



On-farm demonstration of improved and drought tolerant maize varieties with associated management practices

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Abstract

Maize is an important cereal crop in the central Rift Valley of Ethiopia. It plays a greater role in ensuring food security. The study was designed to evaluate and promote Melkassa-6Q variety with standard check (Melkassa-2). The study sites were Adama and ATJK districts. The districts were selected based on their maize production potential and accessibility of the site for demonstration. Training and field days were implemented to facilitate the successful implementation of the activity and create awareness among farmers about the varieties. Grain yield was recorded and the varieties were compared to each other based on their yield performance. Farmers' feedback was also collected and farmers preference ranking of each demonstrated variety was done depending on the farmers' set criteria for variety evaluation. The mean yield of Melkassa-2 (standard check) is about 39 qt/ha across locations whereas the mean yield of Melkassa-6Q is 36.4 qt/ha which is 2.6 qt below the standard check. In addition to yield, Melkassa-2 variety was preferred over Melkassa-6Q variety in overall farmers' evaluation criteria for maize variety evaluation. Therefore, there should be an adequate quality seed supply of Melkassa-2 variety till the best-performing maize variety is released by the research system.

Keywords: Demonstration, Drought, Evaluation, Farmers feedback, Grain yield, Maize varieties, preference.

Citation | Roba, B., & Miruts, F. (2023). On-farm demonstration of improved and drought tolerant maize varieties with associated management practices. *Agriculture and Food Sciences Research*, 10(2), 32-36. 10.20448/aesr.v10i2.5210

History:

Received: 2 October 2023

Revised: 8 November 2023

Accepted: 30 November 2023

Published: 6 December 2023

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Publisher: Asian Online Journal Publishing Group

Funding: This research is supported by Ethiopian Institute of Agricultural Research (Grant number: 62-05).

Institutional Review Board Statement: The Ethical Committee of the Ethiopian Institute of Agricultural Research, Ethiopia has granted approval for this study.

Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

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Contribution of this paper to the literature

The uniqueness of the study lies in using newly research released maize varieties. The study also reports the research finding which makes the study original. The study compares two maize varieties across two location in two production season and better varieties discussed as well as suggests to maize producing stakeholders.

1. Introduction

Maize is one of the world's most important crops produced for food. It has the highest average yield per hectare and ranks third in terms of area and total output in the world behind wheat and rice. It is grown in most parts of the world over a wide range of environmental conditions [1]. It is also among the most important and widely grown crops in Ethiopia.

Among cereal crops produced, maize is the most important crop in terms of production and contributes significantly to the national economy of the country [2]. The smallholder farmers that comprise about 80% of Ethiopia's population are both the primary producers and consumers of maize [3]. In the 2017/18 crop production year, around 8.5 million small-scale farmers were engaged in maize production, compared to 6.7 million for teff and 5.3 million for sorghum. Cereals contributed 87.48% (about 267,789,764.02 quintals) of the grain production. Maize production accounts for 27 percent of total cereal production in Ethiopia, with the highest volume of production (about 8.3 million tons), followed by teff and wheat (1.7 million and 1.5 million tons, respectively) [2]. However, the maize production potential was not yet achieved because of limited utilization of improved production technologies. As findings show, the productivity level of maize was 2.2 tons per hectare [4] in 2008/09 . This by far below the world's average yield which is about 5.21 tons per hectare [5, 6] indicated that maize productivity under farmers' condition is very low.

In addition to the low level of improved production technology utilization, recurrent drought considerably affected the production of the crop [7]. Growing varieties that are drought-resistant is thus a possible approach for enhancing food production, particularly in Ethiopia's drought-prone regions. Access to high-quality maize seed, high-yielding, and drought-tolerant maize varieties influences attempts to attain food security by increasing maize output and productivity. In response to this, 45 varieties of improved maize were released by the National Maize research from 1973-2011 in which 11 varieties were recommended for drought-prone areas and the rest 34 varieties were released for high moisture areas with average annual rainfall more than 900mm [5].

Despite multiple initiatives to reform smallholder agriculture in general and crops in particular, adoption of improved varieties of major crops such as maize in Ethiopia has remained low [8]. Aside from the limited adoption of better technologies, primarily seed, other factors contributing to the low productivity level include low yield potential of seed cultivars, low seed quality, irregular rainfall, and inadequate crop management methods [3]. In general, yield gaps are ascribed to a variety of causes such as frequent drought, diminishing soil fertility, poor agronomic practice, limited input utilization, low seed quality, disease, and others [9]. As a result, there is significant potential to increase maize production in the country as a whole and in the study region in particular by utilizing high-yielding varieties and improved management techniques.

