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Seed Quality Determination of Different Teff [*Eragrostis tef* (Zucc.) Trotter] Seed Sources in Local Seed Business at Halaba Special Woreda and Meskan Woreda, South Ethiopia

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ABSTRACT: The Meskan and Halaba Special Woredas are among Teff producing areas of South Nations Nationalities and Peoples Regional State. Despite the Woredas possesing a potential for Teff production, the productivity is low due to input and quality seed related problems. This study was designed to test seed quality of different sources and classes of Teff seed and to assess use of national seed quality standards by Local Seed Business in Halaba Special Woreda and Meskan Woreda in two seed producing cooperatives namely Napi Leka Nasi and Zerfeyan respectively. The physical purity and moisture content of all samples have met minimum standards of Teff Ethiopian National Seed Quality Standard. Only Certified-1 seed class met the minimum germination percentage of the National Standard while all the rest seed classes failed in germination test. Field emergence index was highly significant and positively correlated with speed of germination and vigor index-II and it was significantly and positively correlated with standard germination, vigor index-I, and seedling dry weight. The seed health quality of Teff seed samples was checked for the presence of fungal seed-borne pathogens using the agar plate method and seven major disease causing fungal genera were identified on Teff seed sources.

Key words: Contractual seed production, seed health, seed system, seed vigour

Agriculture is the mainstay of Ethiopian economy. It is the largest contributor to overall economic growth and poverty reduction [1]. However, the national crop productivity is very low, there is need for improvements. Access and availability of quality seed is widely recognized as the potential to improve actual production and productivity of crops.

In Ethiopia, Teff (*Eragrostis tef*) is the most important crop in area coverage and number of farmers engaged in its production. In 2010/2011 meher season alone 2,761,190.05 ha of land was covered under Teff [2]. Teff is an important cash crop for smallholder farmers in most cereal based farming systems of Ethiopia [3].

In addition to supporting local seed business, ISSD strives to strengthen these regional, national and/or international companies to produce and market quality seed of improved varieties of major food and cash crops in which one of the focus crop is Teff. The local seed business activities have been conducted in many sites including Halaba special Woreda and Meskan Woreda [4].

Seed can play a critical role in increasing agricultural productivity as it relatively determines the maximum upper limit of crop yields and the productivity of all other agricultural inputs, given optimum environment is available [5].

Ethiopian agriculture requires over 700,000 tons of seed each year to grow cereals (such as Teff, maize, wheat, sorghum, barley, and finger millet) and pulses (such as faba beans, field peas, haricot beans, and chick peas) [1].

The Meskan and Halaba Special Woredas are among Teff producing areas of SNNPRGS. Despite

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the Woredas posses a potential for Teff production, the productivity is still found in a very small level due to input and quality related problems. In Halaba Special Woreda Teff had very low productivity in quintal per hectare with 10.05 and in Gurage zone where Meskan Woreda belongs with 12.40. Both are less than the national yield 12.81 quintals per hectare (CSA, 2012) and potential yield of demonstration plots (15.0 to 27.0) in quintals per hectare [6].

Seed certification plays an important role in supplying a good quality seed to the farmers. It provides a control both in the field of seed production as well as in laboratory standards to check whether or not the seed production meets the prescribed minimum standards.

Therefore, the aim of the current research is to test seed quality performance of different classes of seed *vis-a-vis* seed quality standards.

MATERIALS AND METHODS

Laboratory Experiment

The laboratory work was conducted at Haramaya University Seed Science and Technology laboratory as well as in national seed laboratory of Ministry of Agriculture. A completely randomized design (CRD) with factorial arrangement (2x4) was used to carry out the tests. These tests were conducted partly in the laboratory and under field condition. The laboratory tests were physical purity, moisture percentage, standard germination percentage, speed of germination, shoot length and root length (cm), dry weight (mg), vigor index I, vigor index II, electrical conductivity, and seed health test. In a well prepared pot experiment in green house, field emergence index was measured. All tests were conducted according to ISTA (1996).

