EFFECT OF STORAGE PERIOD AND PACKAGING MATERIAL ON WHEAT (*TRITICUM AESTIVUM* L.) SEED VIABILITY AND QUALITY

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Abstract

The objective of this research is to study the effect of packaging materials and storage periods on viability and vigor of seed and changes of some chemical components during storage. Seed samples of five wheat varieties (Sids 12, Sakha 93, Gemmeiza 7, Gemmeiza 10 and Giza 168) have been processed and dried to 12% moisture. The samples were stored in different packages (clothes, plastic, aluminum and polyethylene) for 18 months at room temperature. Changes in seed viability, seedling vigor and some chemical composition (crude protein and total carbohydrate) were determined every six months. Quality parameters such as seed viability (germination %, seed vigor index, accelerated aging germination %, electrical conductivity, seed index, seedling characters and chemical components as affected by storage period and package materials revealed that highly significant differences in seed quality between tested varieties. Gemmeiza 7, Gemmeiza 10 and Giza 168 had more favorable abilities for better storability and had the highest germination percentage and the lowest electrical conductivity than other varieties. Also Gemmeiza 7 and Gemmeiza 10 had the highest significant crude protein and 1000- seed weight and the lowest carbohydrate content compared with other varieties. There was a high reduction in seed germination and seedling vigor as the storage period increased, however, the poor vital seeds were recorded after 18 months from storage. The seed germination percentage for tested varieties after 12 and 18 months of storage was less than the recommended level of standard germination of wheat seed (85%). Wheat seed stored in aluminum and polyester bags showed high seed germination, seedling vigor and kept nutrient contents, and therefore they could delay seed quality deterioration compared with plastic and clothes bags.

***Key words*: Wheat (*Triticum aestivum* L.)*,* Storage package, Storage periods, Seed viability, Seedling vigor and Chemical composition.**

INTRODUCTION

Seed deterioration occurs during storage, leading to reduction of vigor, germination percent, and decreasing seedling growth rate. Temperature and moisture content are the important factors, which influence the viability of seeds during storage (Roberts 1972). In most cases, it has been shown that reducing the temperature of the warehouse and the moisture content of the seeds led to increasing the period of viability. Seed viability and vigor decreased with prolonging storage period. Electrical conductance of seed leachates also increased with storage under unfavorable conditions. Packaging container and storage duration significantly affected viability and seedling vigor (Rao *et. al.,* (2006). Seeds must be properly stored in order to maintain an acceptable level of germination and vigor until the time of planting. The storage period may vary from as little as 6 months, if the seeds are to be planted the next season, or longer if the seeds are to be carried over for one or more seasons. It was noticed that during storage, the seed quality can remain at the initial level for short period and started to decline to a level that may make the seed unacceptable for planting purposes, (El- Borai *et. al.,* 1993). Seed of most species may be safely stored for several years by careful control of temperature and relative humidity. Although such conditions are of high cost for most agricultural seed lots, they may be extremely valuable for preserving germplasm ad certain high value seed stocks. In some parts of the world, especially in the tropics conditioned storage is necessary in order to maintain high viability of some seeds from harvest to planting (Hurrington, 1973). Proper storage minimizes the rate of deterioration and prolongs the first phase, in which relatively little loss of viability occurs (Anonymous,1991). Seed detraction increased and life span decreased as storage temperature and moisture content increased. The packaging methods and equipment used are dictated by the kind and the amount of seed to be packed, type of package, duration of storage, temperature, relative humidity of the storage area, wheather packing is for wholesale, retail or local use and geographical area where the package seeds will be stored, exhibited, or sols.

There is an increasing awareness of saving both time and expense that are realized by using suitable moisture- barrier containers for storing valuable breeding stocks. However, seeds carried over to the second planting season require drying and packing in moisture barrier containers to prevent loss of viability and vigor (Justice and Bass, 1979). Modern packaging uses dozens of methods and materials to keep seeds at their original quality from the time they are processed to the time they are planted.

The objective of this research was to study the effect of some storage conditions on the viability, vigor and chemical composition of seeds of wheat stored for 18 months using four different packages.

MATERIALS AND METHODS

Preparation of seed material

Wheat seed under investigation were produced at Sakha Agricultural Research Station during 2008/2009 season. Chemical analysis and the other laboratory germination studies were conducted at the Seed Technology Laboratory, Field Crops Research Institute, Giza. Five wheat varieties namely (Sids 12 (V1), Sakha 93 (V2), Gemmeiza 7 (V3), Gemmeiza 10 (V4) and Giza 168 (V5)) were utilized in this study.

Seed Storage

Seeds samples were taken immediately after one month from harvesting. The samples were sieved and cleaned from dust, husk or any inert materials and the seed moisture content was 12**%**. Seed samples of each variety were stored in four types of packets: cloth bags (T1), plastic bags (T2), aluminum bags (T3) and polyethylene bags (T4). Each package was filled with 500g of wheat seeds in three replicates and stored for 18 months under room temperature. Random seed samples were taken from each package every six months (P1, P2 and P3) to determine seed viability, vigor and some chemical composition.

