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GERMINANABILITY AND SEEDLING GROWTH OF BEAN AS AFFECTED BY STORAGE OF SEEDS

Nevein A. El-Sawah[1], F. M. Gadallah[2] and H. A. Obiadalla-Ali[3]
[1] Dept. Horticulture, Fac. Agric., Fayoum Univ., Egypt
[2] Dept. Botany, Fac. Agric., Fayoum Univ., Egypt
[3] Dept. Horticulture, Fac. Agric., Sohag Univ., Egypt

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ABSTRACT: *This study was designed to assess some physiological changes during early germination and seedling growth stage in lots of stored and non-stored bean seeds in an attempt to identify whether or not storage of bean seed under ambient conditions can lead to deterioration (loss of viability) that affect germination and seedling growth. Bean seeds (cv. Giza 6); harvested in the three summer successive seasons (2006, 2007 and 2008) were used in this study. The seeds of 2006 and 2007 were stored under ambient conditions for two or one year, respectively. Seeds of 2008 were used without storage to act as a control. The results obtained in this study could be summarized as follows:*

1. *Storage of bean seeds under ambient conditions for one or two years significantly affected seed germination and resulted in delay emergence of the radicle and decrease germinability at declining rate with the length of storage period.*
2. *Both vigour and viability indices were lowered as the storage period was advanced.*
3. *A close relation between germination% and viability% as determined by TTC reduction solution was noticed.*
4. *The fresh and dry weights of embryonic axes were lowered as the storage duration was increased.*
5. *A significant decrease in length of whole axis, root and hypocotyl at a declining rate with increasing storage period was observed. However, the length of root was more adversely affected by seed storage than length of hypocotyl.*
6. *The stored bean seeds exhibited a significant decrease in water uptake, this decreasing effect was more pronounced with increasing the storage period.*
7. *Storage of bean seeds resulted in a marked increase in electrical conductivity (EC) and leakage of N, K, inorganic phosphate (Pi), free amino acids, protein and sugars from the seeds into imbibing medium and this increase was increased as storage advanced.*

This increased leakage with seed age suggests a marked damage to the membrane which limits leakage from tissues and subsequent leaching would impair growth of the seedling by depleting metabolic intermediates. In the light of the preceding results, storage of bean seeds under ambient

conditions can lead to severe deterioration that affects germination and seedling growth.

Key words: *Bean seeds, viability, germinability, storage, imbibition.*

INTRODUCTION

There is no doubt that for optimum performance and yield of crops; seedlings should emerge rapidly and uniformity. However, the performance capability of seeds generally, declines during storage. Crop seeds during storage (under ambient conditions) undergo slow deterioration, resulting in loss of viability. The rate at which such deterioration occurs depends on the conditions of storage; high temperature, moisture of seeds, relative humidity as well as oxygen concentration, all act to reduce the span of seed life (Harrington, 1973). This loss of viability evidenced by delayed germination and emergence, slower growth, increased susceptibility to environmental stresses, and ultimately a decline in germinability. In addition, germinability and longevity are prime considerations in programs that involve the development, multiplication, storage, and distribution of planting seeds. Germinability is a requirement of seed in all phases of the seed industry, but in the development (genetic and breeding) phases, both germinability and longevity are important roles. Therefore, loss of viability is a serious problem in agricultural production, one that is receiving increasing research interest; yet information concerning the actual mechanism of events leading to loss of viability of bean during storage is far from completion.

Hence, it is imperative to understand this process in order to provide conditions to slowdown viability deterioration or prescribe safe seed storage conditions. In this respect, a decline rate in germinability was evident with increasing of storage duration (under high humidity and temperature) of soybean seeds (Tenne *et al.,* 1980 and Teckrony *et al.,* 1993), pea seeds (Robert *et al.,* 1980), cotton (Gadallah, 1999). A significant increase in the fresh and dry weights in the embryonic axes of viable soybean seeds (non-stored) was recorded as compared to stored ones (El-Bagoury *et al.,* 1980 and Gadallah, 1999 on cotton). Also, length of hypocotyl and radicle was decreased with increase in storage period under ambient conditions (Ghosh *et al.,* 1981). Concerning, viability of seeds, Ghosh *et al.* (1981) on rice seeds demonstrated that the red colour developed in alive seeds (as a result of the reduction of tetrezolium) was related to loss of viability. Thus, high quality seeds usually give closure results than low quality ones. Similar results were obtained by Momonoki and Momonoki (1987) on corn, pea and clover seeds as well as Zeid *et al.* (2003) on soybean bean. The different solutes (Na, K, Pi, sugars, amino acids and protein) leaked from soybean seeds (Duke *et al.,* 1983 and Zeid *et al.,* 2003) during imbibition were markedly pronounced in the case of deteriorated seeds. Also, the electrical conductivities of soybean