Experimental Design and Procedure

A total size of the sample for the source seed was from four categories, i.e. the breeder seed, basic seed, certified 1 stage seed and certified 2 stage seed. The breeder seed was taken from Debre Ziet Agricultural Research Center, and basic seed from Idiget union, certified seed from farmers in the two cooperatives and certified 2 from non-participant farmers were collected. In Halaba Wbreda farmers in Nepi Leka Nasi cooperative are using the variety DZ-Cr-37 (Tseday) and in Meskan Woreda farmers in Zerfeyan cooperative are using DZ-Cr-387 (Quncho). 10 grams submitted sample was taken as per ISTA (1996). From 15 farmers a total of 200g of Teff seed was collected from members of the two cooperatives and from 15 non-participant farmers in the two Woredas 200g of Teff seed each was collected. 500g of Breeder seed, 500g of Basic seed, 200g of Certified-1 seed and 200g of Certified-2 was collected from DZARC, Idget Union and participant farmers in the two SPCs and non participants were collected respectively.

Physical purity

The physical purity was conducted by taking 1 gm Teff seed as working sample. Then the sample was divided into pure seed, other crop seed and inert matters [7]. After weighing each separated components of two duplicates, the percentage of physical purity on weight basis was calculated.

$$\text{Purity (\%)} = \frac{\text{Weight of pure seed fraction}}{\text{The sum of the weight of all componenets}} \times 100$$

Moisture determination

The submitted sample was thoroughly mixed and was reduced to working sample and was tested for its moisture determination by using oven methods.

The determination of the seed moisture content was done by oven method [8] was carried out for four replicates for each entry. 10 g of working sample was weighed with a large container and was dried for a period of 2 hours at the temperature of 130 ± 2°C. Then by using weighing balance, the weight in gram of the container, cover and contents after drying the moisture in % was calculated by using the standard formula.

Germination Test

Four hundred seeds were taken from pure seed components of physical purity to conduct germination using TP (top of paper) method in four replications each containing 100 seeds. After

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putting seed for germination it was placed in seed germinator at 25°C temperature for 10 days according to ISTA rules [7]. At the end of the testing period the samples were removed and were evaluated. The normal and abnormal seedlings as well as dead seeds were recorded on the 10^{th} day.

$$\text{Germination (\%)} = \frac{\text{Total number of normal seedlings}}{\text{Total number of seeds planted}} \times 100$$

Speed of germination

Seed lots with similar total germination often vary in their rate of germination and growth [9]. To determine the speed of germination, four replicates of 50 seeds of each entry were planted for a maximum of 10 days at 25°C temperature until no further germination takes place and rate of germination, which is an expression of vigor index I and II, was estimated. Each day normal seedlings were counted at emergence and were removed until all seeds capable to produce normal seedling were germinated.

$$\frac{\text{Number of normal seedling 1st day count} + \cdots + \text{Number of normal seedling on the final day count}}{\text{Total first count days till final count}}$$

Seedling root and shoot length test (cm)

Four replicates of ten seeds of each entry were placed in straight line on a blotter paper moistened with distilled water. A piece of tissue paper was placed over the seeds to hold them in place and covered with additional blotter paper. Germination boxes were tilted at 45° angles, which will cause straight growth of seedlings and thus facilitate measurements of shoot and root length. At the end of the 10^{th} day, the lengths of the seedlings shoots and roots were measured in millimeters using a ruler [10].

Seedling dry weight

Forty seedlings from each replication were taken. The same were kept at 80°C for 24 hours in hot air oven and then dry weight was taken.

Vigor index I and vigor index II

For each sample two vigor indexes were calculated. Seedling vigor index I was calculated by multiplying the standard germination with the average sum of shoot length and root length after 10 days of germination, and vigor index II by multiplying the standard germination with mean seedling dry weight. Seed vigor index I was calculated by the following formula:

Vigor index I = Standard germination(SG%) × Mean seedling length (shoot length + Root length) (cm)

Vigor index II = Standard germination (SG%) × Mean seedling dry weight (mg)

Electrical conductivity test

The experiment was conducted in completely randomized design (CRD) with four replications of 5 g seeds per variety and seed classes. Seeds were surface sterilized with 5% sodium hypochlorite solution and washed in distilled water to remove dust from seeds. The seeds were soaked in 50 ml distilled water in 150 ml flask. This was covered and held at 25°C for 24 hours. Then after, the leachates were separated from the seed and were used for conductivity test. Distilled water conductivity test was also conducted and the value was subtracted from each treatment conductivity readings. The electrical conductivity (ECM) meter was used for measurement.