Viability and vigor tests

1- Standard germination. Three replications of 50 pure seeds of each wheat variety were placed in petri dishes containing filter paper soaked with distilled water. The petri dishes were placed in an incubator at 20± 1°C for 8 days. Normal seedlings were counted according to the international rules of ISTA (1993). Germination percentage was calculated using the following formula outlined by Krishnasamy and Seshu (1990).

$$\text{Germination (\%)} = \frac{\text{Number of normal seedlings x 100}}{\text{Number of tested seed}}$$

2- Seed vigor index was calculated using the following formula **(Copeland, 1976):**

$$\text{Seed vigor index} = \frac{\text{Number of seeds germinated (1}^{\text{st}}\text{ count)}}{\text{Number of days to first count}} + \frac{\text{Number of seeds germinated (last count)}}{\text{Number of days to last count}}$$

2- Accelerated ageing germination. The seeds were kept in an ageing chamber at 45°C and 100 % relative humidity for 3 days. After ageing, the seeds were air dried. Seed survival percentage was determined by the standard germination test at 20 °C and the mean normal seedling percentage was calculated according to the rules of the Association of Official Seed Analysis (AOSA 1991).

3- Electrical conductivity test. The electrical conductivity of seed leachate was determined according to the procedures described by ISTA (1993). Four sub-samples of 50 seeds of each cultivar were weighed and placed into plastic cups with 250 ml of distilled water, and held at 25°C. After 24h, the electrical conductivity of the leachates was determined using EC meter. The mean values were expressed in µS $cm^{1}g^{-1}$ seed weight.

4- Seedling characters: Normal seedlings obtained from standard germination test were used for seedling evaluation according to the rules of (AOSA 1991). Seedling shoot, root length and seedling growth rate were measured after 8 days of germination test. Twenty-five seedlings from each petri dish were randomly selected and shoot and root lengths of individual seedling were recorded. The shoot and root were also dried at 70 °C for 72 h.

Seedling vigor index was calculated using data recorded on seed germination and seedling growth according to International Seed Testing Association (ISTA 1993) by the formula:

Seedling vigor index = Seedling length (cm) X Germination percentage

Seed index (1000 seed weight g): was measured by absolute displacement methods (Kramer and Twigg, 1962).

5- Chemical composition: Samples of about 50g of air dried seeds of each genotype finely ground were randomly chosen from two replicates for estimating chemical composition. Crude protein and total carbohydrates were determined according to the methods of AOAC (2000).

Data were statistically analyzed as completely randomized design according to the procedures outlined by Panes and Sukhatme (1985) and the differences among treatment means (storage periods, varieties and types of bags) were compared using the test of least significant difference (L.S.D.) at the level of 5 %.

RESULTS AND DISCUSSION

The five wheat varieties under investigation showed significant differences in the values of viability and seedling vigor parameters, overall storage periods using the different type of bags as presented in Table (1). The results indicated that Gemmeiza 7, Gemmeiza 10 and Giza 168 had the highest significant seed viability (germination %, 1st and end and seed vigor, accelerated ageing, germination %, electrical conductivity and seed vigor index) and seedling vigor (seedling length, growth rate, seedling dry weight and seedling vigor index) compared with other varieties, while electrical conductivity showed a negative trend.

Table 1. Effect of storage periods and packaging material on physiological quality of wheat seed.

Treatments	First count germination %	End count germination %	Accelerated ageing %	Electrical conductivity µS $cm^{-1}g^{-1}$	Seed vigor index	Seed index (g)
Varieties (V) Sids 12 (V1)	66.2	77.7	52.7	30.6	26.3	41.1
Sakha 93 (V2)	65.4	83.7	55.9	29.7	26.8	41.6
Gemmeiza 7 (V3)	69.9	87.3	58.2	25.9	28.4	47.9
Gemmeiza 10 (V4)	74.9	85.2	54.6	25.5	29.4	37.9
Giza 168 (V5)	71.3	85.6	55.3	26.2	28.5	35.5
L.S.D at 5%	**0.8**	**0.7**	**0.6**	**0.5**	**0.2**	**0.2**
Periods (P) 0 Month (P0)	82.3	97.4	70.7	16.0	32.8	42.2
6 months (P1)	75.3	89.5	56.9	18.5	30.0	41.2
12 months (P2)	62.9	78.9	49.8	23.8	25.6	40.1
18 months (P3)	53.6	69.8	43.9	52.0	22.1	39.7
L.S.D at 5%	**0.7**	**0.6**	**0.6**	**0.4**	**0.2**	**0.2**
Types of package (T) Cloth (T1)	62.4	79.4	51.0	31.0	25.5	40.4
Plastic (T2)	66.3	82.4	53.8	28.9	26.9	40.7
Aluminum (T3)	74.5	88.7	60.3	23.6	29.7	41.3
Polyester (T4)	70.9	85.1	56.3	26.7	28.4	40.9
L.S.D at 5%	**0.7**	**0.6**	**0.6**	**0.4**	**0.2**	**0.2**

