



Participatory Evaluation and Selection of Improved Tef Varieties in Agro pastoral areas of Guji Zone, Oromia Regional State, Ethiopia

Basha Kebede*, Girma Teshome, Kebna Assefa, Obsa Chimdessa, Seyoum Alemu and Yared Tesfaye*

Oromia Agricultural Research Institute, Bore Agricultural Research Center, Oromia, Ethiopia

*Corresponding authors: Kebede B, Oromia Agricultural Research Institute, Bore Agricultural Research Center, Oromia, Ethiopia, Tel: +251114707102; E-mail: bsshkdb@gmail.com

Tesfaye Y, Oromia Agricultural Research Institute, Bore Agricultural Research Center, Oromia, Ethiopia, Tel: +251114707102; E-mail: yaredtesfa19902@gmail.com

Rec date: January 09, 2018; Acc date: February 22, 2018; Pub date: March 27, 2018

Copyright: © 2018 Kebede B, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

The trial was carried out during 2015 and 2016 cropping seasons in Wadera district on 3 pastorals and agro pastoralists field on one kebele based on Tef production potentials. Accordingly, Andowa Keno kebele was selected. Three varieties (Kuncho, Boset and Tsedey) including local check were evaluated with the objective of selecting adaptable and best performing Tef variety under farmers management. The combined analysis of variance done over two years show that there was significant difference between treatments. The combined mean grain yields of Tsedey and Boset varieties were 17.67 and 15.81 qt/ha while remained higher than the local check (9.65/ha). The yield of Kuncho (10.78 qt/ha) was also higher than the local. The combined analysis of variance revealed the mean values of grain yield ranged from Kuncho 9.65 qt/ha to Tsedey 17.67 qt/ha. Kuncho and the local gave 10.78 and 9.56 qt/ha respectively. Agro pastoralists' selection criteria were grain yield, seed color, lodging character, maturity character/earliness and market value. Based on their selection criteria, agro pastoralists preferred Tsedey and Boset for early maturity, market value, grain yield, very white seeded color and lodging character. Since, both varieties were preferred by agro pastoral community they were recommended to be scaled up for further expansion in the agro pastoral area.

Keywords: Agro pastoral preference; Agro pastoral research; Grain yield; Tef

Introduction

Tef (*Eragrostis tef* (Zucc.) Trotter) is a self-pollinated, annual, warm season cereal crop; believed to have originated in Ethiopia and have been domesticated and used throughout the world due to its excellent nutritional value as grains for human consumption and as forage for livestock [1]. Ecologically, Tef is adapted to diverse agro-ecological regions of Ethiopia and grows well under stress environments better than wheat, barley and other cereals known world-wide stated that Tef can grow in low rainfall and drought prone areas characterized by protracted growing seasons and frequent terminal moisture stress [2,3]. According to Seyfu, the plant can be grown from sea level up to 2800 masl under various rainfall conditions, temperature and soil regimes [4,5]. However, for better performance, it requires an altitude of 1800-2100 masl, annual rainfall of 750-850 mm and a temperature range of 10-27°C (Adera, 2016).

Tef grows in dry as well as water-logged soils, can tolerate anoxic situations better than maize, wheat and sorghum; and is resistant to many pests and diseases. Its grains are milled and made to make foods and beverages for human consumption. The nutritional benefits of this cereal have also been acknowledged, appreciated and accepted by many other people around the world. Although Tef is grown for its grain, the straw is also used as forage for livestock as well as to reinforce mud or plasters in construction of houses both in rural and urban areas. Thus, tef is multipurpose crop used for maintaining food security, straw material for house making and generating income for farmers. Tef has both cultural and economic value for Ethiopian

farmers. In recent days it is among the cash crops and has been attracting an export market due to its nutritional value and is believed to be gluten free. However, its productivity is not comparable with other major cereal crops growing in the country. Reduction of Tef crop productivity could be resulted from a complex interaction among the environment, crop genetics, and management, biotic and abiotic stress that could occur across the fields. Average national yield of Tef in 2014/2015 Meher production season ranged from 1281 kg/ha to 1575 kg/ha [5-8].

Tef is the main crop produced in the midland and lowland areas of Guji Zone. Usually the crop is sown after other crops (maize and haricot bean) are harvested. The crop is produced for both household consumption and cash crop. Tef could be produced in both seasons (Meher and Belg) hence the crop is used for double cropping purpose which increases pastoral and agro pastorals production and income. The straw of Tef is also used for construction of house and used as the main feed resource for cattle during drought.

