50 b	82.96 b	84.24 b	1.08 b	12.19 a	10.69 b
F.Test	**	**	**	**	**	**	**	**
				Cultivars				
G.123	79.69 a	77.75 a	90.09 a	87.67 a	106.45 a	1.21 a	11.99 b	10.68 b
G.126	78.67 b	76.67 b	90.15 a	87.82 a	84.16 c	1.05 c	12.02 b	10.65 b
G.127	73.83 c	70.67 c	87.63 b	83.74 b	74.20 d	1.17 b	11.97 b	10.97 a
G.128	67.47 d	63.76 d	83.68 c	78.78 c	96.73 b	1.05 c	12.16 a	10.70 b
G.129	64.53 e	61.14 e	81.81 d	78.01 c	66.09 e	1.02 d	12.26 a	11.01 a
F.Test	**	**	**	**	**	**	**	**

**** indicated P< 0.01.**

Effect of interaction

Regarding the first order interaction between storage time and package material (Fig.1-4) and Table (5) revealed that the highest seed germination%, S.V.I and seed viability (by decrease E.C value and acidity percentage and moisture %) was recorded from seeds stored inside H.D.P after 18 months of storage. Fig. (1-4) and Table (6) observed a decline in seed germination%, (S.V.I) and viability parameter (by increase E.C value, acidity percentage and moisture %) 61.83 %, 1.65, (30.5, 11.6 % and 13.03 %), when stored inside jute compared with stored inside H.D.P material 72.93 %, 2.28, (27.23, 9.97% and 12.11%), respectively.

It is also observed a decline in seedling vigor (root length, shoot length and S.D.W), seed index, R.D, F.E, F.S, R.F.E, R.F.S and crude protein (9.91 cm, 11.72 cm and 26.33mg.), 73.08 g., 0.858, 51.37 %, 48.77 %, 82.21, 78.48, 8.87 %, when stored inside jute compared with stored inside H.D.P (10.78 cm, 14.44 and 30.80 mg) 78.61 g, 0.973, 63.13 %, 60.11 %, 86.23, 81.95, 10.31 %, respectively.

The reduction in seed index is mainly attributable to the decrease in seed density during storage time. Similar results were reported by El-Sayed *et al*. (2017) and El-Sayed *et al*. (2018).

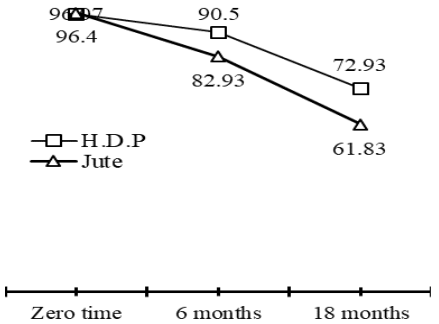

Fig. 1. Effect of the interaction between storage time and packages on germination %

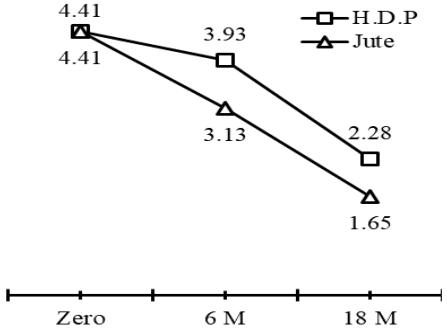

Fig. 2. Effect of the interaction between storage time and packages on (SVI).

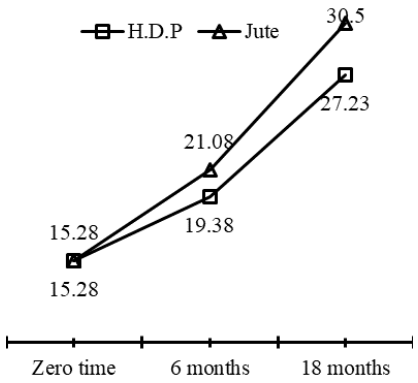

Fig. 3. Effect of the interaction between storage time and packages on (E.C).

