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Eragrostis tef *Tesfa*

Worku Kebede[1], Kidist Tolossa[1], Nigussu Hussein[1], Tsion Fikre[1], Yazachew Genet[1], Abate Bekele[1], Kidu Gebremeskel[2], Atinkut Fentahun[3], Habte Jifar[4], Sonia Plaza-Wüthrich[5], Regula Blösch[5], Solomon Chanyalew[1], Kebebew Assefa[1], and Zerihun Tadele[5]

[1]Ethiopian Agricultural Research Institute, DebreZeit Agricultural Research Center, P.O. Box 32, DebreZeit, Ethiopia; [2]Tigray Agricultural Research Institute, Axsum Agricultural Research Center, P.O. Box 230 Axum, Ethiopia; [3]Amhara Regional Agricultural Research Institute, Adet Agricultural Research Center, P.O. Box 8, Bahir Dar, Ethiopia; [4]Ethiopian Institute of Agricultural Research, Holetta Agricultural Research Center, P.O. Box 31 Holetta, Ethiopia; [5]University of Bern, Institute of Plant Sciences, Altenbergrain 21, CH-3013 Bern, Switzerland

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ጤፍ በኢትዮጵያ ከሚመረቱ የብርዕና አገዳ ሰብሎች ዋናው ሲሆን በየዓመቱ ቁጥር ከ ሚሊዮን የማያንስ አርሶ አደር ያመርተዋል። ይህም አጠቃላይ በብርዕና አገዳ ሰብሎች ከሚሸፈነው ማሳ ድርሻ አለው። ይሁን እንጂ ከሌሎች ሰብሎች ጋር ሲነፃፀር ምርታማነቱ አነስተኛ ነው። ለዚህም ምክንያቱ በከፊል አርሶ አደሩ ያልተሻሻሉ የአካባቢ ዝርያዎችን በመጠቀሙና፣ የሰብሉ ተፈጥሯዊ የመጋሸብ ባህሪ ናቸው። የዚህ ጥናት ዓላማ በተለየ ምርምር አሰራር የተገኘን የጤፍ ዝርያን በመፈተሽ የተሻለ ምርት፣ የአገዳ ጥንካሬን አንዲሁም የዘር ቀለም ያለውና በአርሶ አደሩ ተመራጭ ዝርያ ማፍለቅ ነበር። በጥናቱ በቅርቡ የተለቀቀ አንድ ዝርያና አንድ የአካባቢ ዝርያን ጨምሮ የተለያዩ የጤፍ አይነቴዎችን በማካተት በሰድስት ወካይ ቦታዎች ላይ ተፈትሸው ተሰፉ ደዘ ከሮሰ ተብሎ የተሰየመውና የተለያዩ የጤፍ አይነቴዎች ተዳቅለው የተገኘው ዝርያ ከሌሎች ማወዳደሪያ ተፈታሽ ዝርያዎች የተሻለ ውጤት በማስመዝገቡ በብሄራዊ የዝርያ አፅዳቂ ኮሚቴ ተገምግሞ ለምርት እንዲለቀቅ ተወስኗል። ይህ ዝርያ ከሌሎች ዝርያዎች በንፅፅር መጋሸብን በመቋቋሙ፣ የተሻለ ምርት በመስጠቱ በአርሶአደሩ ተፈላጊ ከመሆኑም በላይ ከዘርያው ባህሪ የተነሳ ለመስኖ አርሻና በሰብል መድረሻ ጊዜ የማጨጃ የአርሻ መሳሪያ መጠቀም ያስችላል።

Tef, (Zucc.) Trotter, is a member of the Grass or Poaceae Family and Chlorodoideae sub-family Tef is an allotetraploid (2n=4x=40) with estimated genome size ranging from 648 to 926Mbp(Ayele ., 1996; Hundera ., 2000), which isapproximately60% larger than the rice genome.It is a self-pollinated with very low degree of out-crossing, that ranges from 0.2% to 1.0% (Ketema, 1997). Tef represents a unique biodiversity component in the agriculture and food security systems of millions of poor farmers in Ethiopia. In Ethiopia, tef is the most valuable source of human food (the grain) and livestock feed (the straw), cash and foreign currency earnings. It ranks first in terms of total area under cultivation where it accounts for 30% of the total acreage under cereal crops (CSA, 2015).Tef is also known to be tolerant to extreme climatic and soil conditions; hence, it is a favorite crop in the semi-arid areas with moisture limitations(Tadele and Assefa, 2012).In recent years, tef is receiving global attention for its nutritional and health-related benefits (Provost and Jobson, 2014) especially due to the absence of gluten, acause for celiac disease,in its grain (Spaenij-Dekking , 2005).

