Agricultural Research & Technology
Open Access Journal
ISSN: 2471-6774

Juniper UBLISHERS
.. key to the Researchers

Research Article
Volume 2 Issue 4 – September 2016
DOI: 10.19080/ARTOAJ.2016.01.555593

Agri Res & Tech: Open Access J

Effect of Seed Storage and Varieties on Seed Quality of Tef [*Eragrostis tef* (Zucc.) Trotter]

Teshager Abebaw[1]*, Wasu Mohamod[2] and Kebebew Asefa[3]

[1]*Ministry of Agriculture and Natural Resources, Ethiopia*

[2]*Haramaya University School of Plant Sciences, Ethiopia*

[3]*Ethiopian Institute of Agricultural Research, Debre Zite Agricultural Research Center, Ethiopia*

Submission: September 20, 2016; **Published:** September 28, 2016

***Corresponding author:** Teshager Abebaw, Ministry of Agriculture and Natural Resources, Post Box No. 10557, Addis Ababa, Ethiopia.

Abstract

Tef is one of the most important cereal crops in Ethiopia which is known for its long grain storage period. However, the longevity of the seed and the seed deterioration dynamics is not well investigated so far. Therefore, set of experiments were conducted to assess the effects of seed storage period on seed quality and the various vigor indices of the crop using six improved tef varieties viz., DZ-Cr-387 RIL 355, DZ-01-974, DZ-01-196, DZ-Cr-37, DZ-01-354 and DZ-01-99 and of the crop's seeds were stored for 7, 19 and 31 months. The treatments were arranged in factorial combinations tested using completely randomized design (CRD) with four replications. Seed moisture content, hundred seed weight, seed germination, seed vigor index II, field emergence index, seedling dry weight and speed of germination showed significant difference due to the interactive effect of varieties and different storage periods. On the other hand, electrical conductivity, seed vigor indexes I and seedling length had significant difference due to the separate effect of variety and seed storage period. Seed purity on the other hand was not affected by all factors treatment effects. The results indicate Tef crop seed quality attributes will be deteriorated due to the synergic effect of elongated storage condition and genotype.

Keywords: Seed quality; Seed vigor; Storage period; Varieties of tef

Introduction

Tef [Eragrostis tef (Zucc) Trotter] is one of the most important cereal crops in Ethiopia. It is the main staple food for the majority of people in Ethiopia and Eritrea. Outside Ethiopia Tef is mainly grown to a limited extent in USA, South Africa, The Netherlands and Australia as a forage and grain crops. The largest production of Tef in the world is from Ethiopia where annually, above 6,562,325 farmers grow Tef on above 2.87 million hectares, which is about 22.95% of the total cultivated land in the country. Production wise out of the total grain crops Tef contributed 16.1 % (4,471,378.7 tons) of the total crop production of the country [1]. Tef is mainly expanding due to the farmer's indigenous farming practice and varietal selection. Several technologies had been developed through the research system in Ethiopia. Despite many efforts had been undertaken in recent years, the productivity from the crop still remains below 1.56 tons per [1].

The major constraint hampering tef productivity is lack of access to improved varieties' seeds which satisfy the national seed standard. Therefore, in most of the cases farmers in Ethiopia are forced to use seed which was saved from previous harvest. For instance, during the 2010/11 main rainy season, only 1.12 % of improved tef varieties' seed was supplied to the farmers nationally, while the rest 98.88 % was covered by farmer's own saved seeds of previous harvests [2]. Tef grain is resistance to quality degradation therefore farmers believed may not deteriorate in their germination capacity in the store.

Unlike most of the other cereals, Tef seed is relatively less affected by storage diseases and insect–pests, as a result, the seed could be stored for prolonged period with very minor deterioration [3-6]. However adequate information on Tef seed storage characteristics, deterioration dynamics in storage and the resulting losses of seed qualities is not well studied. Therefore, the present study was conducted to assess the status how the quality of Tef seeds had been affected after stored for varying period of time.

