Impact of Storage Conditions on Seed Vigor and Viability of Bread Wheat (*Triticum aestivum*) seeds

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M. A. Hamed

Department of field crops College of Agriculture, University Of Anbar, Iraq.
*Corresponding author's e-mail: ag.malath.hamid@uoanbar.edu.iq

Abstract: This experiment was conducted under different storage conditions in the Department of Field Crops, College of Agriculture, University of Anbar in 2019. The objective was to study the effects of storage conditions in seed vigor, viability and field emergence of bread wheat cultivars; Buhooth-22, Adana and Buhooth-158. Seeds were stored for six months under, 5 Cº, 25Cº، sludge house, and open ceiling frame. Seeds stored at 5Cº gave higher values in germination (98.67%), field emergence (93.33%) and coleoptile length (13.99cm). However, there values were not significantly different from those stored at room temperature which gave higher value than the storage method, in radical length, and seedling dry weight. The cultivars were different in all studied traits. Buhooth-158 gave the best values for germination%, radical and coleoptile lengths, seedling dry weight germination vigor, and field emergence. It could be concluded that bread wheat genotypes and methods of storage have significant impact on seed vigor and other related traits.

1. Introduction

Bread wheat has a prime importance in world food security. Cereals contribute about 50% of human calories in the world. Storage condition have important direct effects on quality of stored grains. Many changes take place in the stored seeds quality deterioration as for agricultural production as for human feeding [**1**]. Length of storage is another factor involved in seed quality [**2**]. Successful storage conditions depend on purpose of stored seed and genus [**3**]. The importance of storage has been known since the early times of human settlement. Farmers in general store their seeds for planting for 3-9 months [**2**]. The ways of storage followed by farmers have negative effects on seed quality, such as fat oxidation, metabolism and enzymatic changes, leading to seed deterioration [**4**]. Losses of seeds in poor storage could reach 78.57% after eight years of storage [**3**].

The results of *Strelec et al.,* [**5**] concluded that storing seed under humid conditions had negative effect on bread wheat seed viability. Deterioration differs as genotypes and storage conditions [**1**].

Khatri et al.,[**6**] reported that seeds stored in silos gave 91% germination while those stored in a porous container gave only 79% germination. [**7**] found that wheat seeds stored under 4, 15, 25, and 40Cº gave slower germination decrease as temperature increased towards 40Cº. Meanwhile, *Tekrony et al.,*[**8**] reported the negative affect of high temperature on germination. Whereas *Landschoot et al.,*[**9**] found that wheat seeds stored at -18Cº gave optimum germination as compared to those stored at 20Cº. According to the foregoing results this experiment was applied to investigate the response of some bread wheat cultivars viability, seed vigor, and field emergence stored under different methods and temperatures.

2. Materials and Methods

An experiment was conducted using laboratory storage and field emergence at the Department of Field Crops, University of Anbar. To investigate the response of bread wheat cultivars Buhooth-22, Adana, and Buhooth-158 stored for six months. Storage methods were, room temperature 5, 25Cº, and in a sludge shelter and open metal shelter. The design for laboratory experiments was CRD, while in the field experiment was RCBD in three replicates. After time of storage elapsed, seeds were grown in petri dishes lined with filter papers and incubated at 25Cº ± 2Cº. After 10 days, germination % was calculated for each experimental unit. Then, five seedlings were taken

from each experimental unit and lengths of radicle and coleoptile measured, dried in oven at 80 Cº for 20 hr, cooled and weighed. Seedling vigor was determined according to formula:
Germination % × total length of radical and coleoptile [**10]**. The second experiment from each experimental unit were grown in the field in rows (100 seed each), then emergence % was counted for each experimental unit. All data were tabulated and statistically analyzed according to design used [**11**]. Least significant differences were used to compare treatment means.

3. Results Discussion

3.1 Seed germination (%)

Data in Table 1 show that seeds stored at 5Cº gave higher germination (98.67%) but it did not differ from those stored at 25Cº (98.22%), while those stored under open metal shelter gave 89.0% only. These methods of storage show the difference in laboratory germination. Similar results were found by *Al-Azami & Abdullah* [**12**]. On the other hand, cultivars were different in these traits, since we noticed that Buhooth-158 gave higher germination (97.42%), while other two cultivars gave lower values. Storage without temperature control will cause seed deterioration [**13**]. However, the interactions of Bahooth158 with storing of 25Cº, and Adana stored of 5Cº gave 100% lab, germination,

Table 1. Effect of storage conditions and methods on seed germination (%) and radicle length(cm)

Storage methods (T)	Seed germination (%)				Radicle length (cm)			
	Cultivars (cv.)			Mean	Cultivars (cv.)			**Mean**
	Buhooth 158	Adana	Buhooth 22		Buhooth 158	Adana	Buhooth 22	
5Cº (T1)	98.67	100.00	97.33	98.67	13.50	12.53	12.43	12.82
25Cº (T2)	100.00	98.67	96.00	98.22	14.40	13.07	12.40	13.29
Sludge shelter (T3)	97.33	93.33	92.00	94.22	12.97	11.80	11.33	12.03
Open metal shelter (T4)	93.67	82.67	90.67	89.00	12.87	12.53	12.20	12.53
Mean	97.42	93.67	94.00		13.43	12.48	12.09	
	cv.	T	cv.×T		cv.	T	cv.×T	
LSD 0.05	2.47	2.86	4.95		0.590	0.682	1.181	