Field Emergence Index and Seedling Emergence Percentage

One hundred seeds in four replications were sown in pot and the emerged seedlings were counted daily up to 21 days. Then the field emergence index (X) and seedling emergence percentage were worked out as

$$\text{Seedling emergence(\%)} = \frac{\text{Total number of normal seedlings}}{\text{Total number of seeds planted}} \times 100$$

Seed Health Test

Agar Plate method was used for identification of seed-borne diseases in seed health standards. Seeds were treated with 1% sodium hypochlorite (NaOCl) for two minutes and were washed by distilled water, the randomly selected 100 seeds of each entry were placed per plate in equal distances for

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each replicates. Then after incubating at 28°C of 12 hours alternating cycles of light and darkness, the plate was examined at the end of 11th day through compound microscope to identify the pathogen and record the percentage of infection.

Data Collection

Data for samples from Debre Zeit research center, Idget Union and selected sixty farmers was collected primarily from the germination and vigor tests both in the laboratory and in field emergence experiment. Average normal seedlings were counted from the four replications of all tests throughout the evaluation period in order to estimate germination percentage and germination rate. In addition the samples were tested for their seed purity, moisture content, shoot length and root length (cm), dry weight (mg), Vigor index I, Vigor index II, Electrical Conductivity and seed health.

Data Analysis

The collected data from both laboratory and field emergence experiments were subjected to analysis of variance in factorial arrangement as per completely randomized design (CRD). The analysis of Variance and simple correlation analysis were carried out using SAS-statistical software (SAS Version 9.1, 2008) [11]. Treatment means were separated using least significant difference (LSD). All the seed vigor tests were correlated with field emergence index.

RESULTS AND DISCUSION

Seed Quality Performance

Seed quality tests were performed on two varieties (Quncho and Tseday) and 4 classes of seed Breeder seed was collected from Debre Ziet Research Center, and basic seed from Idiget union, certified-1 seed from farmers in the two cooperatives and certified-2 seed from non-participant farmers in Halaba Special Woreda and Meskan Woreda, SNNPRS Ethiopia. The samples were tested for their seed purity, moisture content, standard germination percentage, speed of germination, shoot length and root length (cm), dry weight (mg), vigour index I, vigour index II, Electrical Conductivity and seed health.

Physical purity analysis

The physical purity of all samples have met minimum standards of Teff Ethiopian National Seed Quality Standard. There were significant ($p < 0.05$) differences in physical purity, weed seed and inert matter between the four seed classes and Cr-37 and Cr-387 variety seed. The highest of percent of pure seed (99.42%) for breeder seed and the least of 98.07% for certified-2 were recorded (Table 1). The maximum number of inert mater and number of other crop seeds were recorded for certified-2 seed with a percentage of 0.97% and 0.97% while the minimum for breeder seed-i.e. 0.40% and 0.18% respectively were recorded.

It was reported that most of the samples collected from farmers satisfied the physical purity standards set for wheat seed production in Ethiopia which was agreeable with Teff in this study [3].

Similarly, a high level of contamination with dirt, stones, and weed seeds would greatly reduce the value of the seed to farmers [12].

Table 1. Physical purity test

	PS	IM	ocs
Seed class			
Breeder	99.42^{a}	0.40^{c}	0.18^{d}
Basic	98.73^{b}	0.73^{b}	0.53^{c}
Certified-1	98.55^{c}	0.77^{b}	0.68^{b}
Certified-2	98.07^{d}	0.97^{a}	0.97^{a}
LSD (5%)	0.1532	0.1663	0.0951
Variety			
Cr-37	98.75^{a}	0.70^{a}	0.55^{b}
Cr-387	98.63^{b}	0.73^{a}	0.63^{a}
LSD (5%)	0.1083	0.1176	0.0672
Mean	98.69	0.72	0.59
CV (%)	0.13	18.74	12.97

Means with the same letter within the column are not significantly different at 5% level. PS=Pure Seed; IM=Inert Matter; OCS=Other Crop seed, LSD=Least Significant Difference

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Moisture Determination

All the samples met the national standard for maximum Teff seed moisture content limit (11%). The average moisture content of the sampled Teff seed was 6.86% and there was significant difference in moisture content between the seed classes and there was no significant difference between varieties. The highest seed moisture content was recorded in the Certifiied-2 seed class (7.81%) and the least for Breeder seed (5.49%) (Table 2). The average moisture content of the sampled wheat seed was 10.76% and there was no significant difference in moisture content between the seed sources and varieties [14].