Despite its versatility in adapting to adverse environmental conditions and being the staple food over 60 million people in Ethiopia, the seed yield of tef is low. The national average yield is 1.57 t ha^{-1}, in contrast to 2.5 t ha^{-1} for wheat and 3.4 t ha^{-1} for maize(CSA, 2015). A major cause of low productivity of tef is lodging, the permanent displacement of the stem from the upright position. Tef has a tall and slender stem, which is susceptible to lodging caused by wind and rain. In addition, when fertilizer is applied to increase yield, stems of tef grow taller and become even more susceptible to lodging, resulting in significantly reduced quantity and quality of grain and straw. Lodging is most likely to occur when tillers have a high center of gravity and a heavy, high yielding panicle (Cheverton ., 1992). On the average, the tef yield loss due to lodging was estimated to be 11-25%(Ketema, 1993).

Since scientific research started on tef five decades ago, 42 varieties were released mainly by DebreZeit Agricultural Research Center (MoANR, 2017). Among these, recently released varieties including (Assefa , 2011), (Assefa ., 2017) and (Chanyalew ., 2017) showed significant yield benefits. This paper presents the performance of the recently released tef variety called comparing with other candidate genotypes and standard variety. In addition, the paper describes morphological and agronomic properties of the new variety.

Theexperimentwas carriedoutat six locations in Ethiopia where tef is the major crop. These locations are Adet, ChefeDonsa, DebreZeit black soil, DebreZeit light soil, Ginchi and Holetta. Details of the six locations in terms of altitude, climate other related parametersare shown in Table 1.

Table 1. The altitude, coordinates and climate of six locations in Ethiopia where candidate tef lines were tested

Location	Altitude (m)	Geographic coordinate	Climate	Average temperature (Max./min.)	Annual rainfall (mm)
Adet	2240	11°16'0"N, 37°29'0"E	Moist-cool	24°C/9°C	658.6
Chefe Donsa	2450	8°57'15"N,39°06'04"E	Cool-wet	23.2°C/10.5°C	950
Debre Zeit black soil	1800	8°45'0"N, 38°59'0"E	Temperate	26.1°C/8°C	892
Debre Zeit light soil	1800	8°45'0"N, 38°59'0"E	Temperate	26.1°C/8°C	892
Ginchi	2236	9°1'60"N, 38°9'0"E	Moist-cool	24.6°C/8.4°C	1095
Holetta	2390	9°06'33"N, 38°49'02"E	Cool-wet	22°C/6°C	1144

The source of experimental materials were two dwarf mutant tef lines, namely (Jost ., 2015) and (Tadele . unpublished), which were identified at the University of Bern in Switzerland fromscreening 5000 mutagenized tef populations. The other parental lines were a popular tef variety called (DZ-Cr-387 RIL355) (Assefa ., 2011)and a landrace called . was selected as a paternal parent for its very white seed color, thick culm and vigorous growth habit. The eight recombinant inbred lines used in the current study were obtained from three independent crosses.Thethree independent crosses were, x (lines 2 to 6), x (line 7) and x (lines 8 and 9). From each cross, 500 F_2 populations were generated and substantially reduced to few lines with best performance after eight generations of stringent selection focusing on standing ability and grain yield. Crossing and early generation testing were done for all breeding population at Debre Zeit Agricultural Research Center from where the National Tef Breeding Program is coordinated. The crossing combinations and names of recombinant inbred lines as well as control materials used in the current study are shown in Table 2.