Despite Tef is used for human consumption, has high nutritional values, used as raw material, used for livestock feeding during drought, the agro pastoralists of Guji Zone were not getting much this benefit. This is due to lack of improved varieties, drought resistant and low application of the recommended packages of Tef.

In the past, there was limited participatory research approach in Tef technology development and improvement in agro pastoral areas. Most participatory activities were done in highland and midland areas of Ethiopia [9-12]. Once the adaptation of varieties was approved elsewhere then varieties were distributed without agro pastorals' preference trait. Agro pastorals have no multiple choice over varieties since they lacked improved varieties and use what they got from seed

suppliers. However, there were no detailed participatory activities conducted in agro pastoral of Guji Zone. Consequently, there is no formal documentation of agro pastoralist production on Tef and Tef preferences by agro pastoral were not addressed in Guji Zone, Ethiopia.

Specific Objectives

- To select best varieties of Tef through agro-pastoral participation.
- To evaluate and recommend high yielding, early maturing, drought stress resistant and diseases resistant improved Tef varieties through Agro Pastoral Research Group participation.
- To assess agro pastoral selection criteria for improved Tef.
- To evaluate the productivity of improved Tef varieties under agro-pastoralists circumstances.
- To build agro-pastoralists' knowledge and skill of production and management of improved Tef technologies.

Materials and Methods

The trial was carried out during 2015/2016 cropping seasons in Wadera district, Andowa Keno Kebele. Site for participatory demonstration was selected based on Tef production potential. The selection of kebele and number of agro pastoralists were done with collaboration of district pastoral and agro pastoral office. Three improved varieties of Tef namely, Kuncho, Tsedey, Boset and one local check were tested for their adaptability with full participation of pastoral and agro pastoralists in the study areas. The spacing between plots and rows were 1.0m and 18cm respectively. Each experimental plot had 10 m ×10 m with a gross area of 100 m². Planting was done in row by drilling at seed rate of 10 kg ha⁻¹. DAP was applied at the rate of 130kg/ha at sowing. UREA was also applied at the rate of 80 kg/hectare. Half was applied at the time of planting while the remaining the second half was applied at the time of tillering.

The experiment was conducted on three agro pastoral research group (APRG). One APRG (22 male and three women) was established. The APRG members were grouped into three experimental pastorals and agro pastoral. Cost sharing (land and labor were provided by APRG while technical support and inputs were delivered by Bore Agricultural Research Center) and memorandum of understanding were signed. Weeding and other management practices were done by APRG members. Data on plant height (cm), number of tillering, panicle length (cm), number of tiller, productive tiller, lodging (%) and grain yield on plant basis were collected and subject to statistical analysis using SAS statistical software (SAS 9.0). Agro pastoralists assessment feedback on Tef production also collected through interacting with agro pastoralists.

Results and Discussion

Capacity building

Before starting this demonstration on agro pastoralists field, training was given to 25 agro pastoralists, three Development Agents and 2 experts on Tef production and important recommended agronomic management practices. Training topics covers from land preparation to post harvest. As a result, the knowledge and skills of agro pastoralists were enhanced during production time.

Technology Demonstration and Evaluation Methods

Three major approaches were used to deliver the varieties with their full packages and to evaluate the field performance of the technology. One approach was done by giving training at different stages of the implementation period, the second approach was preparing exchange visit and lastly field visit was organized during the maturity stages of the crop. Training was given for agro pastoralists and experts on importance of Tef in improving livelihood and the recommended packages (seed and fertilizer rates, recommended spacing and management practices). Exchange visit between experimental APRG was conducted to evaluate the work performance of APRG on their plot. This help the members to share their knowledge and skill on production of Tef. As such one experimental APRG (Wakasha group) was very good in group working and discussing the progress of varieties among themselves. Field visit was organized at the three experimental APRG evaluate and observe the performance of Tef at the sites. The district agro pastoral office leaders were invited and participated on field visit organized at Andowa keno Kebele. During this field visit 25 agro pastorals, five non APRG, and 6 experts were participated to evaluate the varieties and select best varieties.

Agronomic and yield Performance of Tef

The analysis of variance revealed that there is significant variation was observed in yield and agronomic traits among tested Tef varieties Kuncho, Tsedey, Boset and local check.

