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Adaptability Evaluation and Selection of Some Improved tef (Eragrostis tef (Zucc.) Trotter) Variety's in Bench Maji Zone South Western, Ethiopia

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Abstract
The experiment was conducted to identify, select and recommend adaptable, high yielding, Insect pest and disease resistant eleven released and one local variety at Bench Maji zone of SNNPR. Twelve varieties were evaluated in RCBD with three replication on station at South Bench, Guraferda and Sheko on main cropping season of 2015 and 2016. Analysis of variance revealed that except grain filling period at Guraferda woredathere were significant($p< 0.005$) differences among genotypes for culm length, panicle length, plant height, days to heading, days to maturity, grain filling period, primary panicle brunch, grain yield, biomass yield and harvest index at South Bench, Guraferda and Sheko. Based on the obtained result, three improved tef varieties namely;kora, Boset and Dukem at South Bench; Quncho, Gimbechu and Enatit at Guraferda and also Dukem, Quncho and Gimbechu at Sheko showed better performance for most of the studied characters including grain yield. Therefore, these three varieties were selected and recommended for the study area and similar ecologies of Bench Maji Zone.On the other hand Magna at South Bench, Degatef at Guraferda and local variety showed lowest grain yield.
Keywords: Adaptability, Grain yield Tef and varieties

Introduction

Tef *(Eragrostis tef (zucc.)Trotter*) is ancient and an important cereal crop in Ethiopia, where domestication took place before the birth of Christ (CSA, 2014).According to Stallknecht (1997), tef originated in Ethiopia around 4000-1000 BC.It was probably cultivated in Ethiopia even before the ancient introduction of emmer wheat and barley (TadesseEbba, 1975). The fact that several cultivated and wild species of *Eragrostis,* some of which are considered the wild relatives of tef, are found in Ethiopia and the genetic diversity existing in Ethiopia, indicates that tef originated and was domesticated in Ethiopia. Vavilov (1951) has identified Ethiopia as the center of origin and diversity of tef.

In Ethiopia; the five major cereals (tef, wheat, maize, sorghum and barley) occupy almost three-quarters of total area cultivated, and represent almost 70 percent of total value added in recent years (ATA, 2011). Tef is adaptable to a wide range of ecological conditions in altitudes ranging from near sea level to 3000 masl and even it can be grown in an environment unfavorable for most cereal, while the best performance occurs between 1100 and 2950 masl in Ethiopia (Hailu T,2000).

Tef is predominantly grown in Ethiopia as a food crop and not as a forage crop. However, when grown as a food, farmers highly value the straw of tef and it is stored and used as a very important source of animal feed, especially during the dry season. Farmers feed tef straw preferentially to lactating cows and working oxen. Cattle prefer tef straw to the straw of any other cereal and its price is higher than that of other cereals (Seyfu Ketema, 1997).

It is mainly produced in Amhara and Oromia, with smaller quantities in the Tigray and SNNP regions. However last 50 year's many research can done to improve tef in Ethiopia with a primary focus on yield but this con not include whole country; it is only few main tef producing area of the country. In southern nation nationalities and people of regional stat (SNNPR) there are eleven zones and eight special weredas that produce tef. But in south west part of Ethiopia at Bench Maji zone of the in South Bench, Guraferda and Sheko woreda tef cannot be produced and no research was under taken and hence, the adaptability trial of varieties was not takes placed.Therefore, the present study was conducted to evaluating andselecting adaptable, high yieldingimproved tef varieties forSouth Bench, Guraferda and Sheko woreda.

MATERIALS AND METHODS

Description of the study area

The experiment conducted at three locations of Bench Maji zone, namely South Bench, Guraferda and Sheko woreda during 2015 and 2016 main cropping season. The geographical study areas are characterized as semi tropical type with acidic nature of nitosol soil type. The average annual rain fall of the area is wet moist for most months of the year with relative dry season in end of December up to beginning of March.

Experimental materials

About 11 released tef varieties and one local that expected to perform better in the areas were used for this study.

The varieties are selected based on average yield performance and agro ecological adaptation. The verities were obtained from Debrezeyt Agricultural Research center.

Experimental Design

The experiment was laid out in RCBD with three replications and the plot size will be 2mx2m. The spacing was 1m between plots and 1.5m between adjacent blocks. Each genotype was sown at seed rate of 25 kg/ha by row planting.A recommended fertilizer rate 100kg/ha DAP and 53kg/ha ureawere applied.All other trial management activities were carried out asdeemed necessary.