The effect of storage periods on viability parameters of wheat seed is given in Table (1). Increasing storage period from 0 to 18 months significantly increased the mean electrical conductivity (Ec) of the seed from 16.03 to 52.02 µS $cm^{-1}g^{-1}$.seed, overall tested seeds indicating the rapid deterioration of seed during storage. These results confirmed those that obtained by Mersal *et. al*. (2005) who found that prolonging storage period and high seed moisture content reduced germinability (as measured by germination percentage, germination index and germination rate), seedling vigor (plumule, radical lengths, seedling dry weight and its vigor index) and accelerated seed aging. Meanwhile, increasing storage period and high seed moisture content increased mean germination time, electrical conductivity and dry weight losses of the seed. Also Singh *et. al*. (2011) stated that germination was decreased during storage period in wheat because fresh seeds showed better germination percent than stored seeds. Several investigators found high correlation between the electrical conductivity and seed vigor (El – Borai *et. al*. (1993). The means of 1 st count and end counts of germination values were decreased from 75.3 and 89.5 % after 6 months storage, respectively, to less than 53.6 and 69.8 % after 18 months storage. It was noticed that the decrease in 1 st and end counts of germination by about 21.7 % and 18.7 % depends on storage period, type of bags and varieties. Concerning the seed vigor due to storage, there was a high reduction in accelerated aging germination %, seed vigor index and seedling vigor (seedling length, seedling growth rate and seedling dry weight) as the storage period increased (Table 2). These findings agreed with those obtained by Jantana Yaja *et. al.* (2005) and El – Borai *et. al.* (1993) who reported that, as seeds deteriorate during storage, their performance potential and vigor decline before any loss in viability. The four package materials used in the present study had highly significant effects ($P< 0.05$) on seed viability and seedling vigor. Seeds stored in aluminum bags recorded the highest viability and vigor parameters followed by polyester bags. In contrast, cloth bags showed the lowest values, while plastic packages showed a middle range for all parameters (viability and vigor).

Table 2. Effect of storage periods and package material on seedling vigor parameters of wheat seed.

Treatments	**Seedling length (cm)**	**Seedling growth rate (cm/day)**	**Seedling vigor index**	**Seedling dry weight (m)**
Varieties (V)				
Sids 12 (V1)	19.3	2.4	15.0	32.7
Sakha 93 (V2)	19.3	2.4	16.1	34.0
Gemmeiza 7 (V3)	20.8	2.6	18.1	34.7
Gemmeiza 10 (V4)	21.5	2.7	18.3	31.3
Giza 168 (V5)	19.3	2.5	16.5	31.3
L.S.D at 5%	**1.9**	**0.2**	**1.6**	**0.4**
Periods (P)				
0 Month (P0)	27.2	3.4	26.5	39.7
6 months (P1)	19.9	2.5	17.9	34.9
12 months (P2)	18.2	2.3	14.5	30.3
18 months (P3)	14.1	1.8	7.9	25.5
L.S.D at 5%	**1.7**	**0.2**	**1.4**	**0.4**
Types of package (T)				
Cloth (T1)	18.1	2.3	15.1	30.4
Plastic (T2)	19.9	2.4	16.2	31.9
Aluminum (T3)	21.2	2.7	19.1	34.7
Polyester (T4)	21.0	2.6	18.3	33.4
L.S.D at 5%	**1.7**	**0.2**	**1.4**	**0.4**

The five wheat varieties showed significant differences in the values of crude protein and total carbohydrate contents over all storage periods as presented in Table (3). The results showed that the seed of Gemmeiza 7 variety had a high crude protein content (12.6 %) in comparison with other varieties.

Table 3. Effect of storage periods and package material on chemical components of wheat seed.

Treatments	**Crude protein %**	**Total carbohydrate %**
Varieties (V)		
Sids 12 (V1)	10.2	72.0
Sakha 93 (V2)	10.8	72.4
Gemmeiza 7 (V3)	12.6	69.5
Gemmeiza 10 (V4)	11.7	70.3
Giza 168 (V5)	10.5	71.9
L.S.D at 5%	**0.3**	**0.1**
Periods (P)		
0 Month (P0)	12.1	70.4
6 months (P1)	11.2	71.2
12 months (P2)	11.0	71.6
18 months (P3)	10.2	71.9
L.S.D at 5%	**0.3**	**0.1**
Types of package (T)		
Cloth (T1)	10.9	71.5
Plastic (T2)	11.1	71.4
Aluminum (T3)	11.5	70.9
Polyester (T4)	11.1	71.2
L.S.D at 5%	**0.3**	**0.1**

On the other hand, the seed of Sids 12 variety had the lowest crude protein value (10.2%). The other varieties recorded a middle range from 10.5 to 11.8 %. These results are in agreement with those reported by El- Aidy and Abdel- Shafi (1995). The highest total carbohydrate content of wheat seed was recoded for Sakha 93 (72.4 %) and Sids 12 (72.0 %). While the lowest content (69.5 %) was recorded for Gemmeiza 7. The values for other varieties ranged between these two extremes. These results agreed with those reported by (Sharshar *et. al.*, 1995). The results showed that the percentage of crude protein content significantly decreased from 12.1 % to 10.2 % with increasing storage period. In contrast, total carbohydrate content was increased from 70.4 % to 71.9 % after 18 months of storage period (Table 3). The interaction of varieties x storage period x type of package materials (VxPxT) (Table 4), showed that all varieties recorded low conductivity values until 6 months storage indicating high viability levels, which reflected on the high percentages of germination (up to 99.3 %).

Table 4. Effect of interaction between storage period, types of packages and varieties on physiological seed quality of wheat seed.