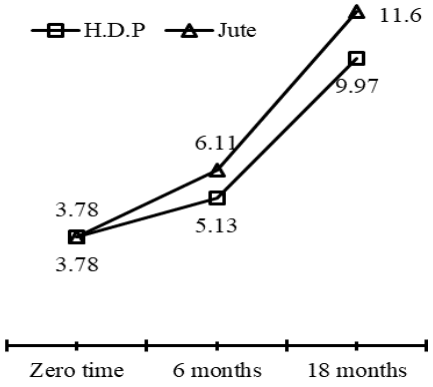

Fig. 4. Effect of the interaction between storage time and packages on grain acidity

Table 5. Interaction effect of storage time and storage packages on seedling vigor, seed index, R.D, F.E, E.S, (R.F.E.), (R.F.S), moisture and crude protein

Storage time	Storage packages	Seedling Vigor			Seed index(g)	R.D	F.E %	F.S %	(R.F.E)	(R.F.S)	Moisture %	Protein %
		Root length (cm)	Shoot length(cm)	S.D.W(mg)								
Zero time	H.D.P	15.50	18.28	45.73	95.43	1.24	86.53	83.74	89.74	86.83	11.52	11.5
	Jute	15.50	18.28	45.73	95.43	1.24	86.53	83.74	89.74	86.83	11.52	11.5
6 M	H.D.P	14.63	17.25	43.20	90.48	1.19	80.40	77.75	88.75	85.78	11.57	11.45
	Jute	13.63	15.55	37.47	80.13	1.08	69.07	65.87	83.36	79.34	12.73	11.19
18 M	H.D.P	10.78	14.44	30.80	78.61	0.973	63.13	60.11	86.23	81.95	12.11	10.31
	Jute	9.19	11.72	26.33	73.08	0.858	51.37	48.77	82.21	78.48	13.03	8.87
F test		**	**	**	**	**	**	**	**	**	**	**
L.S.D0.05%		0.32	0.2	0.8	1.44	0.02	1.01	0.85	1.18	1.52	0.11	0.11

**** indicated P< 0.01**

The interaction effect between storage time and storage forms according to data collected is presented in Fig. (5-8) and Table (6). The highest germination percentage, seedling vigor index and seed viability (by decrease E.C value, acidity percentage and moisture %) was recorded from seeds stored spike form after 18 months of storage.

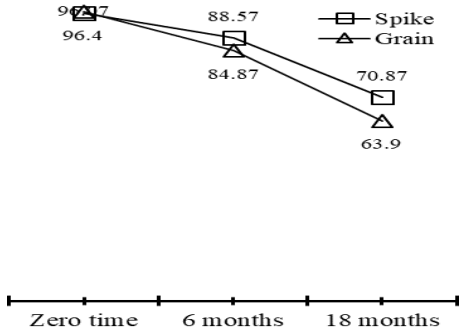

Fig. 5. Effect of the interaction between storage time and forms on G. %.

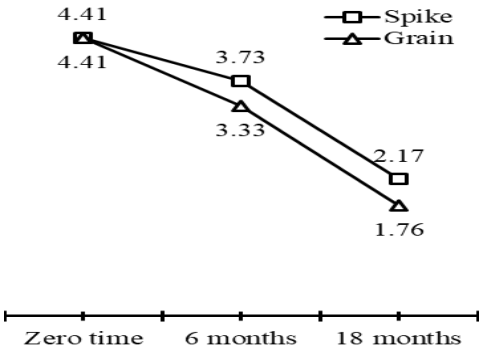

Fig. 6. Effect of the interaction between storage time and forms on (SVI).

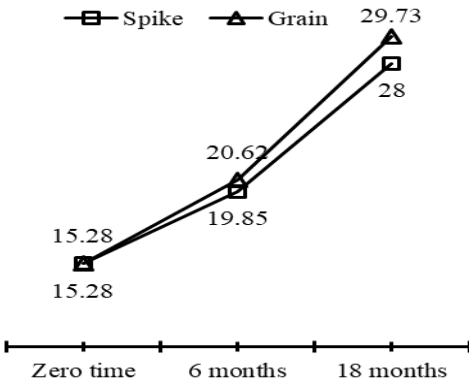

Fig. 7. Effect of the interaction between storage time and forms on (E.C).