Materials and Methods

The seed of six varieties of tef [DZ-Cr-387 RIL 355 (Quncho), DZ-01-974 (Dukem), DZ-01-196 (Magna), DZ-Cr-37 (Tsedey), DZ-01-354 (Enatite) DZ-01-99 (Asgori)] which were harvested from black clay soil of Debre Zeit Agricultural Research Center's experimental field in 2009, 2010, 2011 main rainy seasons were generously supplied by the Center. The seeds were stored for about 7, 19 and 31 months under the same storage condition of ambient temperatures after harvest. As a result, 18 treatment combinations were produced from the 6 varieties and 3 storage periods.

Seed purity test was conducted as per ISTA [7] working guide. Therefore, 2±0.05g Tef seeds were divided in two equal parts of working samples each weighting 1±0.05g which was divided further to half working sample of 0.5±0.05g to produce four replications and sorted under the purity working board and the purity percentage was calculated as:

$$Seed\ Purity\ percentage = \frac{Weight\ of\ a\ pure\ seed}{Weight\ of\ a\ working\ sample} * 100$$

For seed moisture determination, a sample of 16 g of seeds was randomly taken from each treatment combination and divided in to 4±0.05 g which was used in the four replications. The moisture was determined with hot oven method as per ISTA [7] working guide. Finally the moisture content of the seed was determined by the equation:

$$Moisture\ Content\ of\ \ a\ Seed(\%) = \frac{M2 - M3}{M2 - M1} * 100$$

Where:

M1 is the weight of the container;

M2: is the weight of the container and the weight of the seed and

M3 is the weight of the seed and the container after oven dried

100 seed weight was determined by randomly taking 400 seeds from the pure component of the four half working samples in the purity determination test and their weight was measured with 4 digit sensitive balance.

Standard Germination test was setup with four replications (100 seeds on in each replication on top of paper) as per ISTA [7] working guide.

$$Germination\ percentage = \frac{Number\ of\ Normal\ Seedlings}{Total\ Number\ of\ Seeds\ Swon} * 100$$

Speed of germination test was determined with a similar procedure to the standard germination test but the number of germinated seeds were counted and removed every day until there was no further germination.

$$Speed\ of\ Germination = \frac{N1}{C1} + \frac{N2}{C2} + \cdots + \frac{NF}{CF}$$

Where N1, N2, Nf is 1st day count, 2nd day count and final day count and C1, C2, Cf is 1st count, 2nd count and final count

Seed vigor index I and II were determined as per ISTA [7] by taking 50 randomly selected normal seedlings at the final counting date from each treatment in the standard germination test. The length of the samples (shot and root length) was measured using a standard ruler. Dry weight (after oven dried 80oC for 24 and cooled down for 30 minutes on silica gel) was weighted on a sensitive balance. Vigor Index I and II was then determined by the following formulae.

Seed vigor index I = GP x SL

Vigor index II = GP x SDW (mg)

Where GP germination percentage, SDW, SL is seedling length

Field Emergence Index experiment was carried out in a Lath house at Debre Zeit Agricultural Research Center with average relative humidity of 64% and a mean temperature of 25°C. Hundred seeds of the 18 experimental combinations were placed on a pot filled with a heavy black clay agricultural soil from Debere Zeit Agricultural Research Center experimental field which were replicated three times. Seedlings emerged out of the soil were counted, recorded and removed every day until there was no further seedlings emergence out of the soil.

$$Field\ Emergence\ index = \frac{E1}{D1} + \frac{E2}{D2} + \cdots + \frac{EF}{DF}$$

Where: E1 number of seedlings emerged at the first count day, E2 is number of seedlings emerged at the second count day EF is the number of seedlings emerged at the final count, D1, D2 and DF are first, second and final days count, respectively.

The electrical conductivity test was conducted at the National Quality and Standards Authority Laboratory as per ISTA [7] by taking a seed from the treatment combinations.

EC (μscm^{-1}g^{-1})= [EC (sol) -EC (dist.] μscm

Seed weight (gm)

Where EC= electrical conductivity, EC (dist.) electrical conductivity of the distilled water and EC (sol) is electrical conductivity of the leachates.