Treatments	First count germination %	End count germination %	Accelerated aging %	Electrical conductivity µS $cm^{-1}g^{-1}$	Seed vigor index	Seed index (g)
$V_1 P_1 T_1$	80.0	99.3	70.7	19.0	32.4	43.7
$V_1 P_1 T_2$	80.0	99.3	70.7	19.0	32.4	43.7
$V_1 P_1 T_3$	80.0	99.3	70.7	19.0	32.4	43.7
$V_1 P_1 T_4$	80.0	99.3	70.7	19.0	32.4	43.7
$V_1 P_2 T_1$	62.0	77.3	52.0	25.2	25.2	41.0
$V_1 P_2 T_2$	65.3	81.3	55.3	24.3	26.5	42.6
$V_1 P_2 T_3$	72.3	88.0	63.3	21.3	29.1	43.3
$V_1 P_2 T_4$	69.3	82.3	58.7	24.2	27.4	42.5
$V_1 P_3 T_1$	52.0	57.3	41.7	34.9	20.2	38.3
$V_1 P_3 T_2$	58.0	64.0	44.7	32.2	22.5	39.4
$V_1 P_3 T_3$	70.7	74.0	55.7	27.2	26.9	40.2
$V_1 P_3 T_4$	64.7	71.7	42.0	32.5	25.1	40.2
$V_1 P_4 T_1$	52.0	52.3	30.3	60.4	18.2	37.9
$V_1 P_4 T_2$	58.0	58.7	34.3	49.4	20.3	38.4
$V_1 P_4 T_3$	70.7	73.3	43.7	38.4	25.5	39.5
$V_1 P_4 T_4$	64.7	65.3	48.7	44.1	23.5	39.2
$V_2 P_1 T_1$	80.7	97.7	65.0	21.4	32.4	40.0
$V_2 P_1 T_2$	80.7	97.7	65.0	21.4	32.4	40.0
$V_2 P_1 T_3$	80.7	97.7	65.0	21.4	32.4	40.0
$V_2 P_1 T_4$	80.7	97.7	65.0	21.4	32.4	40.0
$V_2 P_2 T_1$	50.7	83.00	54.37	24.12	23.05	32.00
$V_2 P_2 T_2$	64.7	88.00	57.74	23.67	27.17	34.67
$V_2 P_2 T_3$	81.3	94.20	63.79	21.85	32.11	38.33
$V_2 P_2 T_4$	74.0	93.37	59.47	22.94	30.17	36.67
$V_2 P_3 T_1$	49.3	72.0	48.9	23.8	21.3	30.7
$V_2 P_3 T_2$	58.7	74.7	52.6	26.7	24.0	31.7
$V_2 P_3 T_3$	67.7	87.0	59.0	23.4	27.8	36.0
$V_2 P_3 T_4$	62.7	83.7	56.7	24.5	26.1	33.7
$V_2 P_4 T_1$	41.0	59.7	41.2	51.1	17.7	25.0
$V_2 P_4 T_2$	53.0	63.0	44.4	49.1	21.1	26.7
$V_2 P_4 T_3$	61.7	69.0	49.5	47.5	24.0	30.7
$V_2 P_4 T_4$	58.7	66.7	47.3	48.6	23.0	28.7
$V_3 P_1 T_1$	71.0	96.0	69.0	10.8	29.8	48.8
$V_3 P_1 T_2$	71.0	96.0	69.0	10.8	29.8	48.8
$V_3 P_1 T_3$	71.0	96.0	69.0	10.8	29.8	48.8
$V_3 P_1 T_4$	71.0	96.0	69.0	10.8	29.8	48.8
$V_3 P_2 T_1$	76.0	89.0	52.9	13.3	30.1	47.5
$V_3 P_2 T_2$	84.7	89.3	54.1	12.3	32.3	47.9
$V_3 P_2 T_3$	89.3	94.3	66.7	11.4	34.1	48.6
$V_3 P_2 T_4$	85.3	91.0	60.7	11.7	32.7	48.2
$V_3 P_3 T_1$	50.7	81.0	49.8	18.6	22.8	47.2
$V_3 P_3 T_2$	57.7	82.7	52.0	16.5	24.8	47.4
$V_3 P_3 T_3$	70.7	88.3	60.7	13.6	28.7	47.9
$V_3 P_3 T_4$	58.0	83.7	54.7	15.4	24.9	47.5
$V_3 P_4 T_1$	39.7	75.3	46.3	26.4	19.3	46.8
$V_3 P_4 T_2$	43.7	78.0	48.6	27.6	20.7	47.3
$V_3 P_4 T_3$	50.3	82.3	56.7	25.4	22.9	47.6
$V_3 P_4 T_4$	48.0	78.3	51.8	29.6	21.8	47.3

Continue: Table 4. ………….