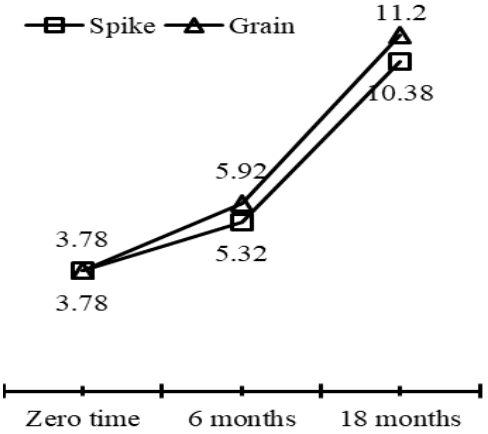

Fig. 8. Effect of the interaction between storage time and forms on grain acidity %.

Table 6. Interaction effect of storage time and storage forms on seedling vigor, seed index, R.D, F.E, E.S, moisture% and crude protein%

Storage time	Storage forms	Seedling Vigor			Seed index (g)	R.D	F.E %	F.S %	Moisture %	Protein %
		Root length(cm)	Shoot length(cm)	Seedling dry weight(mg)						
Zero time	Spike	15.50	18.28	45.73	95.43	1.24	86.53	83.74	11.52	11.50
	Grain	15.50	18.28	45.73	95.43	1.24	86.53	83.74	11.52	11.50
6 M	Spike	14.39	16.82	41.80	87.58	1.17	76.53	73.69	11.99	11.36
	Grain	13.87	15.97	38.87	83.04	1.11	72.93	69.93	12.31	11.28
18 M	Spike	10.62	13.40	30.00	77.45	0.945	60.53	57.60	12.40	9.88
	Grain	9.35	12.76	27.13	74.24	0.886	53.97	51.28	12.74	9.30
F test		**	**	N.S	**	**	**	**	**	**
L.S.D		0.322	0.248	-	1.44	0.016	1.014	0.849	0.114	0.111

**** and NS indicated P< 0.01and not significant, respectively.**

Table (5) observed a decline in seedling vigor (root length, shoot length and S.D.W), seed index, R.D, F.E %, F.S % and crude protein (9.35 cm, 12.76 cm, 27.13 mg, 74.24 g., 0.886, 53.97 %, 51.28 % and 9.30%) of barley stored in seed form were greater than of barley stored in spike form at the end of 18 months of storage (10.62 cm, 13.40 cm, 30.0mg, 77.45 g., 0.945, 60.53 %, 57.60 % and 9.88 %), respectively.

Meanwhile, with seed form recorded a great increase moisture content compared with spike form.

Similar results were reported by El-Sayed *et al*. (2017) and El-Sayed *et al.* (2018).

The interaction between cultivars and storage time according to data collected is presented in Fig. (9-12), Table (7). The seed germination%, S.V.I and seed viability at different time and cultivars inside both H.D.P and jute are shown in fig. (9-12). G. 123 gave the highest seed germination, S.V.I, and seed viability (by decrease E.C value and acidity percentage).

Meanwhile, after 18 months, Giza 129 gave the lowest seed germination% and seed viability (by increase E.C value and acidity percentage), seed index, R.D, F.E %, F.S %, R.F.E and R.F.S.

In spite of, after 18 months, Giza 123 the highest value of seedling vigor, seed index, R.D, F.E %, F.S %, R.F.E and R.F.S.

These differences between cultivars might be due to the genetic factors and seed chemical composition influence the expression on seed deterioration and vigor decline Hummel *et al*. (1954) and Roberts (1972).