Results and Discussion

The result of the analysis of variance had indicated the interaction effect of storage periods and variety had significantly affected germination percentage, speed of germination, field emergence index, seedling dry weight and vigor index II and Seed moisture content. However seed vigor parameters like seedling length, vigor index I and Electrical conductivity were significantly affected by the individual effects of Variety and Storage period than the combined effect. On the other hand, physical purity didn't show any significant difference between varieties, storage period or the interaction. This certainly suggests that physical

How to cite this article: Teshager A, Wasu M, Kebebew A. Effect of Seed Storage and Varieties on Seed Quality of Tef [Eragrostis tef (Zucc.) Trotter]. Agri Res & Tech: Open Access J. 2016; 2(4): 555593. DOI: 10.19080/ARTOAJ.2016.01.555593

purity is not influenced by varietal difference or during the storage conditions. This is due to the class of the seed and the serious seed quality inspection during the seed production in the center.

100 seed weight and moisture content

Hundred seed weight of all the experimental varieties were significantly affected due to elongation of storage period. The result indicates reduction in 100 seed weight when the storage period elongates from 7 months to 19 months. Asgori and Quncho seeds stored for 7 and 19 months followed by Dukem seeds stored for 7 months had weighted significantly heavier 100 seeds weight than the rest of the treatment combinations. On the other hand, 19 months stored seeds of Magna and 31 months stored seeds of Enatite had measured significantly lighter 100 seed weight. On the other hand moisture content of tef seed showed variation between varieties stored at different periods.

Moisture content had declined due to elongation of storage periods too. Therefore, 7 months stored seeds of Tsedey variety had significantly higher moisture content when compared with the rest of the treatment combinations. The lowest moisture content on the other hand was recorded from 19 months stored Enatite variety. Moisture content of all other varieties seeds in their respective storage period category didn't show statistically significant difference at $P<0.5$ (Table 1).

Table 1: Hundred Seed weight and Moisture content of Tef affected by Variety and Storage period.

Storage period	Variety	100 seed weight (mg)	Moisture content
7months	Quncho	28.80b	9.91de
	Dukem	27.66c	10.42abcd
	Magna	25.53fgh	10.10.43abcd
	Tsedey	27.21cd	10.9733a
	Enatite	25.97efg	10.38bcde
	Asgori	30.18a	10.12cde
19 months	Quncho	27.05cd	10.393bcde
	Dukem	26.50def	10.11cde
	Magna	22.54k	10.82ab
	Tsedey	25.87efgh	10.18cde
	Enatite	25.00ghij	9.84e
	Asgori	27.94bc	10.13cde
31 months	Quncho	25.68efgh	10.32bcde
	Dukem	25.30ghi	10.67abc
	Magna	24.36ij	10.76ab
	Tsedey	24.94hij	10.26bcde
	Enatite	24.27j	10.01de
	Asgori	26.64de	10.37bcde
LSD		1.008	0.571
CV (%)		2.32	3.33
Mean		26.19	10.34

How to cite this article: Teshager A, Wasu M, Kebebew A. Effect of Seed Storage and Varieties on Seed Quality of Tef [Eragrostis tef (Zucc.) Trotter]. Agri Res & Tech: Open Access J. 2016; 2(4): 555593. DOI: 10.19080/ARTOAJ.2016.01.555593

Reduction in 100 seed weight through ageing could be attributed to the reduction in seed moisture content and disintegration of the seed coat and the embryo when the seed stored for longer time. The disintegration of the seed coat could result in the release of electrolytes out of the seed. The complimenting effect of release of electrolytes and reduction in moisture content of the seed through storage could have a reductive effect of 100 seeds weight. The results of the seed moisture content and the Electrical conductivity test suggest a similar trend to the 100 seed weight result. The current results have similarities to the works of Workneh [8] who had found a significant variation in 100 seed weight of Tef and Manga [9] who had found a significant seed weight reduction in pearl millet after storing for two years.