seed leachates were shown to be negatively correlated with the vigour (Oliveria *et al.*, 1984 and Vyas *et al.*, 1990).

Thus, the aim of the work embodied in this paper is to investigate some physiological changes during early germination and seedling growth stage in lots of stored and non-stored bean seeds in an attempt to identify whether or not storage of bean seeds under ambient conditions can lead to deterioration (loss of viability), that affect germination and seedling growth.

MATERIALS AND METHODS

Bean seeds (*Phaseolus vulgaris* L. cv.Giza 6) used is this study were produced by Agricultural Research Centre, Ministry of Agriculture, Egypt during the summer seasons of 2006, 2007 and 2008. The seeds of 2006 and 2007 seasons were stored for two or one year, respectively at Botany laboratory, Faculty Agric., Fayoum University under ambient conditions, i.e., in summer, temperature was 21-39°C and relative humidity (RH %) was 47-58% while in winter, temperature was 13-18°C and RH % was 50-80%. The seeds of 2008 season were used as a control, i.e. non-stored seeds. The following studies were carried out:

(A) Seed vigour measurements:

1- Germination%

Seeds (uniformity and free from visible damage) were selected and surface disinfested for 30 seconds in o.3% Rizolex-T50 (0, 2,6-dichloro-4-methyl phenyl 0,0-methylphosphorothioate) solution (w/v), then washed thoroughly with distilled water to remove any adhering chemical. Four hundred seeds in eight replicates for each crop year were allowed to germinate between two sheets (30×30 cm) of moistened Whitman No.1 filter paper, then the paper was folded into a roll (50 seeds in each roll). Paper rolls were kept in polyethylene bags, then the rolls were placed in a darkened germination incubator at a constant temperature of 25°C. Germination % was recorded after 48, 72, 96, 120 and 144h from sowing. Visible radicle protrusion was considered as a criterion for germination. The germination test was carried out according to the International Rules for Seed Testing (ISTA, 1966).

2- Quality index (QI).

Seed quality index was carried out according to the rules of ISTA (1966). This index provides information about the distribution of germination events over time.

3- Vigour index (VI).

Vigour index for each crop year was established by multiplying germination % by length of the hypocotyl plus radical at the end of

germination period (144h) as outlined by Abdul-Baki and Anderson (1973). This index was used as an indicator for providing information about the strength of seedling growth.

4- Seed viability (Tetrazolium test).

Tetrazolium test for seed viability was done according to the method developed by Yaklich and kulik (1979). The colour development was examined and seeds classified as germinable and non-germinable on the basis of ISTA (1966) diagram (Fig.1).

(B) Seedling growth measurements:

For seedling growth studies, eight replicates were made for each crop year after 144h from sowing and the following measurements were conducted:.

1- Length of embryonic axes (radical and hypocotyl).

The length of embryonic axes and its parts; radical and hypocotyl were recorded for the seedling of 144h old.

2- Fresh and dry weights

Three samples of 50 embryonic axes of germinated seeds from each crop year were taken to estimate the fresh and dry weights. Fresh weight of embryonic axes was recorded immediately after sampling. Embryonic axes was dried at 70°C till constant weight was attained (48h), then dry weight was obtained.

(C) Seed imbibition: water uptake and solute leakage measurements.

1- Imbibition studies.