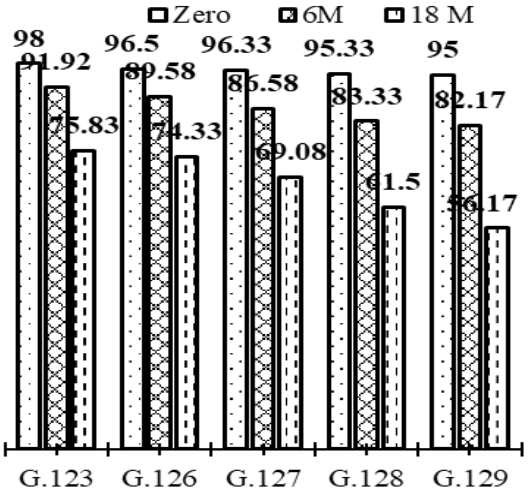

Fig. 9. Effect of the interaction between storage periods and cultivars on G.P %.

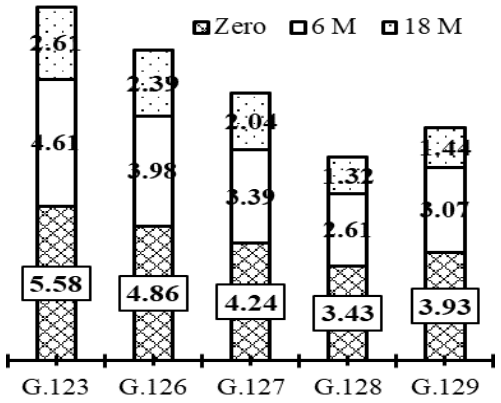

Fig. 10. Effect of the interaction between storage periods and cultivars on (S.V.I).

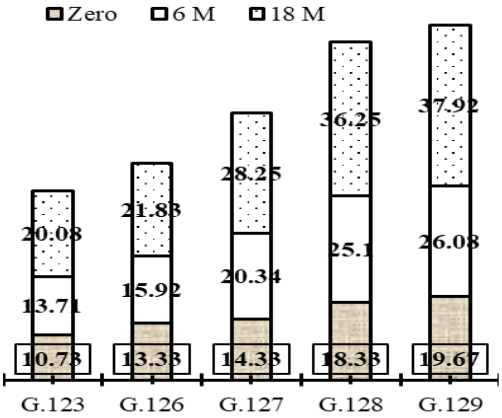

Fig. 11. Effect of the interaction between storage periods and cultivars on (E.C).

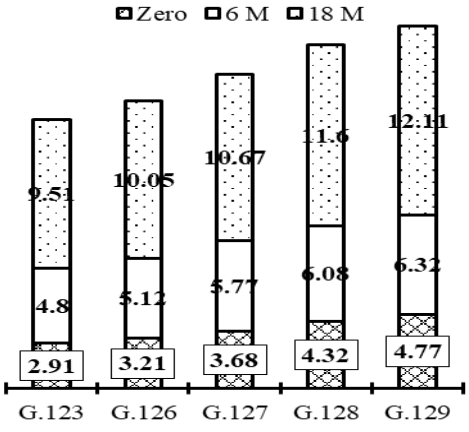

Fig. 12. Effect of the interaction between storage periods and cultivars on grain acidity.

Table 7. Interaction effect of storage time and cultivars on seedling vigor, seed index, R.D, E.C, acidity, F.E, E.S, (R.F.E.) and (R.F.S).

