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PHENOTYPIC PERFORMANCE EVALUATION OF IMPROVED TEF (*Eragrostis tef L*) GENOTYPES IN NORTH GONDAR

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ABSTRACT

Ten improved tef varieties including the local check were evaluated with the objective of selecting adaptable and best performing tef varieties in North Gondar. The trial was conducted at Takusa and Gondar Zuria woredas of north Gondar zone of Amhara region during 2017 cropping season. The design was randomized complete block design with three replications. In Takusa, the mean grain yield of some improved varieties was higher than the local check. Varieties Dz-01-974 and Quncho gave the highest yield, (3226kg/ha) and (2944.3kg/ha) respectively. Similarly in Gondar Zuria woreda, some improved varieties were relatively better than the local check and variety Dz-01-974 and Quncho gave the highest yield (2449.3kg/ha) and (2084kg/ha) respectively. The yield in Gondar Zuria was relatively lower than Takusa woreda. This may be due to the fact that Gondar Zuria woreda is characterized by terminal moisture stress. Generally the combined analysis over location revealed that varieties Dz-01-974 and Quncho gave the highest yield and no significant difference observed among varieties in their maturity period and relatively higher yield. Therefore Dz-01-974 and Quncho were recommended for their high yielding potential and farmer's preference with their production packages. These two varieties were recommended for production in Gondar Zuria, Takusa and similar agro ecologies.

Contribution/Originality: This work investigates the impact of genotype choice for climate change adaptation and for farmers resilient to climate variability.

1. INTRODUCTION

Tef (Eragrostis tef /zucc. /Trotter) is originated in Ethiopia and it's diversity is in Ethiopia [1]. It is a staple food crop covering a large area of arable land (32% of the total cultivated land) [2]. It is adapted to various agro ecologies of the country. It can grow well in areas where production of other cereals is difficult. Its grain provides about two-thirds of the daily dietary protein intakes of most Ethiopians [2].

It has the ability to tolerate drought and water lodging. The resistance of tef to storage insects makes it a valuable crop under adverse situations. It has a multitude of uses other than its use as Ethiopians staple food injera. It is also used for preparation of local beverages. The straw is the most preferred feed for livestock. Being the first preference of Ethiopians for food, and livestock for feed, it fetches premium prices on market [3-5]. However, the grain yield of the current genotypes in Amhara region (900.1 kg/ha) is below the national average yield of tef (1700 kg/ha) on farmer fields [6].

Currently productivity of tef under farmers' condition is very low. Hence, developing improved varieties which are relatively high yielding and early maturing than the existing local cultivars has been one of the priorities given due emphasis.

Tef, *Eragrostis tef* /zucc. /Trotter, belonging to the grass family *poaceae*, is one of a significant cereal crop in only one country in the world-Ethiopia [2]. Its grain provides about two-thirds of the daily dietary protein intakes of most Ethiopians. It is one of the most important cereal crops in Ethiopia that occupies (32%), the largest cultivated area under cereals and 26% of the whole area cultivated to annual field crops by covering about 2 million hectares of land annually [6]. Tef is adapted to environments ranging from drought stress to water logged soil conditions. It can be grown at altitude ranging from sea level to 3000m above sea level, with the maximum production occurs between1700 and 2400m.

Even though research efforts in the last few decades developed important genotypes to develop high yielding varieties, its productivity and farmers accesses to these improved genotypes is limited. Development of improved variety and appropriate agronomic practices, and cropping systems would greatly contribute to overcoming production constraints and improving productivity of tef [7]. Therefore, this experiment was conducted with the objective of evaluating and selecting improved tef varieties for their adaptability, and to select relatively high yielding and early maturing varieties and increasing farmers' awareness and their access to improved tef varieties.

2. MATERIALS AND METHODS

2.1. Area Description

Gondar Zuria: The experiment was conducted on the farmers' field. The trial site was located between latitude 120 25' 14.9" N and longitude 0370 36' 18.5" E at an elevation of 2104 meters above sea level. It has a moist tropical climate and the mean monthly maximum temperature ranges from 25.3 °C to 32 °C with a mean value of 28.5°C, while the mean monthly minimum temperature ranges from 10.6 °C to 16.1 °C with a mean of 13.6 °C. Based on 20 years (2005-2015) data, the total annual rainfall ranges from 641 mm to 1678 mm with an average of 1052 mm. Farmers reported that the rainfall is decreasing year after year, unpredictable in onset and with erratic distribution. This nature of the rainfall is heavily influencing crop production and livestock husbandry and thus farmers' livelihood.