Seeds were selected for uniformity and free from visible damage. Five replicates (50 seeds replication^{-1}) of each crop year; were soaked in 100 ml distilled water in a 250 ml beaker and allowed to leak for 8h at 25°C (in a thermo-regulated water bath). Samples for water uptake and leakage analysis were taken at 1h intervals up to 6h to quantity the rate of both imbibed water and solute efflux from seeds to imbibing medium during imbibition period. At each time of sampling, the seeds were removed from water, quickly blotted dry on filter paper and weighed to determine water uptake (as percentage increase in initial fresh weight). The steep water in which the seeds were imbibed was then analyzed.

2- Analysis of leakage.

Electrical conductivity (EC) of the leakage, for each crop year, was measured each hour up to 8 by a conductivity meter model LF-91 (Eijkelkamp Co., The Netherlands) and expressed as dsm^{-1}100^{-1} ml leachate. Sodium (Na)

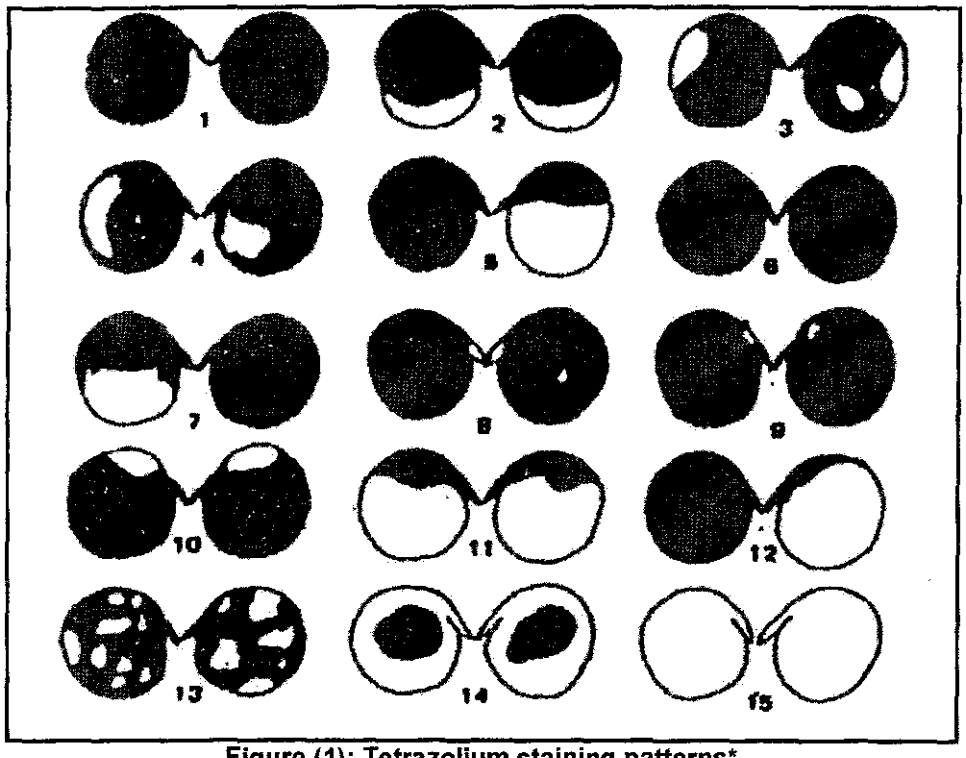

Figure (1): Tetrazolium staining patterns*

Criteria for Interpreting tetrazolium test results, illustrations are paired and depict both sides of seed. Red areas Indicate stained, living tissues; white areas represent unstained and dead tissue.

No. 1	Germinable, Seed completely stained.
Nos. 2-5	Germinable, Non-critical, unstained areas on cotyledons.
No.6	Germinable, Extreme tip of radical unstained.
No.7	Germilnable, Extreme tip of radical unstained: one-half of one cotyledon unstained.
No.8	NON-Genninable, More than extreme tip of radical unstained.
No.9	NON-Germinable, Unstained area on upper portion of radicle.
No.10	NON-Germinable, Juncture of radicle cotyledons unstained.
No.11	NON-Germinable, More than one-half of cotyledonary tissue
No.12	NON-Germinable, One cotyledon almost entirely unstained.
No.13	NON-Germinable, Extensive mottled areas of unstained tissue.
No.14	NON-Germinable, Only small central portion of cotyledons stained.
No.15	NON-Germinable, Seed completely unstained.