Seed moisture content significantly affects the physiological activities of the seed while it is in the store. Increase in moisture content could be the major causes of rapid deterioration of seed vigor Harington [10]. According to "rule of thumbs" established by the author, 1% reduction in seed moisture content doubles the storage life of the seeds. Therefore, even if the temperature and humidity are kept constant every 1% reduction in moisture content has an advantage of doubling the seed longevity. In the current experiment, Enatite had the advantage of seed longevity due to its low level of moisture content. The increased seed longevity with reduced moisture content is associated with higher seed germination rate which is an indicator of seed vigor. Strelec et al. [11] have found that increase in longevity and higher germination rates in seeds with reduced seed moisture content in an experiment with different storage temperatures and relative humidity of stored wheat seeds. In current study, seedling length of Enatite was highest that revealed the presence of higher germination potential and higher vigor after seeds stored for 19 months.

Germination percentage

Germinating percentage of the seeds had declined when storage period elongates. It is also noted the presence of variation in germination capacity among varieties when the storage period increases. The germination percentage falls in the range of 89% for Asgori stored for 31 months to 96 % for Tsedey and Magna seeds stored for 7 months. Germination percentage was reduced by 1.6% as the storage period extended from 7 months to 19 months whereas further storage to 31 months had reduced germination of the seed by 3.7%. The result indicates all the varieties responded with a reduction in germination percentage when the seed storage period increased beyond 7 months. The germination capacity of Tsedey variety had deteriorated significantly when the storage period elongates to 31 months. Similarly Asgori had been significantly altered by seed aging to a higher degree.

Seifu [12] had evaluated more than 1000 tef genotypes and reached to the same conclusion to the current findings that germination percentage was affected by the inherent characteristics of the genotypes. Sterlic, (2010) has also found variation in germination percentage in three varieties of wheat. The highest reduction in germination percentage was recorded from Tsedey and Asgori when the seeds stored for 31 months this could be attributed to the deterioration of seed coat membrane which aggravated seed mortality as compared to 19 months stored seeds.

Ryszard and Dortota [13] had found similar results to the current experiment on timothy grass seeds which were stored for one, two, three, four and 5 years under ambient storage condition. They had observed that germination of timothy grass seed had sharply declined from 90-95% on the fresh harvest to 1% after 5 years. The magnitude of reduction in germination percentage was minimal in seeds stored from 1 year to 2 years; however, subsequent storage periods had severely reduced the germination percentage of timothy grass. Similarly, Rozman et al. [14] reported that a significant germination percentage reduction after storage of two varieties of perennial ryegrass for 9 months at different temperatures. According to Rozman et al. [14], germination percentage had reduced due to seed storage which had stayed above 9 months. The finding of Rozman et al. [14] further indicated that seed germination was affected by storage time and the varietal characteristics in perennial ryegrass (Table 2).

Table 2: Effect of storage period and varieties on germination percentage.

Storage period	Variety	
7months	Quncho	95.00(9.74)abc
	Dukem	95.50(9.77)ab
	Magna	96.00(9.79)a
	Tsedey	96.00(9.79)a
	Enatite	91.25(9.55)efgh
	Asgori	93.00(9.64)cdef
19 months	Quncho	93.50(9.66)bcde
	Dukem	94.00(9.69)abcd

How to cite this article: Teshager A, Wasu M, Kebebew A. Effect of Seed Storage and Varieties on Seed Quality of Tef [Eragrostis tef (Zucc.) Trotter]. Agri Res & Tech: Open Access J. 2016; 2(4): 555593. DOI: 10.19080/ARTOAJ.2016.01.555593

	Magna	95.75(9.78)ab
	Tsedey	91.75(9.57)defg
	Enatite	90.00(9.48)gh
	Asgori	92.25(9.60)defg
21 months	Quncho	92.75(9.63)cdef
	Dukem	92.25(9.60)defg
	Magna	91.00(9.53)fgh
	Tsedey	89.25(9.44)h
	Enatite	91.25(9.55)efgh
	Asgori	89.00(9.43)h
LSD		2.48
CV (%)		8.432
Mean		94.35