Table 2. Moisture content

Treatment	Moisture Content (%)
Seed Class	
Breeder	5.49^{C}
Basic	6.80^{b}
Certified- 1	7.38^{ab}
Certified-2	7.81^{a}
LSD (5%)	0.594
Variety	
Cr-37	6.86^{a}
Cr-387	6.88^{a}
LSD (5%)	0.42
«Mean	6.87
CV (%)	6.98

LSD = Least Significant Difference, figures followed by the same letters in the same column are not significantly different at $P < 0.05$

Physiological seed quality standard germination test

The value of germination percentage, abnormal seedlings and dead seeds in a working sample during germination was recorded. The overall average mean germination percentage was 81.47% with the range of 72.38% up to 93.38% and the highest value was recorded for Breeder seed (93.38%) followed by Certified-1 (92.25%). Only Certified-1 seed class met the minimum germination percentage of the Ethiopian National Standard while all the rest seed classes were failed in germination test. In the contrary it was found results where almost all wheat samples collected from have farmers reached the minimum germination standards for certified seed class [15]. There was significant difference between seed classes as well as varieties. The variety Cr-387 was recorded to have the better germination of the two with 83.88% while Cr-37 had an average germination percentage of 79.06% (Table 3).

Seed Vigor Tests

Several seed vigor tests namely standard germination, speed of germination, seedling shoot and root length and seedling dry weight were measured to assess the vigor of Teff seed lots of breeder (from Debre zeit research Center), basic (Idget union), certified-1 (from the farmers in the cooperatives) and Certified-2 (from non participant farmers). A thorough and careful root and shoot length measurements were taken for seedlings from different samples.

There was significant difference in root length between seed classes but there was no difference between varieties. Breeder seed (1.35 cm) had shown the highest root length; Basic seed showed the lowest root length (1.21cm). While there was significant difference in shoot length among seed classes and there was no significant difference between varieties. The highest shoot length was recorded for Certified-1 (1.76cm) and the lowest shoot length was recorded for Basic seed (1.63 cm). Seedlings with well developed shoot and root length would withstand any adverse conditions and provide better seedling emergence and establishment in the field [30]. Shoot emergence took place when the temperature was lowered to 20°C [17].

The highest Speed of germination was recorded for breeder seed sample (18.59%) and the lowest was (16.04%) for basic seed. At 20°C temperature, the highest speed of germination was recorded 44% on genotype Gea-Lamie and the lowest 28% for genotype Beten for Teff seeds [2]. Seeds which have high germination rate could escape drought

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Table 3. Standard germination test

	Standard germination	Abnormal eedlings	Dead seed
Seed class			
Breeder	93.38^{a}	1.37	5.25^{c}
Basic	74.38^{c}	1.62	24.00^{a}
Certified-1	85.75^{b}	1.75	12.50^{b}
Certified-2	72.38^{c}	1.75	25.87^{a}
LSD (5%)	4.0536	Ns	4.1245
Variety			
Cr-37	79.06^{b}	1.69	19.25^{a}
Cr-387	83.88^{a}	1.56	14.56^{b}
LSD (5%)	2.8664	0.3107	2.9164
Mean	81.47	ns	16.90
CV (%)	4.79	26.00	23.46

LSD = Least Significant Difference, figures followed by the same letters in the same column are not significantly different at $P < 0.05$

condition, thus helping to choose early varieties. Similarly, it was the rate at which the seeds were germinating and those seedlings with higher index or highest on first count were expected to show rapid germination and seedling emergence and to escape adverse field conditions [16]. Seed with a low germination rate can have disastrous effects on a farmer's income by the time it is apparent that the seed would not germinate; it may be too late to plant again in that season [13].

There was no significant difference between seed classes in seedling dry weight but there was significant difference between varieties. The highest seed weight was recorded for Certified-1 seed (8.95 mg) and the lowest for basic seed (8.25) mg (Table 4).