* Based on International Seed Testing Association (ISTA, 1966).

and potassium (K) were quantified with Flamephotomter (Gallenkamp Co., England). Inorganic phosphorus (Pi) was determined colorimetrically using ascorbic acid-ammonium molybdate reagent method as described by Chen *et al.* (1956). Free amino acids were quantitatively determined by ninhydrin technique (Rosein, 1957), using glycine as a standard. Sugars were detected by using phenol-sulphoric technique as described by Dubois *et al.* (1956), using glucose as a standard protein was measured by the Folin-Ciocalteu reagent method of Lowry *et al.* (1951), using bovine serum albumin as a standard. The obtained data were statistically analyzed and comparisons among means of different crop years were performed using the least significant differences procedure (LSD) at p=0.05 level as illustrated by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1- Seed vigour indices:

1.1. Germination%.

Data in Table (1) show that germination% increased gradually as germination proceeded for different crop years. It is also clear that during germination period, the highest percentage of germination was recorded by the new seeds of 2008 as compared to that of 2006 and 2007 seasons, which showed an increase in the germination percentage of 90.49%, 76.13%, 95.05%, 68.15% and 54.32% above that of 2006 season and by 46.16%, 35.44%, 30.08%, 32.75% and 28.61% above that of 2007 season after 48, 72, 96, 120 and 144h of germination, respectively.

Table (1): Germination% of bean seeds of the different crop years during the germination period

Crop year	Germination period (h)				
	48	72	96	120	144
2006	10.09	19.31	32.15	53.03	63.13
2007	13.15	25.11	48.21	67.18	75.75
2008	19.22	34.01	62.71	89.17	97.42
$LSD_{(0.05)}$	1.98	6.11	5.71	7.03	7.89

This means that storage of bean seeds under ambient conditions for one or two years significantly affected seed germination and resulted in delay emergence of the radicle and decrease germinability at a declining rate with the length of storage period. Presumably the inferior germination in old seeds resulted from a loss of viability with age (Roberts, 1973; Ghosh *et al.*, 1981 and Bharat *et al.*, 1993)

1.2. Vigour and quality indices.

Results obtained in Table (2) indicate that both vigour and quality indices were lowered as the storage duration was increased. It can be noticed that the seeds of 2008 season showed the highest vigour index value, which gave an increase by 228.69% and 90.19% above that of 2006 and 2007 seasons, respectively.

Table (2): Vigor and quality indices of bean seeds of the different crop years

Crop years	Vigor index	Quality index
2006	238.00	56.36
2007	411.32	73.92
2008	782.28	106.32
$LSD_{(0.05)}$	47.31	6.52

Although vigour in the practical sense is characteristic of the whole seed, Abdul-Baki and Anderson (1973) inclined to consider the embryonic axis as the site of vigour and to relate certain metabolic changes in the axis to the loss of vigour. They suggested that reduction of vigour was associated with declines in respiration and in synthesis of proteins and carbohydrates, and with increased permeability of membranes. Table (2) also indicates that the fresh seeds of 2008 recorded a significant increase in quality index as compared to that of 2006 and 2007 seeds. The increase was 56.36% and 73.92% above that of 2006 and 2007 seeds, respectively. This means that the new seeds of 2008 seasons would be considered the best quality seed lot, while the old seeds of 2006 would be considered the worst one.

1.3. Seed Viability.

Results of seed viability as determined by TTC (triphenyltetrazolium chloride) reduction are given in Table (3). It could be noticed that the percentage of viability declined significantly with storage period. It is also evident that there was a close relation between percentage of germination and seed viability since the new seeds of 2008 season which showed high germination percentage gave the highest TTC reduction activity, while the lowest had low germination percentage.

Table (3): Viability% of bean seeds of the different crop years as determined by teterazolium chloride (TTC) reduction activity.