3.2 Length of radicle and coleoptile (cm)

Table 1 and 2 show that seeds stored at 5Cº and 25Cº were the best as compared to those stored at the other two methods, since seeds stored is sludge house gave the lower values of radicle length, and those stored under meta1 shelter gave the lower value of coleoptile length. These results are similar to that found by *Hammood et al.,*[**14**]. The same Table (1 and 2) show that cultivars Buhooth158 gave higher value for radical's length (13.43 cm) and coleoptile length (13.45cm). This differences among cultivars could be attributed to embryo size of cultivars kernel. Buhooth158 stored at 25Cº gave longer radicals (14.4cm). while Buhooth22 stored on sludge house gave only 11.33cm. The best values of coleoptile length were with Buhooth-22 stored at 5Cº which gave 13.93cm.

3.3 Seedling dry weight

This trait is an indicator for seed vigor. Seeds gave fast growing seedling in early stages gave better plants establishment and development. Table 2 shows that seed of treatment 25Cº gave the higher weight of seedling (0.208g) while the open metal shelter gave lower value (0.176g). Storing seeds at low and controlled temperatures give better viability for seed traits and seedling Table 1and 2. That cultivars Buhooth158 gave the heavier seedling weight (0.210g), while Buhooth22 gave lower value. The higher value of Buhooth158 in seedling dry weight is attributed to its higher values in length of radicle and coleoptile. The significant interaction shows that Buhooth158 stored at 25Cº gave the higher seedling dry weight (0.236g).

Table 2. Effect of storage conditions and methods on coleoptile length and seedling dry weight

Storage methods (T)	**Coleoptile length (cm)**				**Seedling dry weight (g)**			
	Cultivars (cv.)			**Mean**	**Cultivars (cv.)**			Mean
	Buhooth 158	**Adana**	**Buhooth 22**		**Buhooth 158**	**Adana**	**Buhooth 22**	
5Cº (T1)	13.90	12.50	13.93	13.44	0.206	0.206	0.160	0.191
25Cº (T2)	13.80	12.50	13.56	13.28	0.236	0.210	0.180	0.208
Sludge shelter (T3)	13.63	12.23	12.13	12.66	0.210	0.200	0.140	0.183
Open metal shelter (T4)	12.46	11.43	13.33	12.41	0.186	0.176	0.166	0.176
Mean	13.45	12.16	13.24		0.210	0.198	0.161	
	cv.	T	cv.×T		cv.	T	cv.×T	
LSD 0.05	0.331	0.382	0.661		0.0087	0.0101	0.0175	

3.4 Seedling vigor

Table 3 shows that seedling vigor was the best of seeds stored at 25Cº, but it did not differ than those stored at 5Cº. However, seeds stored under open metal shelter gave lower values. That could go back to value reported in Table 1and 2 of seedling traits. These results are with agreement with that found by *Said* [**15**]. Results in Table 3 show that Buhooth158 gave higher value of seedling vigor, while Adana cv. gave the lower value. These results are correlated with those shown in Table 1and 2. The interaction of cultivars with storage methods show that Buhooth158 stored at 25Cº gave the best seedling vigor as compared to the other treatment which gave lower value.

Table 3. Effect of storage conditions and methods on seedling vigor and field emergence

Storage methods (T)	Seedling vigor				Field emergence (%)			
	Cultivars (cv.)			Mean	Cultivars (cv.)			Mean
	Buhooth 158	Adana	Buhooth 22		Buhooth 158	Adana	Buhooth 22	
5Cº (T1)	27.04	25.03	25.65	25.91	90.00	98.33	91.67	93.33
25Cº (T2)	28.20	25.24	24.95	26.13	86.67	95.00	90.00	90.56
Sludge shelter (T3)	25.94	22.43	21.58	23.32	91.67	60.00	83.33	78.33
Open metal shelter (T4)	23.71	19.81	23.15	22.23	75.00	60.00	76.67	70.56
Mean	26.22	23.13	23.83		85.83	78.33	85.42	
	cv.	T	cv.×T		cv.	T	cv.×T	
LSD 0.05	1.016	1.174	2.033		3.44	3.97	6.88	

3.5 Field emergence %

Table 3 shows that Field emergence % is considered one of the most important parameters for seed vigor evaluation. Results in Table 3 show that storage Methods were different in field emergence %. The T1 treatment gave higher percent (93.33%) but it was not different from those stored at 25Cº. Meanwhile, T4 treatment gave the lower value 70.56%. Buhooth158 and Buhooth22 gave higher value as compared to Adana cv. The higher value of Buhooth158 and storage at 5Cº was a result of higher seed viability. This is similar to that found by [**14,16**]. The interaction in this trait was also significant and the cultivars Adana stored at 5Cº gave higher value (33.98g) of field emergence, while same cultivars Adana stored at T3 and T4 gave lower value (60.0%) each.

4. Conclusion

According to the foregoing results of this study, it could conclude that storage methods of wheat seeds, especially under primitive methods (open metal shelters and sludge house) which used by most of Iraqi farmers have negative effects on seed viability and vigor. Storing seeds at 5c^{o} for long time is the best while storing wheat seeds at 25 c^{o} is suitable for planting seeds of last season. Storage methods not under control of temperature and humidity have negative effects on seed traits for agricultural use. Wheat cultivars are responding differently to different storage methods.

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