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EVALUATION OF IMPROVED VARIETIES OF TEFF IN WEST BELESSA, NORTHWEST ETHIOPIA

Daniel Tadesse[1]† --- Teferi Alem[2] --- Tesfaye Wossen[3]
[1,2,3]Department of Plant Sciences, College of Agriculture and Rural Transformation, University of Gondar, Ethiopia

ABSTRACT

An experiment was conducted at West Belessa district of Northwestern Ethiopia during 2013 main cropping season in order to identify and promote well adapted and promising genotypes of teff. The experiment was laid out in a randomized complete block design with three replications. The data recorded were plant height, spike length, number of tillers per plant, grain yield, biomass yield and harvest index. The data was analyzed using SAS software and means were separated using least significant difference. The analysis showed that varieties varied significantly for plant height, spike length ($P<0.001$), grain yield, biomass yield ($P<0.01$) and harvest index ($P<0.05$). Varieties were not significant for number of tillers per plant. Dukem was shown to be high yielder variety followed by the varieties Boset and Mechare with the values of 1963.7, 1772.0 and 1743.7 kg ha^{-1}, respectively. The varieties Dukem, Kuncho and Mechare were found to be having high biomass with the values of 6111.3, 5833.3 and 5555.3 kg ha^{-1}, respectively. Dukem was superior in almost all the agronomic traits evaluated while the local varieties Awra tef and Bunign were out performed by most of the improved varieties of teff tested. The varieties evaluated had a wide genetic background for the studied traits, thus showing grain yield ranges from 1012.0 to 1963.7 kg ha^{-1}. Therefore, based on objectively measured traits, the variety Dukem was found most promising having the potential to increase the average yield of tef in West Belessa district and is therefore recommended for general cultivation.

Keywords: Teff, Variety, Grain yield, West Belessa, Dukem, Evaluation.

Contribution/ Originality

This study is one of the very few studies which have evaluated improved varieties of teff in moisture stress areas in Ethiopia in general and West Belessa in particular. The study has evaluated fourteen varieties by scientifically comparing them with very important traits and come up with valid conclusion.

† Corresponding author

1. INTRODUCTION

Teff [*Eragrostis tef* (Zucc.) Trotter] is the most important and indigenous cereal crop of Ethiopia. Its production area is increasing due to increased local and foreign market- demand and currently the area covered by tef is about 2.76 hectares [1]. It can be grown in altitudes ranging from near sea level to 3000ms, but the best performance occurs between 1100 and 2950ms [2]. Ethiopia is the only country in the world that grows tef as a staple food crop [3]. During drought years when food scarcity prevails, tef could be harvested and used for food in Ethiopia [4]. The importance of tef straw has been also becoming as equally important as its grain yield as it is preferred for animal feed during dry period and as it is sold at reasonable price locally for the same purpose or for plastering of non-cemented houses. Farmers prefer varieties having larger biomass and give quite good yield.

Since the beginning of the tef improvement research, many varieties have been developed for different agro-ecologies by the research institutes of the country. However, most of these varieties have not been promoted and utilized by farmers, particularly in this moisture stressed and inaccessible area. Some of the reasons for this low adoption of improved varieties, as mentioned by Chilot, et al. [5] is the traditional top-down research and development processes without the participation of the ultimate users, the farmers as well as the inaccessibility of improved varieties to the farmer community. Therefore, evaluation of tef released varieties with farmers in our conditions is a short cut way to identify and promote well adapted and promising genotypes.