Crop year	Viability (%)	Grade* of seed viability as shown by the pattern color development in TTC reduction activity											
		1	2-5	6	7	8	9	10	11	12	13	14	15
2006	64.15	50.20	13.95	(a)	(a)	(a)	(a)	0.90	13.80	(a)	4.70	2.60	13.85
2007	77.00	64.21	12.79	(a)	(a)	1.01	0.50	0.70	6.70	1.40	3.80	1.80	7.09
2008	98.11	91.90	6.21	(a)	(a)	(a)	(a)	(a)	0.49	(a)	(a)	(a)	1.40
$LSD_{(0.05)}$	6.71												

* Based on International Seed Testing Association diagram (Fig. 1). (ISTA, 1966)
(a) absent.

This Table also shows the classification of seeds of different crop years into different grades based on the pattern of color development in TTC reduction test as illustrated by ISTA diagram (Fig.1). It can be seen that freshly harvested seeds of 2008 which exhibited high viability (grade 1) were one and half fold higher than those of 2006 season which had been stored for two years. On the contrary, seeds of 2006 season which exhibited complete loss of viability (grade 15) were about 10-fold higher than of 2008 season. In this connection, it may be mentioned that the failure to produce red formazan colour indicated cell death, since formazan is formed through the reduction of TTC by cell dehydrogenase (Ghosh *et al.,* 1981). A similar results were obtained by Powell and Mattews (1981) and Momonoki and Momonoki (1987).

2. Seedling growth parameters:

2.1. Length of embryonic axis of radicle and hypocotyl.

2.1.1. Length of the whole axis.

The changes in length of the embryonic axis of bean seed during a period of 144h for the germination as influenced by storage are represented in Table (4). The data show that storage of bean seed resulted in significant decrease in mean length of embryonic axis. This decreasing effect was increasingly prominent with increasing storage period since the freshly harvested seeds of 2008 season gave the longest embryonic axis thought all the period of germination as compared to that of 2006 and 2007 seasons which had been stored for two or one year, respectively.

Table (4): Radicle length, hypocotyl length and embryonic axes fresh and dry weights of been seedlings of the different crop years (after 144 h of germination).

Crop years	Radicle length (cm)	Hypocotyl length (cm)	Embryonic axes length (cm)	Embryonic axes weight (g)	
				Fresh wt.	Dry wt.
2006	1.02	2.75	3.77	5.82	0.72
2007	1.87	3.56	5.43	8.96	2.33
2008	3.13	4.90	8.03	10.37	3.89
$LSD_{(0.05)}$	0.49	0.71	1.13	0.67	0.39

2.1.2. Length of radicle and hypocotyl.

From data in Table (4), it was observed also that the length of both radicle and hypocotyl on the sixth day (144h) of germination was directly related to age of seed. It was noticed that relatively the length of radicle was more adversely affected by seed storage than length of hypocotyl. Aged seeds, generally, produced shorter radicles and hypocotyls, many of which were abnormal as compared with the viable ones. Thus, the decrease of embryonic axis and its parts, radicle and hypocotyl may be due to the decreasing of seed vigour as has been pointed out by Alizaga et al. (1987) in their work on soybean and Gadallah (1999) on cotton.

2.2. Fresh and dry weight of embryonic axes.

Table (4) show that both fresh and dry weight of embryonic axes went on increasing in seeds of 2008 season as compared to the other seeds; 2006 and 2007 seasons after 144h of germination. It is evident that storage of bean seeds resulted in a significant decrease in both fresh and dry weights of embryonic axes at a decling rate with increasing the storage period. This seems to be due to the loss of vigour with age. It is interesting to state that although vigour in the practical sense is a characteristic of the whole seed. In this respect, Abdul-Baki and Anderson (1973) inclined to consider the embryonic axis as the site of vigour and to relate certain metabolic changes in the axis to the loss of vigour. Similar results had been found by El-Bagoury *et al.* (1980) and Zeid *et al.* (2003).

3. Seed imbibition: water uptake and solute leakage.

3.1. Water uptake.

Relative water uptake in a 8h period as a function of deterioration is shown in Table (5). If one expressed imbibitional weight gain as a percent of the initial fresh weight, it appears that a tendency to increase water uptake over 8h of imbibition was observed in seeds of all the different crop years, although differential rates of imbibition had developed in response to the seed age. It is clear that stored seeds take up less water than non-stored ones.

Table (5): Changes in water uptake (expressed as% of the initial seed fresh wt.) by bean seeds during imbibition of the different crop years.