V_4 P_1 T_1	91.3	99.7	72.0	12.5	35.3	41.5
V_4 P_1 T_2	91.3	99.7	72.0	12.5	35.3	41.5
V_4 P_1 T_3	91.3	99.7	72.0	12.5	35.3	41.5
V_4 P_1 T_4	91.3	99.7	72.0	12.5	35.3	41.5
V_4 P_2 T_1	73.0	91.7	49.3	17.1	30.0	38.1
V_4 P_2 T_2	79.0	94.3	52.3	15.0	31.5	38.2
V_4 P_2 T_3	88.0	96.7	62.0	13.4	34.1	39.7
V_4 P_2 T_4	82.7	92.7	55.7	13.5	32.3	38.9
V_4 P_3 T_1	67.7	73.7	38. 7	22.7	26.1	35.8
V_4 P_3 T_2	71.7	78.7	46.7	22.3	27.8	35.2
V_4 P_3 T_3	72.7	87.3	53.7	20.4	29.1	37.3
V_4 P_3 T_4	74.0	83.3	52.7	21.5	28.9	36.0
V_4 P_4 T_1	49.0	60.7	36. 7	67.2	19.8	35.0
V_4 P_4 T_2	53.3	68.3	42.7	57.5	21.9	34.5
V_4 P_4 T_3	62.7	78.3	49.3	36.6	25.5	36.5
V_4 P_4 T_4	58.7	73.3	45.7	50.6	23.8	35.5
V_5 P_1 T_1	88.3	94.7	77.0	16.5	33.9	36.8
V_5 P_1 T_2	88.3	94.7	77.0	16.5	33.9	36.8
V_5 P_1 T_3	88.3	94.7	77.0	16.5	33.9	36.8
V_5 P_1 T_4	88.3	94.7	77.0	16.5	33.9	36.8
V_5 P_2 T_1	73.0	86.3	47.3	21.7	29.0	35.1
V_5 P_2 T_2	76.0	90.7	51.7	19.3	30.3	35.4
V_5 P_2 T_3	83.7	93.7	66.3	15.5	32.6	35.6
V_5 P_2 T_4	75.7	92.3	54.0	18.2	30.5	35.5
V_5 P_3 T_1	57.0	77.0	40.3	27.1	23.9	34.9
V_5 P_3 T_2	51.3	83.0	43.7	25.9	23.2	35.2
V_5 P_3 T_3	73.7	92.3	53.0	20.7	29.9	35.4
V_5 P_3 T_4	70.0	83.3	49.3	23.4	27.9	35.2
V_5 P_4 T_1	48.3	63.3	36.7	24.4	20.0	34.3
V_5 P_4 T_2	46.0	67.0	41.0	49.6	19.9	34.3
V_5 P_4 T_3	68.3	88.0	49.0	33.5	28.1	35.1
V_5 P_4 T_4	64.7	73.7	44.7	43.6	25.4	35.0
L.S.D at 5%	**3.3**	**2.7**	**2.5**	**1.8**	**0.9**	**0.7**
C.V. %	**2.9**	**1.9**	**2.8**	**4.2**	**1.9**	**1.0**

V = variety P = storage period T = types of packages

After 18 months storage using aluminium bags, seed of Giza 168 variety had low electrical conductivity value (33.5 µS cm-^{1}g^{-1} seed) and moderately high germination values (1st and end germination 68.3 and 88.0 % respectively), and also gave the highest seed viability and vigor parameters followed by Gemmeiza 7, Gemmeiza 10 and Sakha 93 were superior varieties until 12 months storage with aluminum bags in producing strong and tall seedling and heavier seedling dry weights). Also, seeds these of varieties under aluminum bags material recorded the highest percentage of germination (1st and end germination), Gemmeiza 7 recorded (70.7 and 88.3 %), Gemmeiza 10 had (72.7 and 87.3 %) and Sakha 93 gave (67.7 and 87.0%) respectively. The results of end germination were agreeable with the percentage of germination as standardized by recommendations of Egypt's Ministry of Agricultural (85%). Sids 12 variety with aluminum bags under the same conditions recoded the low germination value and deteriorated rapidly after 18 months storage.

Data of Table (5) showed that seeds of Gemmeiza 10, Giza 168 and Gemmeiza 7 gave the high viability and seedling vigor parameters with aluminum, polyester, plastic and cloth bags at 6 months storage followed by seeds of Sakha 93 which recorded the high viability parameters at this time with aluminum, polyester and plastic bags, on the other hand, Sids 12 gave similar results only with aluminum bags.

The interaction of storage period x varieties x type of package materials (PxVxT) (Table 6) showed that increasing storage period from 6 to 18 months significantly decreased protein content, while total carbohydrate content increased in tested seed wheat varieties using different bags. The four packaging materials used in the present study had highly significant effect on chemical composition of wheat seeds. Seeds stored in aluminum packages recorded the highest crude protein and the lowest total carbohydrate content (11.5 % and 70.9 % respectively). In contrast, cloth bags showed the lowest crude protein content and the highest total carbohydrate content (10.9 and 71.5 % respectively), while polyesters and plastic packages recorded a middle range for both tested nutrients.

Based on the previous results of chemical composition and seed quality, seed deterioration can be reduced to an acceptable level by keeping wheat seed in aluminum bags followed by polyesters bags, while using cloth and plastic bags led to high reduction in the percentage of nutrient loss and detraction of germination and seed parameters (viability and seedling vigor) of wheat seed compared with using other bags

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Table 5. Effect of interaction between storage period, types of packages and varieties on seed vigor parameters of wheat seed.