2. MATERIALS AND METHODS

The reported experiment was conducted at West Belessa district on the experimental station of University of Gondar, Northwestern Ethiopia. The experimental material comprised of fourteen varieties including two standard checks and two local checks obtained from Debrezeit Agricultural Research Center (DARC). The genotypes were planted during the main rainy season of 2013 in a well prepared soil under randomized complete block design with three replications. Row planting with spacing of 0.2m between rows was used on a plot size of 3m x 1.2m. Six rows of teff per plot were planted and the middle four rows were used for data collection and analysis. The spacing between adjacent plots and blocks were 0.2m and 1.5m respectively. Seed rate of 15kg/ha and fertilizer rate of 50kg/ha Urea and 100kg/ha DAP was used. Half of the Urea was applied at the time of sowing and the rest half was applied at tillering stage (top-dressing). Standard cultural practices were followed from sowing till harvesting during the entire crop season. Data was recorded on five competitive plants from the middle rows of each plot for yield related traits viz; plant height (cm), spike length (No.) and number of tillers per plant (No.) while grain yield (kg ha^{1}) and biomass yield (kg ha^{-1}) were recorded by harvesting all the middle four rows per plot. Harvest index was computed by dividing grain yield with biomass yield. The data were subject to the analysis of variance of techniques using SAS software packages [6] wherein means were compared using least significant difference at 5% levels.

3. RESULTS AND DISCUSSION

Analysis of variance (Table 1) indicated that the genotypic mean square values were significant for five of the six agronomic traits recorded, implying that the varieties tested were highly variable. Most of the characters except plant height and tiller per plant showed no significant differences due to environmental effects (replication). The coefficient of variation ranged from 10.56% for biomass yield (kg ha^{-1}) to 21.5% for harvest index.

Table-1. Mean squares values and coefficient of variations for agronomic traits of tef

Source of Variation	Mean Square						
	DF.	Plant height (cm)	Spike length (cm)	Number of tiller per plant	Grain yield (kg ha^{-1})	Biomass yield (kg ha^{-1})	Harvest Index
Replication	2	602.95^{**}	25.02^{NS}	15.03^{*}	163904.86^{NS}	425648.17^{NS}	0.0022^{NS}
Varieties	13	434.50^{***}	104.98^{***}	2.35^{NS}	243361.93^{**}	914471.02^{**}	0.0091^{*}
Error	26	91.67	23.66	2.76	64811.55	287781.40	0.0036
CV (%)		10.86	12.71	15.77	17.96	10.56	21.50

Note: ***, **, * denote effects significant at 0.1%, 1% and 5% respectively *while NS showed non significant variation.*

All varieties showed highly significant difference ($p<0.001$) for plant height (Table 1). Variety Kuncho had the highest plant height (112.33 cm) while short statured plants of 69.33 cm were recorded in local variety Bunign (Table 2). Tef varieties used in the present study had diverse genetic composition and as a consequence produced varying plant height ranging from 69.33 to 112.33 cm.

The variations in spike length in the present investigations were found to be highly significant ($p<0.001$) due to divergent maize genotypes (Table 1). The variety Kuncho had maximum spike length (49.00 cm), while the shortest spike length was recorded in the local check Awra tef (29.00 cm) (Table 2). In this study, spike length ranged from 29.00 to 49.00 cm among varieties.

The studied genotypes showed variation non significantly in number of tiller per plant (Table 1). The highest number of tiller per plant was recorded for Gemechis (12.20). From the studied genotypes the lowest tiller number was recorded for Bunign and Yilmana with the value of 9.53 (Table 2). Mean value of genotypes in number of tiller ranged from 9.53 to 12.20.

Grain yield being complex trait is highly influenced by various environmental factors including biotic and a biotic factors. It is also interplay of various morphological characters which either favor or worsen the final yield. In present investigations grain yield in kg ha^{-1} was found to be highly significantly different ($p<0.01$) due to different maize genotypes (Table 1). The variety Dukem superseded all the genotypes with highest yield of 1963.7 kg ha^{-1}. It was followed by the varieties Boset and Mechare with grain yield of 1772.0 and 1743.7 kg ha $^{-1}$, respectively. The genotype Yilmana showed poor performance in this experiment producing only 1016.3 kg ha^{-1}

(Table 2). The grain yield in the test varieties ranged between 1016.3 to 1963.7 kg ha^{-1}. Variation in yield shows a diverse genetic background of genotypes studied under these conditions. The possible reasons for the observed difference could be variation in their genetic makeup.