Crop year	Imbibition period (h)							
	1	2	3	4	5	6	7	8
2006	25.09	28.62	39.05	52.31	72.28	75.35	81.43	96.54
2007	30.37	35.74	48.88	59.73	76.26	87.40	92.14	105.30
2008	40.11	46.15	54.17	65.64	83.04	104.22	122.11	139.65
$LSD_{(0.05)}$	3.17	4.72	5.23	4.42	3.09	7.32	6.51	8.61

The decreasing effect was more pronounced with increasing the storage period. This may be due to the reduction of ability of stored seeds to develop internal pressures as a consequence of the deterioration of membrane effectiveness and lowered capability for maintaining turgor (Parrish and Leopold, 1978 and Gadallah, 1999).

3.2. Solute leakage during imbibition of bean seeds.

3.2.1. Conductivity of electrolytes leakage.

Loss electrolytes into imbibing medium increased with duration of imbibition and storage (Table 6). It is clear that the conductance of leachate was poorly related with viability even through the old seeds, all had higher readings.

Table (6): Conductivity of electrolytes leakage (EC, $dSm^{-1}100^{-1}$ seeds 100^{-1} ml distilled) bean seeds during imbibition of the different crop years.

Crop year	Imbibition period (h)							
	1	2	3	4	5	6	7	8
2006	0.220	0.356	0.407	0.502	0.618	0.729	0.783	0.813
2007	0.192	0.254	0.361	0.461	0.565	0.647	0.739	0.780
2008	0.149	0.203	0.267	0.402	0.497	0.541	0.578	0.603
$LSD_{(0.05)}$	0.017	0.031	0.042	0.034	0.021	0.055	0.029	0.025

Thus, the increased electrolytes in deteriorating seeds are considered resulting from degradation of cellular membranes and subsequent loss of control of permeability or of a larger pool of electrolytes (Hallion, 1975 and Oliveira *et al.*, 1984).

3.2.2. Leakage compositional changes of inorganic solutes.

Data in Table (7) for the efflux of Na, K and Pi (as inorganic solutes) from the seeds into imbibition medium indicate that, during the all time of imbibition (8h), the efflux of Na, K and Pi increased with seed age. It is evident that the highest rate of leaked Na was observed in the case of two year old seeds. However, the lowest rate was given by the freshly harvested ones for the entire imbibition period. Similar observations have also been noted with K and Pi. It also clear from the data in Table (7) that the amount of leaked K was higher than that of leaked Na and Pi. Thus, generally, the leakage of Na, K and Pi was inversely correlated with seed age. This increased leakage with seed age suggests a marked damage to the membrane which limit leakage from tissues.

Table (7): Leakage compositional changes of inorganic solutes (sodium (Na), potassium (K) and inorganic phosphate (P_i)) expressed as mg 100^{-1} ml leachate 100^{-1} seeds from imbibing bean seeds of the different crop years.

Crop year	Imbibition period (h)											
	1			2			3			4		
	Na	K	P_i	Na	K	P_i	Na	K	P_i	Na	K	P_i
2006	2.83	7.28	0.151	3.10	8.81	0.194	3.89	16.15	0.350	4.58	21.96	0.51
2007	2.48	5.63	0.123	2.23	7.75	0.152	3.10	12.14	0.210	3.80	17.79	0.38
2008	1.60	4.12	0.080	1.54	5.47	0.121	2.80	8.61	0.160	2.98	12.45	0.27
$LSD_{(0.05)}$	0.29	1.01	0.022	0.48	0.89	0.028	0.018	2.14	0.031	0.43	3.88	0.08

Table (7): Continued.