Storage time	Cultivars	Seedling Vigor			Seed index (g)	R.D	F.E %	F.S %	R.F.E	R.F.S
		Root length(cm)	Shoot length(cm)	Seedling dry weight(mg)						
Zero time	G.123	16.23	18.60	57.33	117.80	1.386	90.67	88.67	92.52	90.48
	G.126	15.67	19.67	50.00	91.77	1.173	90.33	88.00	92.81	90.41
	G.127	15.63	18.13	44.00	84.33	1.326	86.33	83.67	89.62	86.85
	G.128	14.60	17.33	36.00	107.33	1.180	83.00	79.53	87.07	83.43
	G.129	15.37	17.67	41.33	75.90	1.157	82.33	78.83	86.67	82.98
6 month	G.123	14.69	16.88	50.00	105.26	1.237	80.75	78.92	88.6	85.76
	G.126	14.43	16.85	44.33	82.63	1.067	79.25	77.75	88.35	86.66
	G.127	14.1	16.4	39.00	74.11	1.223	76.17	72.63	87.95	83.83
	G.128	13.45	15.86	31.17	97.12	1.083	70.08	66.41	84.03	79.58
	G.129	13.98	16	37.17	67.43	1.070	67.42	63.34	81.36	76.96
18 month	G.123	11.29	13.54	35.00	96.29	0.997	67.67	65.67	89.14	86.77
	G.126	10.31	14.46	32.00	78.08	0.897	66.42	64.25	89.3	86.37
	G.127	9.74	12.85	29.33	64.17	0.967	59	55.71	85.31	80.55
	G.128	8.94	12.47	21.25	85.75	0.876	49.33	45.33	79.95	73.32
	G.129	9.64	12.07	25.25	54.94	0.842	43.83	41.25	77.41	74.09
F test		* *	* *	* *	* *	* *	* *	* *	* *	* *
L.S.D		0.51	0.40	1.32	2.28	0.03	1.60	1.34	1.87	2.40

**** indicated P< 0.01.**

With respect to the first order interaction between storage packages and storage forms Table (8). The decrease in seed germination percentage, field emergence field survival and crude protein of barley stored in seed form inside jute package were greater than of barley stored in spike form inside H.D.P package (77.93 %, 66.71 % , 63.91 %, 10.36 %) and (82.84 %, 71.27 % 68.34 %, 10.68 %), respectively. In addition to this, the storage in seed form inside jute package was affected by the increase of seed moisture content.

Table 8. Interaction effect of storage package and storage forms on seed germination%, F.E%, F.S%, moisture and crude protein.

Storage packages	Storage forms	G.P %	F.E %	F.S %	Moisture %	Protein %
H.D.P	Spike	87.49	77.80	75.01	11.71	11.14
	Grain	85.51	75.58	72.72	11.75	11.02
Jute	Spike	82.84	71.27	68.34	12.22	10.68
	Grain	77.93	66.71	63.91	12.63	10.36
F test		* *	* *	* *	* *	* *
L.S.D		0.91	0.83	0.69	0.09	0.09

**** indicated P< 0.01.**

The seed germination percentage, field emergence, field survival, relative field emergence and relative field survival of barley stored inside different packages and cultivars are shown in Table (9)..

Table 9. Interaction effect of storage packages and cultivars on seed germination%, F.E%, F.S%, (R.F.E) and (R.F.S)

Storage Packages	Cultivars	G. %	F.E %	F.S %	R.F.E	R.F.S
H.D.P	G.123	90.94	83.22	81.33	91.43	89.33
	G.126	89.11	82.28	80.28	91.68	89.42
	G.127	86.94	76.94	74.22	88.34	85.16
	G.128	83.61	71.50	67.81	85.21	80.67
	G.129	81.89	69.50	65.69	84.54	79.71
Jute	G.123	86.22	76.17	74.17	88.75	86.01
	G.126	84.5	75.06	73.06	88.63	86.21
	G.127	81.06	70.72	67.12	86.91	82.33
	G.128	76.5	63.44	59.7	82.15	76.89
	G.129	73.67	59.56	56.59	79.09	76.31
F test		* *	* *	*	* *	*
L.S.D		1.44	1.31	1.10	1.52	1.96

**** and * indicated P< 0.01 and 0.05, respectively.**

Storage inside H.D.P package had generally better preserving effect on germination percentage, F.E, F.S, R.F.E and R.F.S for all storage time and cultivars .In spite of, after 18 months, Giza 123 stored inside H.D.P and jute package gave the highest germination percentage, F.E, F.S, R.F.E and R.F.S (90.94, 83.22 %, 81.33 %, 91.43, 89.33) and (86.22 %, 76.17 %, 74.17 %, 88.75, 86.01), respectively. Meanwhile, after 18 months, Giza 129 stored inside H.D.P and jute package gave the lowest seed germination%, F.E,F.S, R.F.E and R.F.S (81.89 %, 69.50 %, 65.69 %, 84.54, 79.71) and (73.67 %, 59.56 %, 56.59 %, 79.01, 76.31), respectively.