Variety	HD	MD	PH	PL	NT	NPT	GYLD
Tsedey	32 c	52 b	80 b	40 b	4.8 a	4.4 a	17.67 a
Boset	31 c	55 b	80 b	37.5 b	5.2 a	4.25 a	15.81 a
Kuncho	37 a	64 a	109 a	46 a	4.8 a	4 a	10.78 b
Local check	34.5 b	55 b	83.5 b	32 c	3.35 b	3 b	9.56 b
LSD (0.05)	1.29	4.25	10.3	4.98	1.29	0.59	3.11
CV (%)	1.2	2.36	3.66	4.03	8.94	4.75	7.27

Table 1: Combined mean yield and agronomic traits for tested Tef varieties of two years in Wadera district.

Analysis of the data indicated that highest plant height was recorded by Kuncho (109 cm) followed by local check (83.50 cm), whereas lower plant height was recorded in Boset variety (80 cm). The statistical result at <5% (p<0.05) showed Kuncho is significantly vary from all tested variety and the local check; but the other tested variety was not show statically different between them.

In case of number tillering per plant, highest number of tiller had recorded by Boset (5.2) whereas local check had the lower than other tested varieties (3.35). Number of productive tillers was show significant difference between tested variety and local check. Generally, there was no significant difference in number of productive tiller between the improved tested varieties but have a significant difference with local check. Similarly, there was significant difference between Kuncho and other tested varieties in terms of plant height and between Local check. But there is no significant difference between Tsedey, Boset and local check. Panicle length ranges from 32 (local check) to 46 (Kuncho). The local check had lowest panicle length compared to other tested varieties.

The lower lodging percentage of was recorded 12% by Tsedey variety which gave better yield than all tested varieties. Tsedey variety had better yield than all tested varieties which gave 17.67 quintal per a hectare; Boset, Kuncho and local check indicates second, third and last with 15.81, 10.78 and 9.56 q/ha respectively. This yield result indicates that agro pastoral areas of Guji Zone were potential to produce Tef as the average yield of Tef in Guji Zone was 14.27 qt/ha (CSA, 2015) which was lower than in the agro pastoral areas. Generally, Tsedey performed better in yield and in all tested yield traits than all other tested varieties whereas local check had low performance in most agronomic and yield traits and yield despite having low lodging due to its short height in nature. Boset was the second better performed variety next to Tsedey.

Agro Pastoral Preference on Tef Varieties

Agro pastoralists have a broad knowledge and experience accumulated over many years and did different experiments by their indigenous knowledge and skills to generate innovations on their farming. Even though agro pastoralists lack control treatment for comparison and statistical tools to test the hypothesis they well knew their environmental condition, crops, cropping system, seasonal calendar and have well documented experiences over their farming

system. Tef has several peculiar features which make it a preferred crop among agro pastoralists. Culturally and nutritionally Tef is very important crop preferred by agro pastoralists. Being the most preferred staple food in the country in general and agro pastoral the demand for Tef production was increasing from time to time.

Agro pastoralists selection criteria were grain yield, seed color, maturity character (earliness) and market value. Based on their selection criteria in both season (i.e., 2015 and 2016) agro pastoralists were preferred first Tsedey among the tested Tef varieties due to its high grain yield, seed color, earliness, lodging character/lodging resistant and market value. Secondly, Boset was preferred by the agro pastoralists due to it is seed color, grain yield and high market demand. Among the agro pastoral selection criteria set in the two seasons, seed color, lodging resistant and high market demand coincide with the participatory varietal selection of Tef. Early maturity crop was preferred by agro pastoralists due to there is a shortage of rain fall and high drought in agro pastoral areas. Tseday variety was earliness to mature and resists drought this make Tseday variety preferred by agro pastoralists in the study area. This result is like the finding of Fekede and Gosa who described seed color, resistant lodging and tolerant to drought Tef was preferred by farmers [11].

Varieties	Agro pastoral selection criteria					Total score	Average score	Rank
	Seed color	Earliness	Lodging tolerance	market value	grain yields			
Tsedey	5	4.8	5	5	5	24.8	4.96	1
Boset	4.6	5	5	5	4.8	24.4	4.88	2
Kuncho	5	3.2	3.8	5	3.6	20.6	4.12	3
Local check	3.2	3.4	3.6	4	3.2	17.4	3.48	4

Table 2: Varietal selection criteria and the average scores given by the agro pastoralists (n= 25). Note: performance scale given for varietal selection was 1-5 (5=excellent, 4=very good, 3=good, 2=poor, 1=very poor).