Speed of germination, field emergence index and vigour index II

Rapid germination of seedlings was recorded at 7 months, followed by 19 months of storage. In this experiment, 31 months storage had recorded a retarded germination. The fastest speed of germination was recorded from Tsedey which was stored for 7 months where it had germinated 15% faster than the mean germination speed of all the varieties. On the other hand Tsedey had germinated 27.83% faster than the treatment which lags far behind than other treatments (Enatite which was stored for 31 months). All the varieties in 31 months storage period had shown an inferior speed of germination when compared with 7 months stored seeds. Quncho had germinated faster than all the varieties in 31 months old storage period the rest of the varieties in 31 months storage period are statistically similar for speed of germination. The magnitude of differences in speed of germination of tef varieties under the same storage period is minimal whereas the difference in speed of germination between different storage periods is large. This indicates that storage period had more pronounced effect on speed of germination in tef than the varietal difference. Therefore tef might lose its germination speed if stored for prolonged time beyond 31 months.

A complementing result to the current research was well demonstrated by the findings of Ryszard and Dortota [13] that the speed of germination in timothy grass which had reduced from 67.5% to 5% after five years of ambient storage condition. They had also observed that the sharp declination was in 4 and 5 years stored seeds. It had been also reported by the works of Melkam [15] that speed of germination in tef was influenced by the varietal difference after studding the speed of germination of 3 tef varieties.

A complimentary result had been found with filed emergence index where filed emergence index declines as the seed ages. Tsedey was inferior by 4.67% to the grand mean. The rest of the treatment combinations didn't show significant difference to each other, whereas, Dukem variety which was 7 months old emerged early out of the soil by 9.35% when compared to the lowest performing variety i.e. Tsedey stored for 31 months and from the grand mean by 4.88%. Field emergence index is an indication of seeds to germinate and develop in to a normal and vigorous plant on the field growing condition. The largest field emergence index did show the vigorous seed [7].

The various vigor tests such as speed of germination, field emergence index, vigor index II had reduced as storage time extends. Tsedey variety (7 months stored) had germinated faster than mean germination speed (by 15%). When compared with Enatite stored for 31 months (have a least speed of germination), Tsedey had germinated 27.83% faster. All the varieties in31 months' storage period had generally exhibited an inferior speed of germination when compared with 7 months stored seeds where Quncho had the highest value and Enatite had the least value (Table 3).

Table 3: Effect of storage and variety on different seed quality characteristics of Tef crop stored at different storage periods.

Storage period	Variety	Speed of Germination	FEI	SDM(g)	VI II
7months	Quncho	31.508ab	27.128ab	0.95a	
	Dukem	31.652ab	27.248a	0.0078bcd	0.749bced
	Magna	32.141a	26.46abcd	0.0085ab	0.816abcd
	Tsedey	31.921ab	26.22bcde	0.010a	0.96a
	Enatite	31.122b	25.58cdefgh	0.009ab	0.821abc
	Asgori	30.236c	26.36abcd	0.0072bcde	0.676cdefg

How to cite this article: Teshager A, Wasu M, Kebebew A. Effect of Seed Storage and Varieties on Seed Quality of Tef [Eragrostis tef (Zucc.) Trotter]. Agri Res & Tech: Open Access J. 2016; 2(4): 555593. DOI: 10.19080/ARTOAJ.2016.01.555593

19 months	Quncho	26.864e	25.46 cdefgh	0.0075bcd	0.702cdef
	Dukem	25.834fg	26.45abcd	0.0066de	0.622efg
	Magna	27.973d	26.42abcd	0.0072bcde	0.692cdefg
	Tsedey	25.527g	25.95cdef	0.01a	0.91ab
	Enatite	26.538ef	25.32efgh	0.0071bcde	0.646defg
	Asgori	25.296g	26.52abc	0.010a	0.922ab
31 months	Quncho	25.219g	25.75cdefg	0.0068cde	0.637efg
	Dukem	23.196h	24.73gh	0.0065de	0.598efg
	Magna	23.529h	25.56cdefgh	0.0061de	0.557fg
	Tsedey	23.708h	24.70h	0.0075bcde	0.669cdefg
	Enatite	23.049h	25.17fgh	0.0057e	0.523g
	Asgori	23.146h	25.45defgh	0.0062de	0.556fg
LSD		0.8347	1.01	0.0018	0.174
CV (%)		2.16	2.76	16.65	16.99
Mean		27.13	25.91	0.0077	0.72