1.1. Objectives

- To evaluate the performance newly released drought tolerant maize varieties with recommended production management practices.
- To create awareness, develop confidence among farmers, development agents, agricultural experts and seed producers for further promotion and dissemination.

2. Materials and Methods

2.1. Description of the Study Area

The demonstration was carried out during 2017 and 2018 cropping seasons in Adami-Tullu Jido Kombolcha (ATJK) and Adama Districts.

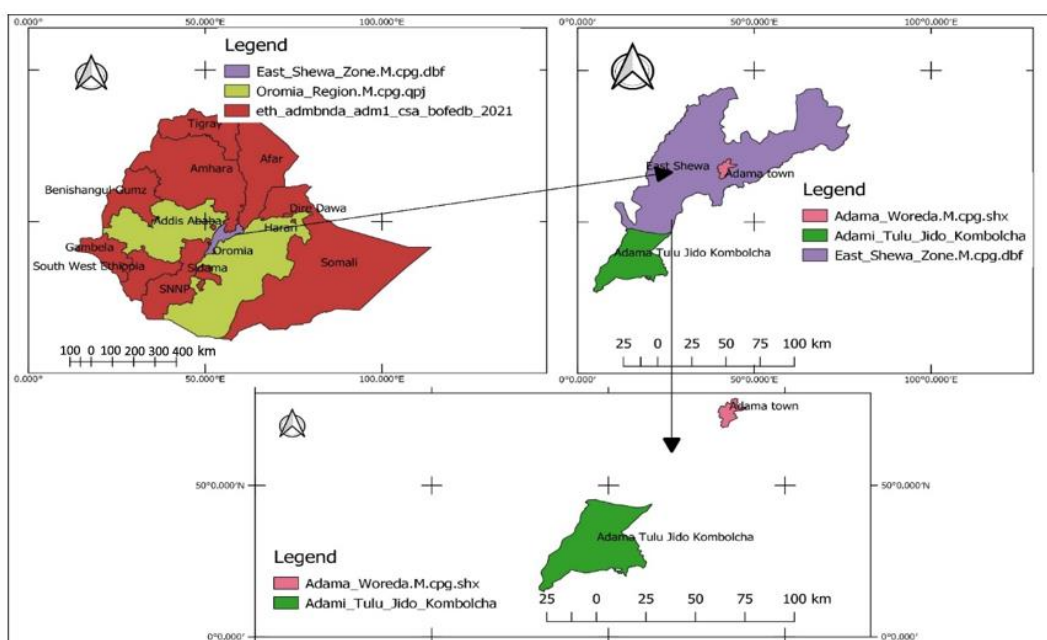


Figure 1. Sketch of study area.

The districts are located in rift valley areas of Oromia regional state. The areas have mixed livestock farming system. In the study area, the major crops grown are maize, teff, vegetables and the main livestock kept by the farmers are cattle, sheep and goats. The districts were targeted for the study based on their maize production potential and accessibility of the site for demonstration. The site selection was made in collaboration with the District Agricultural and Natural Resource Offices.

The above [Figure 1](#) illustrates the district where the study is conducted. Accordingly, the study is conducted in Adama and Adami Tulu Jido Kombolcha districts district of East shewa zone, Oromia regional state, Ethiopia.

2.2. Farmers Selection and Demonstration Field Establishment

The demonstration research activity was conducted in central rift valley of Ethiopia, the districts and kebeles were purposefully selected based on their maize production potential and accessibility of the area for the demonstration. A total of 60 maize farmers were participated in the maize demonstration activity in consideration of gender issues (women, men and youth). The demonstration hosting farmers were selected depending on their interest for maize technology, land provision for this pre-extension demonstration, willingness to share experiences for other farmers and their willingness to work on experiment with their full commitment and in close collaboration with researchers, experts and development Agents.