Data collection

The following quantitative datawere recorded from field observation1):

a) Day from planting to heading
b) Days to maturity
c) Days to grain fill period
d) Culm length (cm)
e) Panicle length (cm)
f) Plant height (cm)
g) Number of primary branches per plant
h) Grain yield per plot (kg)
i) Biomass yield per plot (kg)
j) Harvest index (%)

$$\text{Harvest index (HI)} = \frac{\text{Seed yield/plot (kg)}}{\text{Total biological yield/plot (kg)}} \text{ X } 100$$

Statistical Analysis

The data was subjected to analysis of variance using SAS software v 9.1.3 (SAS, 2004). The significant difference among genotypes was tested by 'F' test at 1% and 5% levels of probability.

RESULTS AND DISCUSSION

The analysis of variance revealed that there were highly significant ($p<0.01$) difference among varieties for culm length, primary panicle brunch, grain yield, biomass yield and harvest index and significant (5%) different in panicle length, plant height, days to heading, days to maturity and grain filling period at South Bench. These results are further supported by Chondie YG, Bekele A (2017) who reported considerable variation in the days to maturity, plant height and panicle length, days to heading and grain yield of different tef varieties when planted over years. Similarly, AliyiKedir (2016) reported that significance differences between varieties for the characters like days to maturity, panicle length, plant height days to heading, days to maturity, grain yield. Grain yield of tested varieties at tested locations which was ranged from 496 Kg/ha (Magna) to 1955 Kg/ha (kora) with mean value of 1340 Kg/ha (Table 1). Korawas among the highest yielding cultivars followed Boset (1827 Kg/ha) and Dukem (1750 Kg/ha) however; statistically there is no significance difference. On the other hand lowest grain yield was recorded by Magna (490 Kg/ha) at South Bench. In agreement with the current study, AliyiKedir*et al.* 2016 reported that Boset, showed better performance for most of the studied characters including grain yield.

Table 1. Mean and Range values for different agronomic traits for 12 cultivars at South Bench in 2015 and 2016

		CL	PL	PH	DE	DH	DM	GFP	PPB	GY Kg/ha	BM	HI
Mean		58	32.48	90.48	5.39	72.12	113.27	41.15	21.64	1340	2.99	19.2
Range	*Max*	68.13	37.46	95.13	8	75.67	118.6	46.3	26.33	1955	5.1	33.23
	Min	50.83	25.86	82.03	3.67	68	109.3	36.3	15.8	496	2	6.44
DZ-Cr-354		57.5bcd	31.2bcd	88.7abc	5.0cd	73.0ab	114abc	41bcde	23.4ab	1424abc	3.4.0b	16.4bc
DZ-01-899		56.7bcde	30.9cd	87.6abc	5.3bcd	72.3abc	112.6bc	40.3bcde	24.3 ab	1230bc	3.3bc	14.8cd
DZ-01-196		61.8b	32.4abc	94.3a	5.6bc	73.0ab	109.3c	36.3e	16.9cd	490d	3.1bcd	6.4d
DZ-01-2675		50.8e	31.2bcd	82.0c	5.6bc	72.3abc	118.6a	46.3a	19.8bcd	1252bc	2.1cd	23.5b
DZ-Cr-438		68.1a	25.8d	94.0a	5.0cd	73.0ab	110c	37de	26.3a	1955a	5.1a	16bc
Ho-Cr-136		60.4b	32.6abc	93.06a	7.0ab	69.0cd	113.3bc	44.3ab	15.8d	960cd	2.0d	20bc
DZ-Cr-387		58.06bcd	37.0ab	95.1a	4.3cd	73.3ab	111.6c	38.3cde	25.5a	1620ab	2.8bcd	23bc
DZ-Cr-409		58.1bcd	33.7abc	91.9ab	4.6cd	68.0d	111.6c	43.6ab	22.6ab	1827a	2.23cd	33.2a
DZ-01-1285		52.5de	31.8abc	84.3bc	8.0a	75.6a	117.3ab	41.6abcd	16.4cd	1220bc	2.8bcd	18.4bc
1DZ-01-255		53.8cde	37.4a	91.2ab	3.6	71.0bcd	114abc	43abc	20.6bc	1040c	2.24cd	18.6bc
CV (%)		6.25	10.67	5.09	19.40	2.89	2.74	7.38	13.1	23.26	23.73	25.73