Vigor index-I was calculated after analyzing root length, shoot length and standard germination while vigor index-II was calculated after testing seedling dry weight and standard germination. Significant differences were observed for both vigor index-I and vigor index-II among seed classes as well as among varieties. Breeder seed did show the highest vigor index I result while Certified-1

Table 4. Seed vigor test under laboratory condition

	RL (cm)	SL (cm)	SDW (mg)	SG (%)	VI (cm)	VII (mg)
Seed class						
Breeder	1.35^{a}	1.66^{ab}	8.50	18.59^{a}	141.24^{a}	798.88^{a}
Basic	1.21^{b}	1.63^{ab}	8.25	16.04^{ab}	108.00^{b}	632. 15^{b}
Certified- 1	1.30^{ab}	1.76^{a}	8.95	17.99^{a}	137.82^{a}	808.08^{a}
Certified-2	1.28^{a}	1.60^{b}	8.86	16.69^{ab}	104.58^{b}	640.48^{b}
LSD (5%)	1.1381	1.5597	Ns	0.7641	8.7553	57.44
Variety						
Cr-37	1.30^{a}	1.67^{a}	8.28^{b}	15.99^{b}	117.19^{b}	654.45^{b}
Cr-387	1.27^{a}	1.67^{a}	8.99^{a}	18.66^{a}	128.63^{a}	785.35^{a}
LSD (5%)	0.8047	1.1029	0.4876	0.5403	6.191	40.62
Mean	1.29	1.67	8.64	17.33	122.91	719.9
CV (%)	8.52	9.02	7.68	4.24	6.85	7.67

RL = root length SL = shoot length, SDW = seedling dry weight, VI = vigor index one, VII = vigor index two, SG = speed of germination. Figure followed by the some letters in the same column are not significantly different $p < 0.05$. LSD = Least Significant Difference

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showed the highest vigor index-II and cerified-2 and basic seed have shown the lowest for the Vigor index I and vigor index-II respectively. The seed lot showing higher seed vigor index was considered to be more vigorous [18].

Electrical Conductivity

Electrical conductivity was performed on the four seed classes (Breeder, Basic, Certified-1 and Certified-2) combined with the two Teff varieties (Cr-37 and Cr-387). And there was significant difference among both the seed classes and among varieties. The highest the electrical conductivity is the more it is stored and the less its quality is.

The highest electrical conductivity was recorded on Breeder seed with 416.00us/cm, followed by Basic seed (383.00us/cm), Certified-2 (330.65us/cm) and the least was recorded for Certified-1 with 315.60us/cm (Table 5). Prediction of seedling performance in relation to electrical conductivity test is based on nutrient leaching from damaged seeds [9]. Loss of membrane integrity is a key physiological symptom of seed damage and it is measured by the conductivity of seed leachates [19]. An association between the readiness with which solutes were leached from different lots of pea seeds and their emergence ability in the field was reported [20].

Table 5. Electrical conductivity test

Treatment	Electrical conductivity (μs/cm)
Seed class	
Breeder	416.00^{a}
Basic	383.00^{b}
Certified-1	315.60^{c}
Certified-2	330.65^{c}
LSD (5%)	17.981
Variety	
Cr-37	383.83^{a}
Cr-387	338.80^{b}
LSD (5%)	12.715
Mean	361.31
CV (%)	4.02

LSD = Least Significant Difference, Figures followed by the same letters in the same column are not significantly different at $P < 0.05$

Field emergence index

Mean of field emergence index from the seed samples was 81.97 with the range of 72.00% to 87.00%. Breeder seed and Basic seed did show field emergence index less than 85%. There was significant difference between Seed classes and among varieties in both field emergence and seedling emergence rate.

On one hand the highest field emergence index was recorded for the Certified-1 seed (87.00%), followed by Certified-2 (86.75%) and Breeder seed (82.13 %) whereas the least was observed for Basic seed (72%). On the other hand the highest emergence rate was recorded for Certified-2 (4.62), followed by certified-1 (4.25), and Breeder seed (3.37) and finally the least again being basic seed (3.08) (Table 6). The quality of the seed planted will affect seedling establishment and yield of cereal crops although different crop cultivars perform differently in percent of field emergence.