2.3. Design of the Field Demonstration Activity

Two quality protein maize varieties released from Melkassa Agricultural Research Center; one newly released variety namely, melkassa-6Q and Melkassa-2 as a standard checks were planted. The varieties were demonstrated side by side in which each variety allocated with 0.25 hectare of land. Two maize varieties namely Melkassa-6Q and Melkassa-2 were demonstrated side by side. Melkassa-2 was the early released maize variety when compared with Melkassa-6Q. Thus, it was used as standard check (control). Each farmer allocated 0.25 hectare of land for each maize variety and all the appropriate agronomic management practices were employed equally for each varieties side by side under the close supervision of researchers and Development Agents. The varieties were replicated across six trial farmers per kebele. Planting was done based on the onset of the rainfall of the growing season early whenever there is enough moisture in the soil. Each variety was planted on a plot size: 25mx25m, at seeding rate of 25-30kg/ha. A spacing of 75cm*25cm (53,333 plants/ha) (Between row and plant) and Nitrogen-phosphat-sulfur fertilizer (NPS) at rate of 100kg/ha were equally applied for all of the plots. For weed control twice hand weeding (the first one at 25 to 30 days after sowing and the second at knee height) is while slashing at flowering stage was done. Culturally removal of volunteer plants and alternate hosts by hand for insect pest control were performed. Finally, the performance of the maize varieties was evaluated against each other which is discussed in detail in the result section.

2.4. Monitoring and Evaluation

The demonstration activity was monitored and evaluated properly starting from the beginning of the implementation to the harvest. All the recommended agronomic management practices were employed properly during the demonstration of the varieties. Farmers were advised to prepare their demonstration field in advance. The demonstration farmers were also used the recommended seed rate and recommended fertilizer rate. Other agronomic management practices like thinning and hand weeding were also employed at the appropriate time.

2.5. Important Tools for Implementation

Training, field visit and field days were used as important tools for the implementation of this activity. Multidisciplinary research team; crop, extension and socio-economic research team and other stakeholders (Offices of Agriculture and Natural Resource) actively participated by sharing their experience and knowledge during the training and field day. Participant farmers were selected and orientation on the improved maize technology demonstration was given in cooperation with development agents (DAs) and subject matter specialist (SMS). Training materials was prepared and practical trainings were given for participant farmers and extension counterparts (DAs & SMS) on production of improved maize technology.

A total of 238 participants (126 farmers, 72 DAs, and 40 SMS trained on maize production and management practices. On top of these 55 participants were participated on different food recipes preparation from maize [Table 1](#). From the participants, 37 were farmers (5 male and 32 female) and 18 were DAs and SMS (12 male and 6 female).

Table 1. The number of participants provided training in the demonstration period (2017-2018).

Participants	Type of training provided to the participants		Total
	Maize production	Food recipe preparation	
Farmers	126	37	163
DAs and SMS	112	18	130
Total	238	55	293

Field day was one of the important demonstration implementation tools in this research activity. The demonstrated fields were demonstrated to farmers, development agents, district Agricultural SMS and other stakeholders to share knowledge and experience about the improved maize technologies and to facilitate for its wider popularization among smallholder farmers. Accordingly, the field day was organized in Adama and ATJK districts with objectives of promoting improved maize production and sharing experiences and knowledge about the variety among the participants. Various stakeholders and partners were participated and they visited the maize demonstration field in the area. A total of 436 participants were participated on the field day event. From the participants, 400 were farmers (256 male and 144 female).

2.6. Extension Material and Media Coverages

Leaflets were produced in local languages (Afan Oromo and Amharic) on common bean production, field managements and, food preparation and utilization. 750 smallholder farmers were provided with the leaflets on field day event. Field day was supported by different media coverage like Television (Oromia Broadcasting Network) and zonal communication offices. The participants' feedback about the improved maize technologies was recorded and transmitted to the wider societies through the media (OBN) for further awareness creation and promotion.

2.7. Data Collection

The types of data collected were grain yield and farmers' feedback with regarding to important crop (technology) traits beginning from pre-harvest agronomic practices to post harvest handling. The collected data were analyzed using descriptive statistics and preference ranking based on farmers' criteria.

3. Result and Discussion

3.1. Yield Performance of the Demonstrated Varieties against the Standard Check

The following Figure 2 describes the yield performances of the demonstrated varieties across the study site. The yield performance of the improved maize variety (Melkassa-6Q) was evaluated against the yield performance of the standard check or control which was in the hand of the farmers for relatively many years. Thus, Melkassa-2 is used as a control in this demonstration research activity. The result shows that the mean yield of Melkassa-2(control) is greater than the mean yield of Melkassa-6Q in almost all research locations in 2017 and 2018 growing season This shows the standard check had better yield advantage over the Melkassa-6Q.