Correlation between studied characters: -

Results in Table (10) indicated positive correlation between stander germination percentage and each of root and shoot length, seedling dry weight, seedling vigor index, field emergence, field survival, relative field emergence, relative field survival, seed index, relative density and protein percentage. In addition, positive correlation between root length and each of shoot length, seedling dry weight, seedling vigor index, field emergence, field survival, relative field emergence, relative field survival, seed index, relative density and protein percentage. Furthermore, shoot length showed highly significant and strong positive correlation with seedling dry weight, seedling vigor index, field emergence, field survival, relative field emergence, relative field survival, seed index, relative density and protein percentage. Significant positive correlations among seedling dry weight and each of seedling vigor index, field emergence, field survival, relative field emergence, relative field survival, seed index, relative density and protein percentage. Meanwhile, seedling vigor index showed positive correlation with both of field emergence, field survival, relative field emergence, relative field survival, seed index, relative density and protein percentage. Significant positive correlations among E.C and each of acidity percentage and moisture content, between acidity percentage and moisture content. In addition, positive correlations between field emergence and each of field survival, relative field emergence, relative field survival, seed index, relative density and protein percentage, between field survival and each of relative field emergence, relative field survival, seed index, relative density and protein

percentage. Furthermore, relative field emergence showed significantly and strong positive correlation with both of relative field survival, seed index, relative density, between relative field survival correlated and each of seed index and relative density, between seed index and relative density, between relative density and protein percentage. On the other hand, negative correlation between germination percentage and each of E.C., acidity percentage and moisture content, between root length and each of E.C, acidity percentage and moisture content, between shoot length and each of E.C, acidity percentage and moisture content, between seedling dry weight and each of E.C, acidity percentage and moisture content, between seedling vigor index and each of E.C, acidity percentage and moisture content, between E.C and each of field emergence, field survival, relative field emergence, relative field survival, seed index, relative density and protein percentage, between acidity percentage and each of field emergence, field survival, relative field emergence, relative field survival, seed index, relative density and protein percentage, between field emergence and moisture content, between field survival and moisture content, between seed index and moisture content, between relative density and moisture content, between moisture content and protein percentage.

Table 10. Correlation coefficients between means of studied characters for barley cultivars under storage time, storage packages and storage forms

Characters		X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
X1	Germination(%)	0.9319**	0.9366**	-0.8865**	-0.9564**	0.9754**	0.966**	0.6695**	0.6327**	0.5977*	0.8866**	-0.7816**	0.8227**	0.8417**	0.9081**
X2	Rootlength(cm)	1.00	0.9132**	-0.8075**	-0.9591**	0.9034**	0.8971**	0.5645*	0.5646*	0.5037*	0.8783**	-0.7304**	0.8670**	0.8382**	0.8917**
X3	Shootlength(cm)		1.00	-0.8188**	-0.9370**	0.9376**	0.9310**	0.6635**	0.6420**	0.5253*	0.8459**	-0.8171**	0.8333**	0.8328**	0.8920**
X4	E.C			1.00	0.8569**	-0.9187**	-0.9348**	-0.7858**	-0.8002**	-0.6447**	-0.8080**	0.6264**	-0.5930*	-0.8946**	-0.9061**
X5	Acidity				1.00	-0.9310**	-0.9266**	-0.5957*	-0.5941*	-0.5761*	-0.8994**	0.7189**	-0.8590**	-0.855**	-0.915**
X6	F.E					1.00	0.9943**	0.8027**	0.7585**	0.6239**	0.8790**	-0.8029**	0.7554**	0.8768**	0.9287**
X7	F.S						1.00	0.8078**	0.7997**	0.6322**	0.8733**	-0.8006**	0.7373**	0.8914**	0.9378**
X8	R.F.E							1.00	0.9064**	0.5366*	0.6137**	-0.6095**	0.3681	0.7071**	0.7036**
X9	R.F.S								1.00	0.5176*	0.5892*	-0.5934*	0.3497	0.7290**	0.7149**
X10	Seed index									1.00	0.600**	-0.4839	0.3031	0.5682*	0.6046**
X11	R.D										1.00	-0.7678**	0.7858**	0.8432**	0.8872**
X12	Moisture											1.00	-0.7011**	-0.6643**	-0.730**
X13	Protein												1.00	0.6494**	0.7182**
X14	S.D.W													1.00	0.9841**
X15	S.V.I														1.0

