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Pre-extension Demonstration of Improved Tef Varieties in the Potential Growing Areas of West Shewa Zones of Oromia, Ethiopia

Endale Mekonnen, Hana Amare

Ethiopian Institute of Agricultural Research (EIAR), Holeta Agricultural Research Center (HARC), Holeta, Ethiopia

Email address:
endaleaman95@gmail.com (Endale Mekonnen), hanaamare72@gmail.com (Hana Amare)

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Abstract: This research trial was implemented in Ejere, Ejersa, Lefo and Dendi districts of west Shewa zone Oromia with the objective of demonstrating the newly released teff variety Ebba and Niguse with standard check Dagime to the smallholder farmers of selected districts. Three districts and three Kebeles from every district were purposively chooced based on accessibility and potentiality for teff production. After selecting farmers training was provided across the districts. Then after, two variety, Ebba and Niguse (a newly released variety) as well as Dagime (as standard checks) were planted on 20m*15m adjacent plots on 6 farmers' and 3 FTC field. All advised agronomic technics were equally applied to each plots. Organized team of researchers, Farmers and development agent collaboratively evaluated the varieties were reached maturity. Despite the modest distinctions in requirements stablished by farmer's plant height, disease tolerance, lodging resistance, Tilering ability, seed color, seed size, early maturity, straw yield, grain yield, were the common selection criteria across all locations. Ebba exceed the standard checks and has met the criteria of the farmers. With regard to yield, 22 qt/ha, 20.03 qt/ha and 18.33 qt/ha were obtained from Ebba, Niguse and Dagime; respectively putting Ebba on the first rank. Ebba gave yield advantage of 3.67qt/ha and 16.68% yield increment over the standard cheek Dagime. The net benefit that were obtained from Ebba, Niguse and standard cheek Dagime were 67619.15 ETB, 59969.15 ETB and 63969.15 ETB respectively Given that the farmers desired requirements were met by the verity Ebba hence Based on these result obtained fact, Ebba variety with recommended input was suggested for next scale up and cluster farming for demonstration districts and other comparable location.

Keywords: Demonstration, Farmers, Tef, Verities

1. Introduction

The agricultural sector is the cornerstone of Ethiopia's economy with approximately three-quarters of the economically active population engaged in agricultural production activities [1] Creates 33% of gross domestic production (GDP), employs 66% of its population, and creates 76% of export commodity value Four major cereal crops Tef barley wheat and maize account 71% of the total production in 2020/21, growing in 64% of the cultivated land [2].

In terms of the area planted and the amount of food produced, cereals are the main crop. In the interim, grains covered 81.19% hectares. Teff, maize, sorghum, and wheat made up 22.56% hectare), 19.46% hectares) 12.94% hectares, and 14.62% hectares, respectively, of the grain crop area. [3] In terms of productivity as they do in terms of farmland area. About 88.36% of the grain production came from cereals. In the same order, the grain output was dominated by maize, teff, wheat, and sorghum, accounting for 30.88% quintals 16.12% quintals 16.91% quintals, and 13.22% quintals of the total of the grain production, in the same order [3].

Teff (*Eragrostis tef*) Ethiopia's indigenous staple food is one of the main yields for farm income, food, and nutrition security in Ethiopia. [4] Teff is well known by Ethiopians and Eritreans for its superior nutritional quality. It contains 11% protein, 80% complex carbohydrate and 3% fat [5] Teff is well adapted to the heavy, well-drained, clay soil (vertisol) areas of the Ethiopian highlands where most other cereal crops cannot be grown easily. Teff grows best in moderate altitude levels. The preferred altitude condition for teff is

1700-2200 meters. This matches most closely with altitudes in the highland areas of Ethiopia at 1800-2100 meters. [6]

The large-scale grown of teff is related to its tolerance to diverse environmental challenges, which include both excess and insufficient soil moisture. In addition to being nutritious, tef grains are free of gluten [7] a causal agent for celiac disease; and hence teff is becoming globally popular as a life-style crop. [8] Despite these agronomical and nutritional benefits of tef, both the total production and productivity of tef is relatively low. The main reasons for inferior yield of tef are suboptimal genetic gain, low access to seeds of improved varieties, poor agronomic practices and lodging [9] Although 42 improved tef varieties have been released by the National Research System in Ethiopia [10] their adoption by farmers is low [11]. The central issue of applying the latest agricultural technology and/or innovation lies not only on the improvement of farm performances but also on the impact of technology on social and economic conditions of rural households, and on the promotion of land and labor productivity in agricultural sector.