Seedling dry matter had significantly reduced when seed storage period prolonged to 31 months. The reduction in seed vigor index II as storage period prolonged was observed in all of the varieties. The present findings also had shown variability between varieties for seedling dry weight. Therefore, the highest vigour index II was recorded from Tsedey and Quncho seeds which were stored for 7 months. However, Tsedey exhibited 30.31% decline in vigour index II as the seeds storage period increased from 7 months to 31 months. Similarly, Quncho had recorded 32.94% reduction in vigour index II for the same storage period which suggests that seed aging had a detrimental effect on vigour index II for the two varieties. In comparison, Tsedey had higher seed vigour index II of 45.52% as compared to the lowest performing variety Enatite for similar storage period of 31 months. The highest drop in vigour index II was recorded in seeds which were stored for 31 months (Table 1).

A complementing result to the current research was well demonstrated by the findings of Ryszard and Dortota [13] where speed of germination in timothy grass was reduced from 67.5% to 5% after five years of ambient storage condition. They had also observed that the sharp declination was in 4 and 5 years stored seeds. It had been also reported by the works of Melkam [15] that speed of germination in tef was influenced by the varietal difference after studying the speed of germination of 3 tef varieties.

The reduction in seed vigor of the 31 months stored seed in the current experiment could be attributed to the oxidation of the nutrient reserve in the endosperm through ageing which resulted significant reduction in the seed capacity to emerge out of the soil. Ryszard and Dortota [13] had found that a reduction in field emergence of timothy grass varieties when seed storage period was increased to 5 years. According to present research findings, a one year and two years old seeds did lower the field emergence by 30-35%. However, when the seed storage period progressed to 5 years, they had recorded 8% field emergence. The influence of varietal character on field emergence was observed by Workneh [8]. He had indicated that field emergence index had shown a significant difference between two varieties of tef (Quncho and Tsedey) which were stored for 8 months after harvest. Generally, it was noted Quncho had the highest field emergence index than Tsedey.

Electrical conductivity of seeds

Electrical conductivity reading was significantly ($P<0.05$) influenced by storage time and variety. However, the interaction effect of storage time and variety didn't have a significant influence on the electrical conductivity readings.

Electrical conductivity reading had increased with extended storage period. Seeds stored for 31 months exhibited the largest electrical conductivity (109.22 $\mu scm^{-1}g^{-1}$) followed by 19 months stored seeds. Meanwhile, 7 months stored seeds had recorded the lowest electrical conductivity readings. On the other hand, the magnitude of the varietal difference on electrical conductivity was minimal. The two varieties viz., Enatite and Asgori did register significantly lower conductivity readings than other four varieties. The four varieties (Quncho, Dukem, Magna and Tsedey) had shown rest higher but non-significant electrical conductivity readings. The result of the electrical conductivity test revealed that Enatite and Asgori had a varietal strength to withstand seed ageing and release of electrolytes. Therefore, those two varieties didn't deteriorate fast, whereas, the other four varieties could be deteriorated easily.

Ryszard and Dortota [13] had found significant difference in the conductivity of leachates among the seed lots of timothy grass which were stored up to 5 years. However, they had observed the lowest electrical conductivity reading in 4 and 5 years stored seeds than 1 and 2 years stored seed. Their current finding is in consistent with the established fact which indicates that during ageing seed membrane will disintegrate and increased electrolytes will be released. They had further indicated that

How to cite this article: Teshager A, Wasu M, Kebebew A. Effect of Seed Storage and Varieties on Seed Quality of Tef [Eragrostis tef (Zucc.) Trotter]. Agri Res & Tech: Open Access J. 2016; 2(4): 555593. DOI: 10.19080/ARTOAJ.2016.01.555593

cell membrane degradation in small seeded grass is improbable during ageing; therefore, the use of electrical conductivity test during vigor determination of timothy grass is useless. In contrast to the above finding other researchers indicated that conductivity is a good indicator of vigor to large seeded legumes and cereals [11,16]. Melkam [15] had observed variation in electrical conductivity reading and seed deterioration of Quncho and Tsedey. Strelec [11] had also found a complementing result to Samson [17] from two wheat varieties (Table 4).