Treatments	**Seedling length (cm)**	**Seedling growth rate (cm/day)**	**Seedling vigor index**	**Seedling dry weight (m)**
$V_1 P_1 T_1$	29.1	3.6	28.9	40.0
$V_1 P_1 T_2$	29.1	3.6	28.9	40.0
$V_1 P_1 T_3$	29.1	3.6	28.9	40.0
$V_1 P_1 T_4$	29.1	3.6	28.9	40.0
$V_1 P_2 T_1$	18.1	2.3	14.0	34.3
$V_1 P_2 T_2$	18.8	2.3	15.2	35.0
$V_1 P_2 T_3$	21.4	2.7	18.8	39.0
$V_1 P_2 T_4$	20.4	2.5	16.8	37.0
$V_1 P_3 T_1$	13.9	1.7	7.9	27.3
$V_1 P_3 T_2$	14.3	1.8	9.2	31.0
$V_1 P_3 T_3$	16.9	2.1	21.6	33.3
$V_1 P_3 T_4$	16.0	2.0	11.5	31.0
$V_1 P_4 T_1$	11.8	1.5	6.2	19.7
$V_1 P_4 T_2$	12.3	1.5	7.2	22.3
$V_1 P_4 T_3$	15.4	1.9	11.3	27.3
$V_1 P_4 T_4$	13.6	1.7	8.9	25.3
$V_2 P_1 T_1$	26.7	3.3	26.0	40.0
$V_2 P_1 T_2$	26.7	3.3	26.0	40.0
$V_2 P_1 T_3$	26.7	3.3	26.0	40.0
$V_2 P_1 T_4$	26.7	3.3	26.0	40.0
$V_2 P_2 T_1$	19.03	2.38	15.79	32.00
$V_2 P_2 T_2$	19.50	2.44	17.16	34.67
$V_2 P_2 T_3$	21.11	2.64	19.89	38.33
$V_2 P_2 T_4$	20.24	2.53	18.90	36.67
$V_2 P_3 T_1$	14.9	1.9	10.8	30.7
$V_2 P_3 T_2$	16.4	2.1	12.2	31.7
$V_2 P_3 T_3$	20.2	2.5	17.6	36.0
$V_2 P_3 T_4$	17.7	2.2	14.8	33.7
$V_2 P_4 T_1$	10.5	1.3	6.3	25.0
$V_2 P_4 T_2$	11.5	1.4	7.2	26.7
$V_2 P_4 T_3$	17.1	2.1	11.8	30.7
$V_2 P_4 T_4$	13.6	1.7	5.1	28.7
$V_3 P_1 T_1$	26.5	3.3	25.5	40.0
$V_3 P_1 T_2$	26.5	3.3	25.5	40.0
$V_3 P_1 T_3$	26.5	3.3	25.5	40.0
$V_3 P_1 T_4$	26.5	3.3	25.5	40.0
$V_3 P_2 T_1$	17.2	2.2	15.3	34.0
$V_3 P_2 T_2$	18.2	2.3	16.3	36.7
$V_3 P_2 T_3$	20.7	2.6	19.5	38.3
$V_3 P_2 T_4$	19.4	2.4	17.7	36.7
$V_3 P_3 T_1$	15.2	1.9	11.3	30.0
$V_3 P_3 T_2$	15.9	1.9	13.2	32.0
$V_3 P_3 T_3$	19.7	2.5	17.4	36.0
$V_3 P_3 T_4$	14.2	5.2	14.3	34.7
$V_3 P_4 T_1$	11.5	1.4	8.6	24.7
$V_3 P_4 T_2$	14.2	1.8	11.1	27.0
$V_3 P_4 T_3$	18.4	2.3	15.1	34.0
$V_3 P_4 T_4$	14.5	1.8	11.3	31.3
$V_4 P_1 T_1$	27.8	3.5	27.8	37.7
$V_4 P_1 T_2$	27.8	3.5	27.8	37.7
$V_4 P_1 T_3$	27.8	3.5	27.8	37.7
$V_4 P_1 T_4$	27.8	3.5	27.8	37.7

Continue:Table 5. ………….

V_4 P_2 T_1	20.3	2.5	18.6	32.3
V_4 P_2 T_2	21.2	2.7	20.0	33.3
V_4 P_2 T_3	23.5	2.9	22.7	36.7
V_4 P_2 T_4	21.9	2.8	20.4	36.0
V_4 P_3 T_1	18.6	2.3	13.7	24.0
V_4 P_3 T_2	18.9	2.4	14.9	28.0
V_4 P_3 T_3	20.6	2.6	17.9	30.7
V_4 P_3 T_4	19.8	2.5	16.5	29.3
V_4 P_4 T_1	15.2	2.9	9.2	22.7
V_4 P_4 T_2	16.4	2.1	11.2	23.7
V_4 P_4 T_3	18.6	2.3	14.6	27.3
V_4 P_4 T_4	17.1	2.1	12.6	25.7
V_5 P_1 T_1	25.7	3.2	24.3	40.7
V_5 P_1 T_2	25.7	3.2	24.3	40.7
V_5 P_1 T_3	25.7	3.2	24.3	40.7
V_5 P_1 T_4	25.7	3.2	24.3	40.7
V_5 P_2 T_1	17.4	2.2	15.1	30.0
V_5 P_2 T_2	18.3	2.3	16.6	30.7
V_5 P_2 T_3	21.2	2.7	19.9	34.0
V_5 P_2 T_4	20.2	2.5	18.7	32.3
V_5 P_3 T_1	12.8	1.6	9.9	24.0
V_5 P_3 T_2	15.3	1.9	12.7	25.3
V_5 P_3 T_3	18.3	2.3	16.9	28.7
V_5 P_3 T_4	16.3	2.0	13.6	27.7
V_5 P_4 T_1	10.0	1.3	6.3	18.7
V_5 P_4 T_2	11.3	1.4	7.6	21.3
V_5 P_4 T_3	15.8	1.9	13.9	25.3
V_5 P_4 T_4	12.6	1.6	9.2	23.3
L.S.D. at 5%	**7.6**	**0.9**	**6.4**	**1.6**
C.V. %	**23.9**	**23.9**	**23.1**	**2.9**

Table 6. Effect of interaction between storage periods, types of packages and varieties on chemical components of wheat seed.