In the oromiya region of Ethiopia total of 1.4 million hectares of land were covered by tef in the 2018/19 cropping season. From this, 26.9 million quintals production was produced. At the regional level and 6.86 million rural households of Ethiopia were engaged in *Teff* cultivation [3] In West Showa Zone, teff is the main crop produced by the majority of smallholder farmers. Usually, the crop is sown in this area early July up to end of this month and November - December harvested. The crop is produced for both household consumption and cash crop. In this area the straw of teff is also used for construction of house and used as the main feed resource for cattle Despite the yield of the crop is low in the area of West Shoa Zone due to lack of improved seed and low application of the recommended packages of teff. To over-come these problems demonstration of improved teff variety was initiated.

Therefore, this study was proposed with an objective of demonstrating and promoting improved variety of teff, evaluating the performance of improved teff variety along with management practices under farmers' perception and to enhance awareness of farmers about newly released teff variety in the study area.

2. Materials and Methods

2.1. Description of the Study Areas

The demonstration was conducted at Ajere, Ejersa Lefo and Dendi districts of West Shoa Zone for two consecutive cropping seasons. *Ejere* district is located in Oromia Regional State, West Shoa Zone, with the capital located at 50 km west of Addis Ababa. The altitude of the district varies from 2,060 meters to 3,185 meters above sea level. It receives an annual rainfall of 900-1,200 mm and has an annual temperature range of 90c-180c. The district has two agro-ecologies which are Dega (45%) and Weina Dega (55%) which implies highland and midland respectively [12] Second district *Ejersa Lafo* district land use types showed 70.19% arable land, 18.5 % grazing land, 9.4% forest land and 1.9% others. The mean average temperature of the area was 19.67°C, and the minimum and maximum temperature 5.4°C and 26.41°C, respectively. The mean annual rainfall is between 750-1170 mm. The major crops produced are teff, wheat, barley, maize and sorghum, chickpea, horticultural crops, vegetables, root crops, pulses, and oilseeds [13] while Dendi is one of district part of the West Shoa Zone. The annual rainfall of district 1078mm/year and altitude 2278 m.a.s.l It has a mean maximum and minimum temperature ranges of 10°C and 24°C respectively. Major areas of district soil type Verti sol/silt soil with deep black and certain areas brown color [14].

2.2. Site and Farmers Selection

Purposive sample selection procedure was employed Site and farmers selection was done in participatory way with district Agricultural Office and experts working on cereal production. Accordingly, three district and three Kebeles from each district were purposively selected based on potential production of teff among others. Similarly, farmers selection were done with collaboration of agricultural Office experts, and Developmental Agent by considering different selection criteria's like farmers interest to the technology, model farmers and managing the field as required. Accordingly, a total of six (6) farmers and three (3) FTC were selected from three districts (two farmers and one FTC from each kebele).

2.3. Planting Materials and Design Used

Two recently released tefe variety (Ebba and Niguse) with one standard check (Dagime) were planted on selected farmers' land with simple plot design (15m x 20m) for each variety in the main cropping season. Full packages were applied in which row planting with the spacing of 20cm between rows; recommended seed rate of 15kg per hectare and fertilizer rate of 65.4kgNPS and 158kg UREA per hectare was applied. In addition, twice hand weeding was done on time (i. e. the first weeding one month after planting and the second weeding was done one month later after of the first weeding).

2.4. Method of Data Collection and Analysis

Both quantitative and qualitative data were collected. The collected data were: agronomic data (yield data), total number of farmers and other stakeholders‟‟ participated in field visits and field days, total number of farmers and other stakeholders‟‟ participated in training and farmers‟‟ perception on the attribute of the technology.

The collected qualitative data was analyzed and described using descriptive statistics such as mean, tables and percentages. Also quantitative data collected were subjected to SPSS software to analyses mean, standard deviation, Be sides ranking scale was used to evaluate and select best bet varieties and to rank their criteria according to real situation

of the area. According to the research [15] Yield advantage and % increment were calculated using the following formula.

Yield advantage was also calculated as:

1) Yield of new variety - Yield of standard check.
2) Yield advantage % = Yield of new variety - Yield of standard check X 100 Yield of new variety.

3. Results and Discussion

3.1. Participatory Variety Selection

The verities were assessed after reaching maturity using the farmers‟ selection criteria. The farmers were then helped to write down their own evaluation criteria, which were subsequently ranked using the score ranking technique. The criteria were ranked according to the weights assigned to each attribute. Each variety was assessed against them. At the conclusion of the evaluation process the findings were presented to the evaluators, and discussed regarding to the next steps In order to do this, Farmers ranked each verity on a scale of 1–5 for each specific attribute they thought was important. (5=excellent value 4=very good value 3=good value 2=poor value 1=very poor).

As a result, the most important selection factors for each teff variety were yield, disease resistance, tillering ability, seed color, and early maturity. The top-ranked favored variety was assessed based on the overall mean score. So Ebba was chosen based on all of its features, including yield, and Niguse was chosen second.