Crop year	Imbibition period (h)											
	5			6			7			8		
	Na	K	P_i	Na	K	P_i	Na	K	P_i	Na	K	P_i
2006	7.26	26.93	0.72	8.80	32.11	0.88	9.34	34.79	1.02	11.72	36.03	1.33
2007	5.86	21.11	0.58	6.33	23.57	0.71	7.13	27.52	0.89	8.38	31.03	0.92
2008	4.61	14.03	0.32	5.27	17.49	0.48	6.56	21.95	0.67	6.92	26.01	0.79
$LSD_{(0.05)}$	1.12	5.21	0.09	0.78	4.03	0.013	0.43	4.33	0.08	1.12	3.72	0.08

The obtained results in case of Na and K agreed with those recorded by Hallion (1975); Duke *et al.* (1983); Mullett and Considine (1980) as well as Hisashi *et al.* (1992). With respect to Pi, the results are in accordance with those of Ching and Schoolcraft (1968) who found that an increase in Pi leakage from the stored seeds of crimson clover and ryegrass. They indicated that the origin of Pi could be from phytin via the activity of phytase and the different phosphate-containing metabolites and structural components by various phosphatases and subsequent leaching would impair growth of the seedling by depleting substrate and metabolic intermediates.

3.2.3. Leakage compositional changes of organic metabolites.

3.2.3.1. Free amino acids.

Relative leakage of free amino acids from bean seeds harvested in different crop years is shown in Table (8). It is obvious that the amount of leaked free amino acids increased with increasing storage period. Over 8h of imbibition, the amount of leaked amino acids was maximal from seeds of 2006 season, which leached 52.60% and 52.66% above that of 2007 and 2008 seasons, respectively.

Table (8): Leakage compositional changes of organic metabolites (free amino acids (FAA), protein (Pr) and sugars (S)) expressed as mg 100^{-1} ml leachate 100^{-1} seeds from imbibing bean seeds of the different crop years.

Crop year	Imbibition period (h)											
	1			2			3			4		
	FAA	Pr	S	FAA	Pr	S	FAA	Pr	S	FAA	Pr	S
2006	72.10	28.38	120.31	76.69	37.19	160.70	89.33	85.11	71.01	94.06	120.55	92.90
2007	68.65	24.13	124.63	73.00	34.36	154.90	69.48	50.70	46.41	79.36	75.17	87.11
2008	48.30	20.88	93.33	70.49	29.94	140.13	61.35	38.50	39.62	65.28	48.25	69.05
$LSD_{(0.05)}$	2.81	2.56	3.47	1.78	2.01	12.03	4.62	8.77	5.31	10.37	14.81	3.77

Table (8): Continued.

Crop year	Imbibition period (h)											
	5			6			7			8		
	FAA	Pr	S	FAA	Pr	S	FAA	Pr	S	FAA	Pr	S
2006	135.00	440.55	126.45	166.00	560.27	133.50	181.50	607.30	170.15	191.07	651.15	186.6
2007	110.65	285.58	92.19	133.97	332.50	125.00	145.11	401.12	132.80	152.13	470.79	163.70
2008	78.50	204.12	82.79	105.50	292.00	95.01	119.00	329.15	105.17	125.16	355.50	113.72
$LSD_{(0.05)}$	17.16	67.35	7.08	17.42	21.15	5.42	28.01	72.81	17.19	22.03	92.16	13.91

These results are in a good agreement with those reported by Ghosh *et al.* (1981) who found that in rice seeds, the loss of free amino acids in the leakage increased with storage time. They suggested that such increment may be associated with loss of membrane integrity.

3.2.3.2. Proteins.

Results presented in Table (8) show that leakage of protein was proportional to the length of seed storage period. Increased protein release was obtained for the entire imbibition period from the seeds of 2006 season (8h) which exhibited an increasing rate of protein leaching as compared to those of 2007 and 2008 seasons by 38.31% and 83.16%, respectively. These results are in accordance with these obtained by Samshery and Baneji (1979) who attributed the enhanced leaching of protein from pea seeds to the decline of membrane integrity.

3.2.3.3. Total sugars.

An increase in sugars leakage was observed during all time of imbibition from seeds of different crop years although differential rates sugars had

developed in response to the seed age (Table 8). Maximum leakage of sugars was obtained from the more aged seeds of 2006 season which leached 13.99% and 64.09% above that of 2007 and 2008 seasons, respectively. This reflects the membrane deterioration with seed age. Similar results had been found by Ghosh *et al.* (1981) and Rocha (1989). Generally, these results indicate that subsequent leaching would impair grow of the seedling by depleting substrate and metabolic intermediates. In addition, increased leakage of metabolites (either inorganic or organic) from deteriorated seeds might indirectly enhance their destructions by stimulating the growth of contaminating micro-organisms.