The performance of 10 tef genotypes which includes 8 inberd lines from the three independent crosses to semi-dwarf tef lines as well as two controls (farmers' check and improved variety were tested at six locations(Adet, Chefe Donsa, Debre Zeit black soil, Debre Zeit light soil, Ginchi and Holetta) using Randomized Complete Block Design with three replications. Agronomic and yield data were collected and subjected to statistical analysis in order to identify the best genotypes of the evaluated genotypes. Summary of the results of the study is shown in Table 2 and below under variety description.

Based on a two-year multi-location trial, RIL181 was selected for its high grain and biomass yield as well as additional traits indicated below. Hence, RIL 181 was given the name and applied for registration as a new improved tef variety. Based on the application, the National Variety Release Committee in Ethiopia investigated the two-year performance of RIL 181 and visited several locations where the new variety was grown for evaluation. Consequently, the committee approved the release of RIL 181 as a new variety with the name ‘ ’.

Table 2. Combined mean agronomic performance of candidate tef lines at the National variety Trial at Adet, Chefe Donsa, Debre Zeit black soil, Debre Zeit light soil, Ginchi and Holetta

Candidate line	Genotypes	DTH	DTM	GFP	PH	PL	LI	SMB/HA	GY/HA
Quncho	DZ-Cr-387 (control)	54.3	105.2	50.9	104.8	40.5	80.0	11604.2	2420.9
RIL-227	*kinde*x Kay Murri	48.2	103.2	55.0	90.4	32.5	78.1	9562.5	2198.3
RIL-181	***Kinde* x Kay Murri**	**47.1**	**103.0**	**55.9**	**91.4**	**35.2**	**78.6**	**10500.0**	**2443.7**
RIL-110	*Kinde*x Kay Murri	50.8	103.2	52.4	88.5	33.6	79.7	9645.8	2233.8
RIL-232	*Kinde*x Kay Murri	47.7	103.9	56.2	87.2	29.3	76.5	8994.8	2137.5
RIL-237	*Kinde*x Kay Murri	49.3	104.2	55.0	93.0	32.8	74.0	8729.2	1958.2
RIL-195	KayMurrix *kegne*	50.8	104.4	53.5	94.2	35.8	77.3	10802.1	2289.6
RIL-171	*Qunchox kinde*)	48.5	103.5	55.0	93.0	33.8	79.2	9822.9	2342.3
RIL-189	*Qunchox kinde*	50.5	103.6	53.1	96.3	36.1	78.8	9484.4	2097.8
Local check		47.0	101.3	54.4	89.0	33.9	84.4	10380.2	2364.4
	Mean	49.4	103.5	54.1	92.8	34.3	78.7	9952.6	2248.7
	R^2	**0.98**	**0.98**	**0.93**	**0.84**	**0.77**	**0.77**	**0.84**	**0.68**
	CV	**3.1**	**2.1**	**4.8**	**5.0**	**6.7**	**8.0**	**11.7**	**14.9**
	LSD(0.05)	**0.8**	**1.2**	**1.5**	**2.6**	**1.3**	**3.6**	**666.78**	**191.86**

Abbreviations. DTH: days to heading; DTM: days to physiological maturity; GFP: grain filling period; PH: plant height; PL: panicle length; LI: lodging index; SBM: shoot biomass; GY: grain yield.

In general, tef variety had above average yield and the variety with non-shattering type, thick culm, and compact panicle form which makes it suitable for both rainfed and irrigated agriculture. is the first variety with compact panicle to be released by tef researchers in Ethiopia while all other 41 tef varieties released in the country are with loose or semi-loose panicle type.

The new tef variety named (DZ-Cr-457 RIL-181) is the product of a cross between a semi-dwarf mutant line called and a landrace called isa medium size plant with compact panicle type (**Fig. 1**). Other distinct characters of are pinklemma color, red anther color, and a very white seed color. On the average, reaches the heading stage in 47 days and physiological maturity in 103 days after sowing. From the average plant height of 91 cm, the panicle of contributes to 40%.

Figure 1. The newly released Tesfa tef variety grown at DebreZeit Research Center, Ethiopia. Photo: Zerihun Tadele.

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