Takusa: The temperature was ranged from 8.2-19.160c. The trial at site was located at an elevation of 1785 meters above sea level with latitude 12°12′N 37°03′E and longitude 12°12′N 37°03′E.

2.2. Research Methodology

Ten improved varieties namely, DZ-D1-787, DZ-D1-354, DZ-Cr-387, DZ-Cr-358, DZ-D1-99, DZ-D1-974, Etsub, Yilmana, Quncho and Local variety were included in the study. It was conducted in 2015. The trial was laid down in randomized complete block design with three replications. Each experimental plot had three meter by seven meter with a gross area of 21 m^2. Planting was done by broadcasting at seed rate of 25 kg ha^{-1}. Fertilizer was applied at the rate of 41/46 kg/ha N and P_2O_5 respectively. Half of the total nitrogen and total phosphorus were applied at the time of planting while the remaining nitrogen was applied at the time of tillering. Breeding data plant height, panicle length, days to maturity and grain yield were taken from the net plot. Weeding and other management practices were done as required. Farmers were invited to set their selection criteria and to select best performing varieties based on their selection criteria. Analysis of variance was computed using the SAS statistical software –SAS version 2004.

3. RESULT AND DISCUSSION

In Takusa, The analysis of variance revealed that there was no significant ($p<0.05$) difference among varieties in parameters plant height and panicle length but significant difference was observed in parameters maturity date

and grain yield. Variety DZ-D1- 787 matured early (around 102 days) and variety DZ-D1-974 matured relatively longer period (around 109 days). Variety DZ-D1-974 is the high yielder variety than the others (3226 kg/ha) whereas variety DZ-D1-787 is the low yielder variety (1996 kg/ha) Table 1. This was in agreement with Assefa, et al. [2].

In Gonder Zuria, the analysis of variance revealed that there was a significant difference among varieties in all parameters. Variety DZ-Cr-358 is the shortest among all varieties which is not preferred to farmers due to its low straw and variety DZ-D1-974 is the tallest variety with relatively resistant to lodging and preferred by farmers due its high straw biomass. DZ-D1-974 had also the longest panicle and high grain yield. DZ-D1-787 was the earliest variety (around 100 days) whereas DZ-D1-974 was relatively late (112 days) compared to others. General speaking all varieties are relatively early maturing which fits to the current climate change. The highest grain yield was due to DZ-D1-974 (2449 kg/ha) and the lowest was due to DZ-D1-787(1447.3 kg/ha) Table 2.

Table-1. Mean values of yield and yield related traits of improved tef varieties during 2017 main season at the vertisols of Takusa woreda (Mekonta kebele), North Gondar.

Varieties	Plant height (cm)	Panicle length (cm)	Days to maturity	Grain yield (kg/ha)
DZ-D1-974	118.5	58.7	109.0^{a}	3226.0^{a}
DZ-Cr-358	107.5	57.3	102.3^{bc}	2036.5^{b}
DZ-Cr-387	110.5	58.0	106.7^{abc}	2159.0^{b}
DZ-D1-354	111.5	58.0	106.7^{abc}	2241.7^{b}
DZ-D1-787	103.2	57.0	101.7^{c}	1996.0^{b}
DZ-D1-99	110.1	57.7	106.0^{abc}	2088.7^{b}
Etsub	116.7	58.3	107.7^{abc}	2303.0^{b}
Local	118.5	58.3	108.3^{ab}	2277.3^{b}
Quncho	111.9	58.3	107.0^{abc}	2944.3^{a}
Yilmana	108.4	57.3	103.3^{abc}	2053.0^{b}
Mean	111.7	46.3	106	2332.5
CV	10.5	13.2	3.6	9.62
Lsd	20.1	10.5	7	385

Table-2. Mean values of yield and yield related traits of improved tef varieties during 2017 main season at the vertisols of Gondar Zuria woreda (Das Dinzaz kebele), North Gondar.