Out of the two varieties Cr-387 was found to have 88.81% field emergence index and seedling emergence rate of 4.45 while Cr-37 had 75.13% field emergence index and seedling emergence rate of 3.21 (Table 6). Germination was reduced in soybean plant that experienced stress during seed filling, where as the largest reduction did occur when high air temperature and water stress was occurred at the same time [21].

Simple correlation coefficients of physiological quality tests and seedling emergence for Teff crop were performed (Table 7). Seedling root length was significantly and positively correlated (r = 0.43) with vigor index-I while highly significantly and negatively correlated (r = -0.48) with seedling dry weight. Seedling shoot length and vigor index-I were significantly and positively correlated. Standard germination was highly significant and positively correlated (r = 0.87, 0.66, 0.46) with Vigor

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Table 6. Field emergence test

Treatment	Seedling emergence (%)	Field emergence Index
Seed class		
Breeder	82.13[b]	3.37[b]
Basic	72.00[c]	3.08[b]
Certified-1	87.00[a]	4.25[ab]
Certified-2	86.75[a]	4.62[a]
LSD (5%)	2.5206	1.1213
Variety		
Cr-37	75.13[b]	3.21[b]
Cr-387	88.81[3]	4.45[a]
LSD (5%)	1.7824	0.7929
Mean	81.97	3.83
CV (%)	2.96	28.18

Figures followed by the same letters in the same column are not significantly different at P < 0.05, LSD = Least Significant Difference

index-I, speed of germination and vigor index-II respectively (Table 7). Moreover, the correlation between standard germination and field emergence index was significant and positively correlated (r = 0.43). In another finding, the correlation between seedling emergence rate and germination percentage were significant, weak and negatively correlated (r = -0.36**, at p < 0.01) [22].

Significant correlation between germination test and field emergence of previously sprouted hard red wheat was reported [23]. The correlations between speed of germination within the pot and the standard germination test did support other findings that single vigor tests are not adequate for determining seed vigor [24].

On one hand, vigor index-I was highly significantly and positively correlated (r = 0.57) with speed of germination, and was significantly and positively correlated with field emergence (r = 0.38), and on the other hand speed of germination was highly significant and positively correlated (r = 0.78, 0.66) with both vigor index-II and field emergence respectively. Seedling dry weight was highly significant and positively correlated (r = 0.81) with vigor index-II and was significantly and positively correlated (r = 0.45) with field emergence. Finally vigor index-II was highly significant and positively correlated (r = 0.69) with seedling

Table 7. Simple Pearson correlation coefficients between vigor tests and seedling emergence in Tef, Halaba Special Woreda and Meskan Woreda

	RL	SL	SG	VI-I	SPG	SDW	VI-II	FE
Seedling Root Length	1	-0.19	0.06	0.43*	0.08	-0.48**	-0.26	-0.03
Seedling Shoot Length	1	0.26	0.44*	0.07	0.24	0.21	0.17	
Standard Germination	1	0.87**	0.66**	0.10	0.46**	0.43*		
Vigor Index-I	—	1	0.57**	-0.05	0.31	0.38*		
Speed of Germination	—	—	1	0.27	0.78**	0.66**		
Seedling Dry Weight	—	—	—	1	0.81**	0.45*		
Vigor Index-II	—	—	...	—	1	0.69**		
Field Emergence	—	—	—	—	—	1		

*,**significant at p < 0.05 and p < 0.01, respectively; RL= Seedling root length SL= Seedling shoot length SG = Standard germination, SPG = Speed of germination, VI-I = Vigor index I, VI-11 = Vigor index II, SDW = Seedling dry weight, FE = field emergence index

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emergence (Table 24). Zewdie (2004) indicated that field emergence was highly and significantly correlated with all physiological tests. However, other scholars have reported that there was no correlation between root length and shoot length with seedling emergence of hard red wheat [23, 25], but the report was similar to our results where shoot and root length did not correlate with field emergence (Table 7).

Seed health test

Seven major disease causing fungal genera were identified on Teff seeds in Breeder (from Debre Zeit Research Center), Basic (from Idget Union), Certified-1 (from the farmers in the two cooperatives) and Certified-2 (from non participant Farmers) on Cr-37 and Cr-387 varieties.