The analysis result of genotypes revealed that highly significant difference ($p<0.01$) in biomass yield (Table 1). Genotypes mean value of biomass yield ranged from 4444.3 to 6111.3 kg ha^{-1}. The highest and poorest biomass yield was recorded for Dukem and Tsedey with the values of 6111.3 and 4444.3 kg ha^{-1}, respectively (Table 2).

Table-2. Mean performance for six traits of tef genotypes planted at West Belessa district of North western Ethiopia, during 2013.

Varieties	Plant height (cm)	Spike length (cm)	Number of tillers per plant	Grain yield (Kg ha^{-1})	Biomass yield (kg ha^{-1})	Harvest index
Awra tef	74.00gh	29.00g	11.06a	1449.7bcd	4861.3cd	0.3000abc
Boset	93.00b-e	36.00c-g	10.13a	1772.0ab	5416.3abc	0.3300ab
Bunign	69.33h	29.66fg	9.53a	1448.0bcd	4444.7d	0.3266ab
Dima	83.66c-h	35.33d-g	9.73a	1453.3bcd	5417.0abc	0.2700abc
Dukem	98.66abc	46.00ab	11.93a	1963.7a	6111.3a	0.3233ab
Etsub	95.66bc	43.00a-d	11.26a	1154.7de	5000.0bcd	0.2300bc
Gemechis	100.66ab	41.33a-e	12.20a	1306.3cde	4861.0cd	0.2700abc
Kuncho	112.33a	49.00a	9.60a	1300.7cde	5833.3ab	0.2166c
Magna	89.33b-g	35.66d-g	10.06a	1012.0e	4722.0cd	0.2133c
Mechare	94.00bcd	44.00abc	10.80a	1743.7ab	5555.3abc	0.3266ab
Simada	77.33e-h	33.66efg	10.00a	1460.0bcd	4305.7d	0.3333a
Tseday	90.66b-f	37.33c-f	11.13a	1604.0abc	4444.3d	0.3633a
Yilmana	79.33d-h	40.33b-e	9.53a	1016.3e	4722.3cd	0.2133c
Zobel	76.33fgh	35.33d-g	10.60a	1164.7de	5416.7abc	0.2100c
LSD (5%)	16.06	8.16	2.78	427.27	900.35	0.1012

Source: Own study

Harvest index is important yield parameters in various grain crops including tef. The more harvest index showed more grain yield over biological yield and vice versa. The variation in harvest index was significantly ($p<0.05$) affected due to various maize genotypes (Table 1). The ranged for harvest index was recorded from 0.2100 to 0.3633. The highest harvest index was noticed at genotype Tseday (0.3633) followed by Simada (0.0.3333). Some other better but statistically uniform genotypes namely Dukem, Bunign and Boset were recorded with an average harvest index 0.3233, 0.3266 and 0.3300, respectively (Table 2).

It was further observed that the variety Dukem remained superior in term of both grain and biomass yield as well as in other important yield components (Table 2). It is, therefore suggested that this variety must be brought forward for testing across the various ecological areas of the studied district in a couple of years.

The possible reason for the observed differences for all the traits recorded could be because of variation in the genetic makeup of the studied varieties. In support of this finding, different researchers have reported significant amount of variability in different tef populations studied.

4. CONCLUSION

After evaluating the performance of 14 different tef genotypes, it is concluded that the genotype Dukem remained superior in terms of yield production as well as in other important yield components. It is, therefore suggested that Dukem should be brought forward for testing across the various ecology of west Belessa in particular and similar agro ecologies at large. The present study revealed considerable amount of diversity among the tested populations which could be manipulated for further improvement in tef breeding.

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