Table 4: Effect of storage and varieties on seedling length, Vigor Index I and Electrical Conductivity.

Storage	Seedling length (cm)	Vigor index I	Electrical conductivity(µscm^{-1}g^{-1}_)
7 months	2.956a	279.33a	80.66c
19 months	2.846ab	264.65b	93.18b
31 months	2.767b	251.55b	109.22a
LSD (5%)	0.146	13.73	5.379
Varieties			
Quncho	2.876ab	269.54ab	99.81a
Dukem	2.983a	280.55a	99.78a
Magna	2.912a	274.90a	96.47a
Tsedey	2.691b	248.60c	99.60a
Enatite	2.789ab	253.43bc	87.07b
Asgori	2.888ab	264.02abc	83.39b
LSD (5%)	0.2065	19.42	7.607
CV (%)	8.83	8.94	8.432
Grand Mean	2.85	265.17	94.35

Seedling length and vigour index I

Seedling length and vigour Index I were significantly influenced by variety types and storage period but the interaction of the two doesn't have a significant effect.

Tef seeds stored for 7 months had produced longest and vigorous seedlings than seeds stored for 31 months. The result also showed that storing tefseeds beyond 7 months, particularly for 31 months reduce the seedling length by 6.64%.The reduction in seedling length could be attributed due to the depletion of the nutrients in the endosperm because of seed ageing.The current research ad further found that seedling length in tef was influenced by the inherent characteristics of varieties. On the other hand Dukem and Magna had significantly longest seedling length while Tsedey had the shortest. Accordingly, Vigour index I had been significantly affected by storage period. Seeds which were stored for 7 month exhibited statistically higher vigour index I from seeds stored for 19 and 31 months. On the other hand, 19 and 31 months stored seeds did not vary statistically. Storing the seed beyond 7 months to 19 months reduce vigour index I by 3.72%. Further extending storage period to 31 months had an effect of reducing vigour index I by 6.39 %. Similarly the influence of variety on seed vigour index I was statistically significant. The highest vigour index I was recorded for Dukem (280.55) followed by Magna (274.9). On the other hand, Tsedey had the lowest vigor index I (248.6) which was 31.95 % less than Dukem.

Sterlic [11] had reported a reduction in seedling length of two wheat varieties stored for varying number of days up to 360 days. He had reported that reduction in seedling length was attributed to the decline of seed vigor because of the prolonged storage period. Accordingly Ryszard and Dortota [13] finding indicate that, seedling length had sharply declined when the seed did ages from 1 year to 5 years in timothy grass. However, a sharp reduction in seedling length was recorded for seeds that were stored for 3 years. Rozman et al. [14] had reported a slight reduction in seedling length of two varieties of perennial ryegrass was reported after the seeds were stored for 9 months. The magnitude of the reduction was also significantly high between the two varieties tested at the same temperature.

Seed vigour index I is the product of germination percentage and seedling length [7]. Therefore, the results of seed vigor Index I were highly influenced by seedling length. Sterlic [11] and Melkam [15] had found complimenting results to the current study results. Sterlic [11] had observed reduction in vigor index I of two wheat Varieties which were stored for varying storage periods up to 360 days. The reduction in seedling length was attributed to the decline in vigor through storage. On the other hand, Workneh [8] reported that seed vigor index I was affected by varietal variation in his study on two varieties of tef.