CONCLUSION

Seed storage under different packages materials and types of storage form gives an effect on the viability and seed quality during the storage time. Storage using spike form led to an increase in longevity of the seeds survival period and high germination, in contrast to storage in the form of grains. Using high density polyethylene package is very crucial particularly seeds that indicating deterioration prior to storage, the rate of seed quality decline is quite drastic.

Thus, it can be concluded that to keep barley seeds for a long time with high viability, they can be stored in the form of spike in high density polyethylene package for a period of up to 18 months.

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حيوية و صفات البادرة لبعض أصناف الشعير متأثرة ببعض ظروف التخزين

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أجريت هذه الدراسة بقسم تكنولوجيا البذور بسخا– معهد المحاصيل الحقلية خلال الفترة من ٢٠١٩ إلي ٢٠٢٠ لدراسة بعض ظروف التخزين علي جودة وحيوية تقاوي خمسة أصناف من الشعير (جيزة ١٢٣, جيزة ١٢٦, جيزة ١٢٧, جيزة ١٢٨ وجيزة ١٢٩) عند تخزينها علي فترات من ٦ و١٨ شهر من بدء التخزين بأستخدام عبوات من البولي إيثلين عالي الكثافة وعبوات من الجوت وتم تخزين التقاوي علي شكل سنابل وأخري في صورة حبوب .وتم تسجيل التغيرات التي حدثت أثناء التخزين من حيث نسبة الإنبات , قوة البادرة وحيوية الحبوب متمثلة في التوصيل الكهربي والحموضة الكلية للحبوب.أوضحت الدراسة زيادة معنوية لمحتوي التقاوي من الرطوبة ومعامل التوصيل الكهربائي والحموضة الكلية مع طول فترات التخزين في كلا العبوتاين وكلا الشكلين, كذلك أوضحت النتائج المتحصل عليها تأثير معنوي لشكل التقاوي أثناء التخزين حيث أعطي التخزين في شكل سنابل نسبة إنبات مرتفعة كذلك قوة البادرة وحيوية التقاوي بانخفاض قيمة التوصيل الكهربي والحموضة الكلية للحبوب كذلك محتوي الحبوب من الرطوبة بمقارنتها بتخزين التقاوي في شكل حبوب وهي الطريقة المعتادة في التخزين . أيضا أظهرت النتائج أن التخزين بأستخدام عبوات البولي إيثلين عالي الكثافة مع كلا من الشكلين (سنابل وحبوب) تدهور أقل في جميع الصفات تحت الدراسة بالمقارنة بالتخزين في عبوات الجوت. وقد أظهرت الدراسة تفوق الصنف جيزة ١٢٣ حيث سجل أعلي القيم لنسب الإنبات وقوة البادرات مع أنخفاض التوصيل الكهربي والحموضة الكلية بينما سجل الصنف جيزة ١٢٩ أقل نسبة إنبات وقوة بادرة بالإضافة إلي انخفاض حيوية التقاوي و ذلك من خلال ارتفاع قيمة التوصيل الكهربي ورطوبة الحبوب كذلك الحموضة الكلية للحبوب بالمقارنة بالأصناف تحت الدراسة.يمكن الإستفادة من هذه الدراسة بالحد من تدهور حيوية تقاوي الشعير وإمكان تخزينها لمدة موسمين زراعيين علي هيئة سنابل وفي عبوات من البولي إيثلين عالي الكثافة مع الاحتفاظ بأعلي خصائص للبادرة.