CL=Culm length, PL=panicle length, PH=plant height, DH=days to heading, DM =days to maturity, GFP=grain filling period, PPB=primary panicle brunch, GY=grain yield, BMY= biomass yield, HI=harvest index.Mean within a column followed by the same letter(s) within a column are not significantly different from each other at 5%.by DMRT

At Guraferda, the analysis of variance indicated that there were highly significant ($P<0.01$) difference among varieties in plant height, days to emergency, grain yield and biomass and significant ($P<0.05$) in culm length, panicle length, days to heading, days to maturity, primary panicle brunch, and harvest index. Grain filling period is only character that show non significance. Grain yield of tested varieties ranged from 950 Kg/ha (Degatef) to 1723 Kg/ha (Quncho) with mean value of 1279 Kg/ha. High grain yield was recorded by variety

Quncho1723 Kg/ha followed Gimbechu (1650 Kg/ha) and Enatit (1630 Kg/ha). However; there is no statically difference between them. Earlier workers also reported that Quncho and Gimbichu for its short maturity period and its higher grain yield for Hosanna areas relatively (Chondie YG, Bekele A., 2017). Lowest grain yield was recorded by Dega tef (950 Kg/ha) (Table 2).

At Sheko, the analysis of variance indicated that there were highly significant (P<0.01) difference among varietiesin culm length, plant height, days to emergency, days to heading, Panicle length and Grain filling period and significantly different in days to maturity, primary panicle brunch, grain yield, biomass yield and harvest index. A wide range of variability was recorded for grain yield among genotypes (table 3). It's ranged from 790 Kg/ha (local) to 1733 Kg/ha (Dukem) with mean value of 1130 Kg/ha. Dukem (1730 Kg/ha) followed Quncho (1380 Kg/ha) and Gimbechu (1380 Kg/ha) were among the highest yielding cultivars at Sheko(Table 3). Lowestgrain yield was recorded by local variety (791 Kg/ha). In agreement with the current finding, Chondie YG, Bekele A.,2017,reported that higher grain yield and easily adaptability Quncho and Gimbichu variety for Hosanna areas.

Table 2 Mean and Range values for different agronomic traits for 12 cultivars at Guraferda in 2015 and 2016

		CL	PL	PH	DE	DH	DM	GFP	PPB	GYKg/ha	BM	HI
Mean		57.4	31.8	89.2	5.3	68.83	101.75	32.91	20.19	1279	2.76	19.23
Range	*Max*	68.7	37.1	104.1	8	73.3	106	37.6	25	1723	3.8	26.4a
	Min	46.6	25.8	79.3	3.6	63.6	97.3	26.6	16.9	950	1.73	15.3
Local		51.5def	30.5bcde	82def	5.6b	73.3a	106.0a	32.6abc	18.6bcd	1220cd	2.2cd	22.1ab
DZ-Cr-354		46.6f	32.6abcd	79.3f	3.6e	68.6bc	103.6abc	35ab	22.1abc	1630ab	16.3ab	19.7bc
DZ-01-899		54.5def	28.6de	83.2def	4.6cd	68.6cb	100.3cd	31.6abc	18.5cd	1650a	16.5a	20.3bc
DZ-01-196		59.6bcd	30.8bcde	90.4bcd	5.6b	68.3bc	97.3d	29bc	18.3	1120cd	11.2cd	15.4c
DZ-01-2675		50ef	29.8cde	79.8ef	6.0b	67.3bcd	105ab	37.6a	16.9d	950d	1.94d	19.5bc
DZ-Cr-438		56.8cde	25.8e	82.6def	4.3de	69.6abc	101.3bcd	31.6abc	25a	1330bc	3.4ab	15.5c
Ho-Cr-136		56.8cde	31.9bcd	88.7cde	7.3a	69.3ab	104.3abc	35ab	19.2bcd	1150cd	2.08d	22.1ab
DZ-Cr-387		68.7a	35.4ab	104.1a	5.3bc	71.3ab	98cd	26.6c	21.9abc	1720a	3.8a	18.2bc
DZ-Cr-409		58.1bcd	34.7ab	92.8bc	4.6cd	65.6cd	97.6d	32abc	19.8bcd	1180cd	2.9b	16.03bc
DZ-01-1285		65.2ab	31.6bcd	96.8abc	8.0a	71ab	103abc	32abc	17.2d	1050cd	1.73d	26.4a
1DZ-01-255		61.1bc	37.1a	98.2ab	3.6e	63.6d	100.3cd	36.6a	21.6abc	1220cd	3.1ab	15.3
CV (%)		6.55	9.38	6.21	10.71	3.61	2.59	13.05	12.47	14.15	14.7	18.69