Treatments	**Crude protein %**	**Total carbohydrate %**
$V_1 P_1 T_1$	11.4	71.2
$V_1 P_1 T_2$	11.4	71.2
$V_1 P_1 T_3$	11.4	71.2
$V_1 P_1 T_4$	11.4	71.2
$V_1 P_2 T_1$	9.8	72.4
$V_1 P_2 T_2$	10.4	72.2
$V_1 P_2 T_3$	10.3	71.5
$V_1 P_2 T_4$	10.5	71.9
$V_1 P_3 T_1$	9.4	72.7
$V_1 P_3 T_2$	9.6	72.4
$V_1 P_3 T_3$	10.3	71.9
$V_1 P_3 T_4$	10.1	72.1
$V_1 P_4 T_1$	8.3	72.8
$V_1 P_4 T_2$	8.6	72.6
$V_1 P_4 T_3$	9.5	72.5
$V_1 P_4 T_4$	9.4	72.4

Continue Table (6)..........................

Treatments	**Crude protein %**	**Total carbohydrate %**
V_2 P_1 T_1	11.7	71.6
V_2 P_1 T_2	11.7	71.6
V_2 P_1 T_3	11.7	71.6
V_2 P_1 T_4	11.7	71.6
V_2 P_2 T_1	11.26	72.92
V_2 P_2 T_2	11.29	72.73
V_2 P_2 T_3	11.41	71.87
V_2 P_2 T_4	7.98	72.29
V_2 P_3 T_1	10.6	73.1
V_2 P_3 T_2	10.8	72.9
V_2 P_3 T_3	11.1	72.3
V_2 P_3 T_4	10.9	72.9
V_2 P_4 T_1	9.9	73.3
V_2 P_4 T_2	10.2	73.0
V_2 P_4 T_3	10.0	72.6
V_2 P_4 T_4	10.4	72.8
V_3 P_1 T_1	13.4	68.8
V_3 P_1 T_2	13.4	68.8
V_3 P_1 T_3	13.4	68.8
V_3 P_1 T_4	13.4	68.8
V_3 P_2 T_1	12.1	69.9
V_3 P_2 T_2	12.4	69.5
V_3 P_2 T_3	13.3	69.1
V_3 P_2 T_4	12.6	69.3
V_3 P_3 T_1	12.0	70.1
V_3 P_3 T_2	12.2	69.9
V_3 P_3 T_3	13.1	69.4
V_3 P_3 T_4	12.4	69.7
V_3 P_4 T_1	11.5	70.3
V_3 P_4 T_2	11.8	70.2
V_3 P_4 T_3	12.5	69.8
V_3 P_4 T_4	11.9	69.9
V_4 P_1 T_1	12.7	69.1
V_4 P_1 T_2	12.7	69.1
V_4 P_1 T_3	12.7	69.1
`V_4 P_1 T_4	12.7	69.1
V_4 P_2 T_1	11.4	70.5
V_4 P_2 T_2	12.0	70.1
V_4 P_2 T_3	12.3	69.6
V_4 P_2 T_4	12.2	69.8
V_4 P_3 T_1	11.3	71.7
V_4 P_3 T_2	11.5	71.1
V_4 P_3 T_3	12.0	69.9
V_4 P_3 T_4	11.9	70.6
V_4 P_4 T_1	10.1	71.5
V_4 P_4 T_2	10.3	71.8
V_4 P_4 T_3	10.9	70.6
V_4 P_4 T_4	10.6	71.4

Continue: Table (6) ……………..

Treatments	Crude protein %	Total carbohydrate %
V_5 P_1 T_1	11.5	71.2
V_5 P_1 T_2	11.5	71.2
V_5 P_1 T_3	11.5	71.2
V_5 P_1 T_4	11.5	71.2
V_5 P_2 T_1	10.2	72.0
V_5 P_2 T_2	10.6	71.9
V_5 P_2 T_3	10.9	71.7
V_5 P_2 T_4	10.7	71.9
V_5 P_3 T_1	10.0	72.3
V_5 P_3 T_2	10.4	72.2
V_5 P_3 T_3	10.9	71.9
V_5 P_3 T_4	10.5	71.1
V_5 P_4 T_1	9.2	72.8
V_5 P_4 T_2	9.5	72.6
V_5 P_4 T_3	9.9	72.2
V_5 P_4 T_4	9.7	72.3
L.S.D. at 5%	**1.1**	**0.6**
C.V. %	**6.1**	**0.4**

REFERENCES

1. Anonymous. 1991. Safe seed storage, reported by a working group of the NARP central administration for seed . Seed Technology Component page 1-6.
2. AOAC. 2000. Official Methods of Analysis, of the Association of Official Analytical Agricultural Chemists, 15 th ed. Published by Association of Official Methods of Analysis Chemists, Arlington, Virginica, U.S.A.
3. AOSA. 1991. Association of Official Seed Analysis. Rules for testing seed. J. of Seed Technology 12, (3): 1-25.
4. Copeland, L.O. 1976. Principles of Seed Science and Technology. Burgess Pub. Com., Minneapolis, Minnesota, USA.
5. El- Aidy, A. Nadia and A. M. Abdel- Shafi. 1995. Effect of pesticide concentration and storage period on pesticide residual chemical composition, viability and vigor of wheat seed. J. Agric., Sci. Mansoura Univ., 20(7): 3173-3179.