Conclusion and Recommendation

Three varieties (Tsedey, Boset and Kuncho) including local check were evaluated with the objective of selecting adaptable and best performing Tef variety with full participation of agro pastoralists. The experiment was carried out on three agro pastoralist Research Group (APRG) field for 2015 and 2016 cropping season in Wadera district. Agro Pastoral Research Group members were conducting research on Tef during production season. Agro Pastoral Research Group evaluate different types of Tef varieties on their land. Different phenology, growth and agronomic traits like plant height, number of tillering, panicle length, lodging and grain yield were considered by the researchers as evaluation criteria. The combined analysis of variance showed higher yield of Tsedey which is 17.67 quintal per hectare followed by Boset whereas lower grain yield was recorded by local check 9.65 quintals per hectare. Agro pastoralists' feedback assessment about the adaptability and performance of Tef were assessed. Accordingly, the demonstrated Tef varieties were adapted and showed good performance in agro pastoral area. Agro pastoralists' selection criteria for Tef varieties were market demand, lodging tolerance, grain yield and seed color. Based on their selection criteria, agro pastoralists selected Tsedey and Boset for grain yield, earliness and seed color. Since, both varieties were preferred by the agro pastoralists in the study

area they were recommended to further extension in the agro pastoral areas to increase Tef production and improve agro pastoral production.

References

1. Baye K (2014) Tef: nutrient composition and health benefits. The Ethiopia Strategy Support Program, International Food Policy Research Institute and Ethiopian Development Research Institute, Addis Ababa, 67: 1-18.
2. Refissa Leta (2012) Effects of sowing methods and fertilizer types on yield and yield components of tef (*Eragrostis tef*) at Guduru woreda, Western Oromia, Ethiopia. M.Sc. thesis, Haramaya University, Haramaya, Ethiopia.
3. Sida A (2017) Participatory Demonstration and Evaluation of Improved Variety of Tef in Selected Districts of West and Kellem Wollega Zones. *International Journal of Education, Culture and Society* 2: 143-146.
4. Seyfu Ketema (1997) Tef [*Eragrostis tef* (Zucc.) Trotter]. Promoting the conservation and use of underutilized and neglected crops. Biodiversity institute, Addis Ababa, Ethiopia.
5. Sharma JJ, Adera S (2016) Response of Tef [*Eragrostis tef* (Zucc.) Trotter] to Different Blended Fertilizer Rates on Vertisols in Jama District, Northeastern Ethiopia (Doctoral dissertation, Haramaya University).
6. Alaunyte I, Stojceska V, Plunkett A, Ainsworth P, Derbyshire E (2012) Improving the quality of nutrient-rich Tef (*Eragrostis tef*) breads by

-
- combination of enzymes in straight dough and sourdough breadmaking. *Journal of Cereal Science* 55: 22-30.
7. Kibatu G, Chacha R, Kiende R (2017) Determination of Major, Minor and Trace Elements in Tef Using Portable Total X-Ray Fluorescence (TXRF) Spectrometer". *EC Nutrition*, pp: 51-59.
 8. Central Statistical Agency (CSA) (2015) Agricultural Sample Survey Report on area and production of major crops, 1, Addis Ababa.
 9. Gurmu F (2013) Assessment of Farmers' Criteria for Common Bean Variety Selection: The case of Umbullo Watershed in Sidama Zone of the Southern Region of Ethiopia 5: 4-13.
 10. Mulu A, Gedebo A, Mohammed H (2016) Participatory Variety Evaluation of Red Common Bean (*Phaseolus vulgaris* L.) in Borecha District of Southern Ethiopia. *Advances in Crop Science and Technology* 5: 1-4.
 11. Gemechu F, Alemu G (2016) Participatory Demonstration of Improved Tef Variety in Habro and Oda Bultum Districts of West Hararghe Zone, Oromia Regional National State, Ethiopia. *International Journal of Agricultural Education and Extension*, 2: 44-47.
 12. Mehadi S, Beriso M, Worku Y (2016) Participatory variety selection of improved tomato (*Lycopersicum esculentum* Mill.) varieties in the lowlands of Bale, South-Eastern Ethiopia. *African Journal of Agricultural Economics and Rural Development* 4: 458-462.