In conclusion, in the light of preceding results, it may be concluded that storage of bean seed under ambient conditions can lead to deterioration which affect germination and seedling growth. Thus, it is recommended to use fresh seeds and avoid those seeds stored under ambient conditions for sowing in bean production.

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تأثير التخزين على القدرة الإنباتية ونمو البادرات فى الفاصوليا

نيفين على السواح[١] ، فاروق جاد الله[٢] ، حازم عبيد الله على[٣]

[١] قسم البساتين – كلية الزراعة– جامعة الفيوم– مصر

[٢] قسم النبات الزراعى– كلية الزراعة– جامعة الفيوم– مصر

[٣] قسم البساتين– كلية الزراعة– جامعة سوهاج– مصر

الملخص العربي

إستهدفت هذة الدراسة التعرف على بعض التغيرات الفسيولوجية والتى تحدث أثناء مرحلة إنبات ونمو البادرات فى بذورالفاصوليا المخزنة (تحت ظروف الغرفة) وغير المخزنة ولقد إستخدمت لذلك بذور الفاصوليا (صنف جيزة ٦) والتى تم حصادها فى ثلاث مواسم متتالية (٢٠٠٨،٢٠٠٧،٢٠٠٦م) حيث بذور موسمى ٢٠٠٦،٢٠٠٧ بذوراً مخزنة لمدة عامين وعام على التوالى تحت الظروف الجوية المحيطة (العادية) ، أما بذور موسم ٢٠٠٨م فقد إستخدمت بدون تخزين (للمقارنة– كنترول).

ولقد تبين من النتائج ما يلى :

- لوحظ أن تخزين بذور الفاصوليا لمدة عام أو عامين أثر معنويا فى إنبات البذور ونتج عنه تأخر فى إنبثاق الجذير ونقص القدرة الإنباتية بمعدل متناقص مع زيادة طول الفترة التخزينية.
- وجد أن النسبة المئوية لحيوية البذور قد تناقصت معنوياً مع زيادة فترة التخزين كما لوحظ وجود علاقة وثيقة بين النسبة المئوية للإنبات وحيوية البذور المقدرة بالفاعلية الإختزالية لثلاثى فينيل تترازوليم كلوريد.
- أظهرت النتائج أن الوزن الطازج والجاف للمحاور الجنينية الناتجة أثناء الإنبات تتناسب عكسياً مع طول فترة التخزين كما أدى تخزين البذور إلى نقص معنوى فى طول المحور الجنينى والجذر والسويقة الجنينية السفلى بمعدل متناقص مع زيادة فترة التخزين.

- سجلت البذور المخزنة نقصاً معنوياً فى إمتصاص الماء بواسطة البذور حيث إزداد هذا التأثير المتناقص وضوحاً بزيادة مدة التخزين.
- وجد أن درجة التوصيل الكهربى للمتسرب الإلكتروليتى من البذور وأيضاً معدل تسرب الصوديوم- البوتاسيوم- الفوسفات غير العضوية- الأحماض الأمينية الحرة- البروتين- السكريات من البذور إلى وسط التشرب قد تزايدت مع زيادة عمر البذور (طول مدة التخزين)، ويشير هذا التشرب المتزايد إلى حدوث تلف فى الغشاء الذى يحد من تسرب هذة الذائبات من الأنسجة مؤدياً بذلك إلى ضعف نمو البادرات لإستنفاذ مركبات الأيض اللأزمه للنمو وتسربها خارج البذور.

وأخيراً... وفى ضوء النتائج السابقة يمكن الإستنتاج أن تخزين بذور الفاصوليا تحت الظروف المحيطة (العادية) تؤدى بدورها إلى حدوث تدهور فى البذور والذى قد يسبب بدوره ضعف إنبات البذور وقوة نمو البادرات الناتجة، وبناءً علي ذلك فإنه من غير المقبول إستخدام بذور الفاصوليا المخزنه (تحت الظروف العادية) فى الزراعة أو أى أنشطة أخرى تعتمد على جودة البذور.