Varieties	Plant height (cm)	Panicle length (cm)	Days to maturity	Grain yield (kg/ha)
DZ-D1-974	85.7^{a}	38.7^{a}	110.7^{a}	2449.3^{a}
DZ-Cr-358	66.3^{c}	30.1^{cd}	100.0^{c}	1630.7^{de}
DZ-Cr-387	76.8^{abc}	32.9^{abc}	104.0^{bc}	1784.3^{cd}
DZ-D1-354	77.0^{abc}	34.5^{abc}	104.0^{bc}	1820.3^{cd}
DZ-D1-787	65.9^{c}	25.4^{d}	99.3^{c}	1447.3^{e}
DZ-D1-99	71.7^{abc}	31.6^{bc}	102.7^{bc}	1661.0^{cde}
Etsub	81.5^{ab}	35.7^{abc}	105.0^{b}	2084.0^{b}
Local	82.2^{ab}	36.4^{ab}	105.0^{b}	1891.0^{bc}
Quncho	77.5^{abc}	34.7^{abc}	105.0^{b}	2085.3^{b}
Yilmana	70.5^{bc}	30.1^{cd}	101.7^{bc}	1649.3^{cde}
Mean	75.52	33	104	1850
CV	11.11	10.29	2.68	8.11
Lsd	14.4	5.8	5	257

3.1. Variety Evaluation Methods

Two major approaches were used to deliver the varieties with their full packages and to evaluate their performance on the field condition. This was done by giving training and conducting field visit at different stages of the crop growth. Field day was organized at the vegetative growth and maturity stage of the crop to see and evaluate the new varieties with local variety. Similar approach was used by Bänziger, et al. [8] on maize.

Training was given for small holder farmers and development agents on the tef production methods (including seed bed preparation methods, the use of appropriate seed rate, fertilizer rate and application of herbicides and pesticides). The trainees consisted of a total of 60 farmers (30 from each woreda), 10 development agents and 6 subject matter specialists. Among the participant farmers 42 of them were male and 18 were female.

Field day was organized on Mekonta kebele of Takusa woreda and Das Dinzaz kebele of Gondar Zuria woreda on different dates so that farmers of each kebele could be able to exchange for field visit. Similar approaches were used by Ayalew [9].

Table-3. The combined mean values of yield and yield related traits of improved tef varieties in the vertisols of North Gondar combined over location.

Varieties	Plant height (cm)	Panicle length (cm)	Days to maturity	Grain yield (kg/ha)
DZ-D1-974	97.6	42.2	104.3^{ab}	2523.2^{a}
DZ-Cr-358	86.9	37.8	105.2^{ab}	1918.7^{cd}
DZ-Cr-387	98.1	42.6	103.3^{ab}	1966.8^{bc}
DZ-D1-354	94.5	39.4	103.7^{ab}	1910.0^{cd}
DZ-D1-787	92.7	37.6	107^{ab}	1721.7^{cd}
DZ-D1-99	90.9	38.9	106.5^{ab}	2084.2^{bc}
Etsub	96.8	42.6	106.7^{ab}	2060.3^{bc}
Local	92.2	36.8	105.5^{ab}	1869.0^{cd}
Quncho	96.7	41.4	103^{b}	2696.8^{a}
Yilmana	89.4	37.0	102.8^{b}	2163.5^{b}
Mean	93.6	39.6	104.8	2091.40
Var*location	**	**	**	**
CV	11.4	13.1	3.16	8.9

3.2. Farmers' Preference on the Varieties

Farmers have broad knowledge base about their environment, crop behavior and cropping systems developed from many years of experience. They are able to examine among different treatments and generate innovation even though they lack control of treatment for comparison and statistical tools to test the hypothesis [8].

Tef is the most preferred crop due to its peculiar features which make it a preferred crop among farmers [10]. Farmers' selection criteria were grain yield, seed color and lodging resistance. Based on their selection criteria, in both Woredas, DZ-D1-974 (for its good stand and high yield) and Quncho (for its yield and lodging resistance) were selected by farmers respectively. Both varieties were white seeded in color and more preferable for market.

4. CONCLUSION

Ten varieties namely, DZ-D1-787, DZ-D1-354, DZ-Cr-387, DZ-Cr-358, DZ-D1-99, DZ-D1-974, Etsub, Yilmana, Quncho and local variety were evaluated with the objective of selecting adaptable and best performing tef variety with farmers' participation. It was carried out in two woredas (districts) (Takusa and Gondar Zuria). Different agronomic parameters were recorded and varieties were compared by grain yield, seed color and lodging resistance as evaluation criteria.

DZ-D1-974 showed outstanding performance in both Takusa and Gonder zuria woredas in the current broad casting planting method. The varieties showed earliness behavior in both areas which is around 103 days and 106 days to mature for Gonder zuria and Takusa woredas respectively. These varieties could give higher yield when planted in rows and transplanting and should be confirmed by research.

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