Figure 1. *Participatory variety selection.*

Table 1. *Score Ranking of Teff Variety by Farmers across the Districts.*

Varsities	Plant height	Early maturity	Disease Resistant	Lodging Resistant	Tillering ability	Seed size	Seed Colure	Threshing ability	Grain Yield	Straw Yield	Total Scour	Rank
Ebba	4.5	5	5	4.	5	4	5	5	5	4	46.5	1st
Niguse	4	4	4.5	3	4	4	4	4	4.5	4	41	2nd
Dagime	4	3.5	4.5	3	3.5	4.5	4	4	4	4	39	3rd

Note: Value 5=Excellent Value 4=Very Good Value 3=Good Value 2=poor Value 1=Very poor.

3.2. On-Farm Yield Performance

The result of teff variety demonstration revealed that, the newly released Ebba and Niguse variety performed better than the standard check Dagime variety at all demonstration sites. As a result, the overall mean yield performance of the demonstrated varieties is presents in the table below (table 2). Accordingly; a mean yield of 22 qt/ha, 20.03 qt/ha and 18.33 qt/ha for Ebba, Niguse and Dagime varieties; respectively were recorded.

Table 2. *Overall Mean Yield Across the Districts.*

Varieties	Area	Ejere	Ejersa Lefo	Dendi	Overall mean
Ebba	Hector	20’.5	24	21.5	22
Niguse	Hector	19.65	23	17..45	20.03
Dagime	Hector	19	20	15	18.33

3.3. Yield Advantage

The mean grain yield advantage of the improved tef varieties across locations is illustrated in table 3. Among the demonstrated tef varieties the yield data also revealed that Ebba and Niguse varieties over standard cheek (Dagime) were 3.67 and 1.7 qt/ha a mean yield advantage and similarly 16.68 % and 8.48%, a mean yield increment respectively.

Table 3. *Yield Advantage and increment over the Standard Check.*

Demonstrated Varsities	Actual Yield qt/ha	Yield advantage over the standard cheek Dagime	% yield increment over the standard cheek (Dagime)
Abba	22	3.67	16.68%
Niguse	20.03	1.7	8.48 %
Dagime	18.33		

3.4. Cost- Benefit Analysis

The net benefits that were obtained from Ebba were higher than Niguse and Dagime. The net benefit of Ebba is 76484.15ETB and that of Niguse were 67619.15 and Dagime 59969.15 ETBs This indicates that using variety Ebba makes benefit for the farmers 11.59% and 21.58% than Niguse and Dagime respectively and also using variety Niguse increases the income of the farmers by 11..31% compared to the using variety Dagime (Table 4).

Table 4. *Cost Benefit Analysis.*

S. N	Items	Quantity	Unit price/cos	Varieties		
				Ebba	Niguse	Dagime
1	Average yield (kg/ha)	kg		2200	2003	1833
2	Adjusted yield (-10%)			1980	1802.7	1649.7
3	Total gain	Birr	50	99000	90135	82485
4	Seed Cost	kg	139.79	2096.85	2096.85	2096.85
5	Fertilizer costs	NPS/ kg	65.4	2289	2289	2289
		Urea /kg	158	5530	5530	5530
		Total	223.4	7819	7819	7819
6	Land preparation	ha	2500	2500	2500	2500
7	Labor costs p/day	Sowing	2day*10person*100	2000	2000	2000
		Weeding	2day*8person*100	1600	1600	1600
		Fertilizer app.	1day*5*100	500	500	500
		Harvesting & transporting	2day 10*100	2000	2000	2000
	Total Cost			18515.85	18515.85	18515.85
	Net Benefit			80,484	71,619	63,969

3.5. Training for Farmers, DAs and Experts

Training is one of the fundamental extension tool used in technology intervention and dissemination theoretical and practical training was organized at three districts to farmers and different stakeholders by the respective researchers from tef and extension researchers. Totally 47 farmers, 11 Developmental Agent and 3 Experts were Participated. Below table 5 summarizes stakeholders" participated on the training across the districts.

Table 5. *Training Participant.*

District	Participant						Total		
	Farmers		DA		Experts				
	M	F	M	F	M	F	M	F	
Ejere	19	2	4	1	1	1	24	4	28
Ejersa Lefo	12	1	1	0	0	0	13	1	14
Dendi	11	2	3	2	1	0	15	4	19
Total	42	5	8	3	2	1	52	9	61

4. Conclusion and Recommendation

This research activity was implemented in Ejere, Ejersa, Lefo and Dendi districts of west Shewa zone Oromia two newly released and one standard check varieties of tef were demonstrated. Farmers select the best varieties according to the listed criteria. Demonstration result showed that the Ebba variety was recorded high yielder than Niguse and Dagime at all location. It was also preferred by participant farmers for its better agronomic performance. On the other hand Cost benefit analysis also indicated that Ebba variety had a better benefit than the other varieties that were demonstrated. Based on these facts, Ebba variety suggested for further scale up and cluster farming for demo districts and other similar location.

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