References

1. Central Statistical Agency (CSA) (2013) Agricultural sample survey 2012/2013. Vol. I. Report on area and production for major crops (private peasant holdings, *meher* season). Statistical Bulletin, Addis Ababa, Ethiopia.
2. Central Statistical Agency (CSA) (2011) Agricultural sample survey 2010/2011. Vol. III. Report on Farm Management Practices (private peasant holdings, *meher* season). Statistical Bulletin, Addis Ababa, Ethiopia.
3. Zewdie M, Ellis RH (1991a) The upper-moisture-content limit to negative relations between seed longevity and moisture in niger and tef. Seed Sci & Technol 19: 295-302.
4. Zewdie M, Ellis RH (1991b) Survival of tef and Niger seeds following exposure to sub-zero temperatures at various moisture contents. Seed Sci & Technol 19: 309-317.
5. Alemayehu Rafera (2001) Tef: Post-harvest Operations. Tef Post-harvestCompendium, Ethiopian Institute of Agricultural Research, Holeta Agricultural Research Center, Holeta, Ethiopia, pp. 37.
6. Abate Bekele, Gezahegn Ayele (2007) Market price index for quality characteristics of tef: A hedonic price analysis of six markets in the Eastern Showa, Ethiopia, Technical report Addis Ababa, Ethiopia.
7. International Seed Testing Association (ISTA) (2009) International rules for seed Testing 2009 Edition. Bassersdorf, Switzerland.
8. Workneh Bedada (2009) Growth, Lodging and Yield of Tef (*Eragrostis Tef*) As Influenced by Seed Size and Depth of Sowing. MSC. Thesis. Haramaya University, College of Agriculture. Alemaya. Ethiopia, pp. 34.

How to cite this article: Teshager A, Wasu M, Kebebew A. Effect of Seed Storage and Varieties on Seed Quality of Tef [Eragrostis tef (Zucc.) Trotter]. Agri Res & Tech: Open Access J. 2016; 2(4): 555593. DOI: 10.19080/ARTOAJ.2016.01.555593

9. Manga VK, Yadav OP (1995) Effect of seed size on developmental traits and ability to tolerate drought in pearl millet. Journal of Arid Environments 29: 169-172.

10. Harrington JF (1973) Biochemical basis of seed longevity. Seed Science and Technology 1: 453-461.

11. Strelec, Ruža Popovic, Ilonka Ivanišic, Vlatka Jurkovic, Zorica Jurkovic, et al. (2010) Influence of Temperature and Relative Humidity on Grain Moisture, Germination and Vigour of Three Wheat Cultivars During One Year Storage. Agriculture 16(2): 20-24.

12. Seyfu Ketema (1993) Phenotypic Variation in Tef germplasm. Agronomic and Morphological Traits: A Catalog. Technical Manual No. 6, Institute of Agricultural Research. Addis Ababa, Ethiopia.

13. Ryszard J Gorecki, Dorota Mierzejewska (1989) The vigor of timothy (*phuleum pretense L.*) seed stored up to 5 years. Acta societastis botanicorum poloniae 58(2): 263-272.

14. Rozman Vlatka, Gordana Bukvic, Anita Liška, Renata Balicevic, Andrijana Eđed, et al. (2010) Differences in Traits of Seeds and Seedlings of Perennial Ryegrass Cultivars after Nine Months Storage at Different Temperatures. Notulae Botanicae Horti Agrobotanici Cluj-Napoca 38(1): 155-158.

15. Melkam Anteneh (2011) Seed System and Quality Analysis of Tef [*Eragrostis tef* (Zucc.) Trotter] in East Gojjam Zone, Ethiopia. MSc. Thesis, Haramaya University, Haramaya, Ethiopia.

16. Crop Talk (2002) OMAFRA Field crop specialists your crop information source. 2(2).

17. Samson Seife (2013) Assessment of Seed Quality Standards Implementation in Local Seed Business of Tef [*Eragrostis Tef* (Zucc.) Trotter] Seed Production: The Case of Halaba Special and Meskan Woredas, South Ethiopia. MSc. Thesis, Haramaya University, Hramaya, Ethiopia.

How to cite this article: Teshager A, Wasu M, Kebebew A. Effect of Seed Storage and Varieties on Seed Quality of Tef [Eragrostis tef (Zucc.) Trotter]. Agri Res & Tech: Open Access J. 2016; 2(4): 555593. DOI: 10.19080/ARTOAJ.2016.01.555593