The most frequent genus associated with Teff seed was *Saccharomyces* spp. which is a type of yeast that catalyzes fermentation before baking. *Alternaria* spp. was identified in all but Cr-387 basic seed. *Asprgillus* spp. was found in Cr-37 basic seed, Cr-37 Certified-1 and Cr-387 Certified-1 and Cr-387 Certified-2. *Cladosporium* spp. was not identified in all Cr-37 seed classes, while it was found on Breeder, Basic and Certified-1 seed classes of Cr-387 and was absent in Certified-2 of Cr-387. *Mucor* spp. was identified from Cr-37 Basic and Certified-1 seeds but was absent in the rest of the samples. *Penicillium* spp. was found in Cr-37 Breeder, Basic and Certified-2 and was absent in Cr-37 Cetified-1 seed; whereas, it was identified only on Breeder seed class of the variety Cr-387, and it was absent in the other three seed classes (Basic, Certified-1 and Certified-2). The least frequent of all the fungal genera was *Rhizopus* spp. it only being identified in Certified-2 seed classes of the two varieties (Table 8).

Teff rust (*Uromyces eragrostidis* Tracy) and head smudge (*Helminthosporium miyakei* Nisikado) have been reported as the most important diseases on Teff [26, 27]. In the major Teff production regions of the country, however, leaf rust disease epidemics in farmers' fields is generally low and it usually occurs after heading thereby, inflicting less loss [28].

CONCLUSION

This study was conducted to assess implementation of the national seed quality standards by Local Seed Business and to test the quality of different source seed of Teff in two weredas Halaba Special

Table 8. Tef seed health testing on PDA treated with 1% Clorox (NaOCl)

No	Fungal spp	Variety							
		Cr-37				Cr-387			
		Seed class				Seed class			
		Breeder	Basic	Cer-1	Cer-2	Breeder	Basic	Cer-1	Cer-2
1	*Alternaria spp*	6	6	10	5	1	0	2	2
2	*Asprgillus spp*	0	12	11	7	0	0	3	1
3	*Cladosporium spp*	0	0	0	0	8	1	3	0
4	*Mucor spp*	0	2	0	4	0	0	0	0
5	*Penicillium spp*	1	6	0	2	1	0	0	0
6	*Rhizopus spp*	0	0	0	1	0	0	0	1
7	*Saccharomyces spp*	21	17	23	14	4	48	13	0
Total % of infected seeds		**28**	**41**	**44**	**33**	**14**	**49**	**21**	**4**

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Woreda and Meskan Woreda during 2011/2012 cropping season.

The woredas are among the major Teff producing areas of SNNPRG. Despite their potential for Teff production, the productivity is still found to be very low due to input and quality related problems.

The physical purity and moisture content of all samples have met minimum standards of Teff Ethiopian National Seed Quality Standard. Only Certified-1 seed class met the minimum germination percentage of the National Standard while all the rest seed classes failed in germination test. There was significant difference in root length between seed classes but there was no difference between varieties. While there was significant difference in shoot length among seed classes, there was no significant difference between varieties. The highest Speed of germination was recorded for breeder seed sample (18.59%) and the lowest was (16.04%) for basic seed. There was no significant difference between seed classes in seedling dry weight but there was significant difference between varieties. Significant differences were observed for both vigor index-I and vigor index -II among seed classes as well as among varieties.

Field emergence index was highly significant and positively correlated with speed of germination and vigor index-II and it was significant and positively correlated with standard germination, vigor index-I, and seedling dry weight.

There was no information about the Teff seed health status used by the farmers in the study areas. The seed health quality of Teff seed samples was checked for the presence of fungal seed-borne pathogens using the agar plate method and seven major disease causing fungal genera were identified on Teff seed sources. Further studies would be required to understand the extent of seed health problems with bacterial and viral diseases of Teff.

During the study it was observed that there was a problem of getting different classes of seed at proper time in the same cropping season. This was due to distribution of similar seed classes in a particular year and the next class in the year ahead, for instance, each SPC distributes basic seed in one year and certified-1 seed in the next year. This makes it difficult to get different seed classes at a time. It is essential to consider continuous check up in the quality of seed throughout the pipeline of seed classes as well as the performance of the varieties in the SPCs so as to know the fraction where quality is compromised. Further study should be done on genetic purity of the varieties involved in the seed production by the seed producing cooperatives in order to know the exact productivity status of the varieties under production.

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