6. El- Borai, M. A., Nadia A. El-Aidy and M. El-Emery. 1993. Effect of different storage periods on seed quality of three soybean cultivars. J. Agric. Sci. Mansoura Univ. 18(8): 2206-2211.
7. Hurrington, J. F. 1973. Packaging seeds for storage and shipment. Seed Science and Technology, 1: 701-709.
8. International Seed Testing Association ISTA. 1993. International Rules for Seed Testing –Seed Sci. and Technol., 21, 25-46
9. Jantana, y., P. Elke and S. Vearasilp. 2005. Prediction of soybean seed quality in relation to seed moisture content and storage. Conference on International Agricultural Research for Development. Stuttgart –Hohenheim Germany, October pp 11-13.
10. Justic, O. H. and H.N. Bass. 1979. International rules for seed testing Seed Sci. and Technol., 21: 25-46.
11. Krishnasamy, V. and D. V. Seshu. 1990. Germination after accelerated ageing and associated characters in rice varieties. Seed Sci. Technol., 18: 147- 156.
12. Mersal, I. F., A. A. M. El-Emam and Amal H. Selim. 2006. Effect of storage period, seed moisture content and insecticides treatment on Wheat (Triticum aestivum L.) seed quality. Annals of Agric.Sci.,Moshtohor. 44 (1):111-124.
13. Panse, V. G. and P. V. Sukhatme. 1985. Statistical Methods for Agricultural Workers. Indian Counsel of Agricultural Research, New Delhi. India pp 359.
14. Rao, R. G. S., P. M. Singh and Mathura Rai. 2006. Storability of onion seeds and effects of packaging and storage conditions on viability and vigor. Sci. Horticulturae 110: 1-6.
15. Roberts, E. H. 1972. Storage, environment and control of viability, cytological, genetical and metabolic changes associated with loss of viability. Inc: Viability of Seeds. Roberts, E.H. (ed.). Chapman and Hall, London, pp. 253-266.
16. Sharshar, M. S., M. M. El- Shami, A. H. Abd. El- Latif and Nadia A. El- Aidy. 1995. Response of some agronomic and quality traits of wheat to nitrogen and Zink fertilization. Egypt. J. Appl. Sci., 10(9): 189-204.
17. Singh J., S. Srivastava, Shikha, A. Sinha and B. Bose. 2011. Studies on seed Mycoflora of wheat (Triticum aestivum L.) treated with potassium nitrate and its effect on germination during storage. Research Journal of seed Science 4(3): 148-156,

تأثير مدة التخزين ونوع العبوه على حيوية وجودة تقاوى القمح

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قسم بحوث تكنولوجيا البذور – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية الجيزة

يهدف البحث الى دراسة تأثير فترات التخزين ومواد العبوات على حيوية وجودة تقاوى خمس أصناف من القمح (سدس 12، سخا 93، جميزة 7، جميزة 10، جيزة 168) وكذلك تقدير التغيرات التى تحدث فى بعض المكونات الكيماوية ، حيث تم تخزين تقاوى ا لاصناف موسم 2009/2008 فى أربع عبوات من مواد مختلفه (القماش – البلاستك – الالومنيوم – بولى استر) لمدة 18 شهرا (تحت ظروف الحراره العادية) وكانت النسبة المئوية للرطوبة داخل البذور (12%) . تم تقدير حيوية البذور (% للانبات)، وقوة انباتها من خلال التوصيل الكهربى والاسراع بالتدهور ودليل قوة البذور وكذلك صفات البادرة (طول الجذير وطول الريشه والوزن الجاف للبادرات ودليل قوة انبات البادرات)، كما تم تقدير محتوى البذور من البروتين والكربوهيدرات وكذلك وزن الــ 1000 بذره فى بداية التجربة (بعد الحصاد وقبل التخزين) وكل ستة اشهر. وقد أظهرت النتائج أختلاف حيوية البذور وقوة انبات البذور وخصائص البادرات والتركيب الكيماوى للبذور اختلافا معنويا بين الاصناف وكانت الاصناف جميزة 7، جميزه 10، جيزة 168 هى الاكثر مقاومة للتدهور والاكثر تحملا لظرف التخزين حيث سجلت اعلى القيم من حيث الحيوية واقل قيمه توصيل كهربائى مقارنة بالاصناف الاخرى تحت الدراسة. أظهرت النتائج ارتفاع معنوى فى محتوى الصنف جميزه 7 من البروتين وانخفاض معنوى في محتواه من الكربوهيدرات مقارنة بالاصناف الاخرى. كما ان زيادة فترة التخزين أدت الى انخفاض معنوى فى حيوية البذور وقوة البادرات حيث كان اقلها بعد فترة 18 شهرا. وسجلت حيوية بذور كل الاصناف بعد التخزين لمدة 12 و18 شهر وباستخدام انواع العبوات المختلفة قيم مئوية للإنبات اقل من الحد الموصى به من وزارة الزراعه لبذور القمح (85%). كما سجلت بذور القمح المخزنه فى عبوات من الالومنيوم اعلى النتائج فى حيوية البذور وقوة البذور والبادرات وكانت الاكثر احتفاظا بالمركبات الغذائيه مما أدى الى المحافظه على جودتها مقارنة بالتخزين فى العبوات الاخرى وقد سجلت بذور القمح المخزن فى عبوات من القماش تدهورا اكثر عن العبوات الاخرى.