CL=Culm length, PL=panicle length, PH=plant height, DH=days to heading, DM =days to maturity, GFP=grain filling period, PPB=primary panicle brunch, GY=grain yield, BMY= biomass yield, HI=harvest index. Mean within a column followed by the same letter(s) within a column are not significantly different from each other at 5%.by DMRT

Table 3.Analysis of variance for different characters of tef germplasm.studied at Sheko

		CL	PL	PH	DE	DH	DM	GFP	PPB	GY Kg/ha	BM	HI
Mean		62.5	32.12	94.63	4.72	68.52	113.13	44.61	21.74	12.79	2.75	16.82
Range	*Max*	74.73	38.8	111.8	7.67	75.3	119.3	104.3	25.8	17.23	4.33	24.2
	Min	51.6	25.8	84.3	3.67	56	104.3	34	18.2	9.5	1.63	10.58
Local		56.5efg	30.5cde	87.0ef	4d	70cde	115.6ab	45.6b	18.2d	12.2cd	2.6bcd	10.6c
DZ-Cr-354		51.6g	32.6bcd	84.3f	3.6d	56g	114.6abc	58.6a	23.1abc	16.3ab	16.3ab	16.1bc
DZ-01-899		59.5def	28.6de	88.2def	d4d	67.3e	110.6bcd	43.3b	25.6a	16.5a	16.5a	15.9bc
DZ-01-196		64.6bcd	30.8cde	95.4bcde	4d	70.6cde	113abc	42.3	20.7abc	11.2cd	11.2cd	21.5ab
DZ-01-2675		55.0fg	29.8cde	84.8	5bc	62.6f	104.3d	41.6b	21.4abcd	9.5d	9.5d	24.3a
DZ-Cr-438		63.1cde	25.8de	87.6ef	4d	70.cde	114.3abc	44.3b	24.3ab	13.3bc	13.3bc	12.7c
Ho-Cr-136		63.1cde	31.9bcd	93.7cdef	7.6a	63f	119.3a	56.3a	20.2bcd	11.5cd	11.5cd	20.2ab
DZ-Cr-387		74.7a	37.0ab	111.8a	4d	75.3a	114abc	38.6bc	22.9abcd	17.2a	17.2a	20.5ab
DZ-Cr-409		63.1cd	34.7abc	97.8bcd	4.6cd	68de	110.6bcd	42.6b	18.2d	11.8cd	11.8cd	17.5abc
DZ-01-1285		70.2ab	31.6bcd	101.8bc	7ab	71.3bcd	113.6abc	42.3b	18.9cd	10.5cd	10.5cd	15bc
1DZ-01-255		66.1bc	38.8a	104.9ab	4d	75ab	109cd	34.c	21.3abcd	12.2cd	12.2cd	12.4c
DZ-Cr-974		64.8bcd	33bcd	97.8bcd	3.6d	73abc	118.3a	45.3b	25.8a	11.1cd	11.1cd	15.4bc
CV%		6	10.38	6.11	20.16	3.22	3.36	9.86	12.94	23.13	3.24	24.07

CL=Culm length, PL=panicle length, PH=plant height, DH=days to heading, DM =days to maturity, GFP=grain filling period, PPB=primary panicle brunch, GY=grain yield, BMY= biomass yield, HI=harvest index. Mean within a column followed by the same letter(s) within a column are not significantly different from each other at 5%.by DMRT, CV=coefficient of variation.

Conclusions and Recommendation

The tef adaptation trial was conducted at three locations representing mid- land agro-ecologies of Bench Maji Zone, SNNPR 2015 and 16 cropping season to evaluate and select adaptable, high yielding, early maturing ,diseases resistant varieties. Grain yield is an important character to be considered for variety selection to address the objective of the conducted activity. For this reason, three improved varieties i.e.kora, Boset and Dukem at South Bench; Quncho, Gimbechu and Enatit at Guraferda and also Dukem, Qunchoand Gimbechu at Sheko showed better performance for most of the studied characters including grain yield. Therefore, these three varieties were selected and recommended for the study area and similar ecologies of Bench Maji Zone.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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