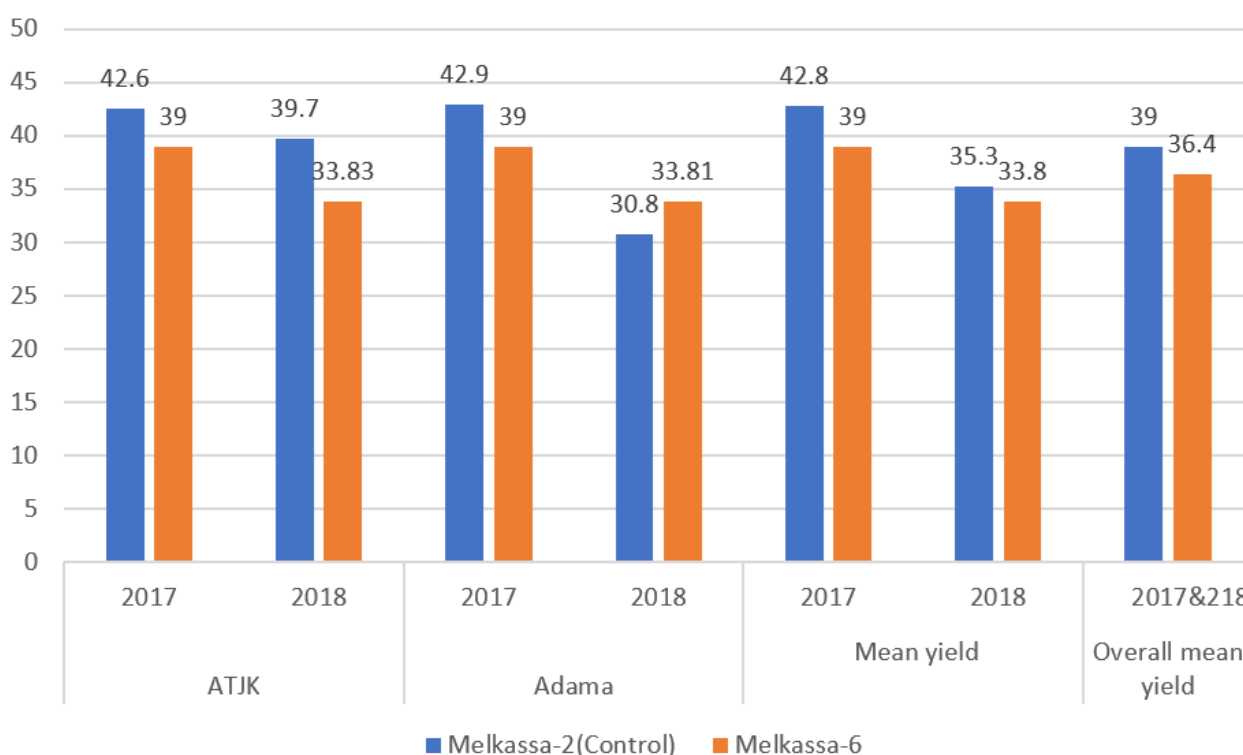


Figure 2. Yield performance of the varieties across location.

3.2. Farmers Preferences

Farmers made selection among demonstrated maize varieties depending on their own preference criterion. The criteria used were yield, drought tolerance, market, grain color, food taste and Earliness in maturity. The farmers' preference rank is determined based on the evaluation score weight. The variety with high score weight is most preferred by the farmers and given first rank.

Accordingly, the result indicated that farmers ranked Melkassa-2(control) first and Melkassa-6Q variety second in both demonstration sites (Districts). The variety is ranked first across location, since its mean score weight is 0.78 which is greater than the mean score weight of Melkassa-6Q which is about 0.64 Table 2. To sum up Melkassa-2variety is more preferred maize variety than Melkassa-6 in the research areas. This reveals that melkassa-6Q no longer replace the standard check (Melkassa-2).

Table 2. Farmers preference ranking for the varieties with respect to different criterion.

District	Varieties	Yield	Drought tolerant	Market	Grain color	Food taste	Earliness	Total score	Weight	Rank
ATJK	Melkassa-6Q	1	2	2	2	2	2	11	0.61	2
	Melkassa-2 (Check)	3	3	1	1	1	3	12	0.67	1
Adama	Melkassa-6Q	2	3	2	2	2	1	12	0.67	2
	Melkassa-2 (Check)	3	3	3	2	2	3	16	0.89	1
Mean weight (M-6Q)		1.5	2.5	2	2	2	1.5	11.5	0.64	2
Mean weight (M-2)		3	3	2	1.5	1.5	3	14	0.78	1

Note: Preference ranking based on preference scores out of 3 points with 1= Low score, 2= Moderate score and 3= High score.

M-6Q= Melkassa-6Q and M-2= Melkassa-2

Source: Farmers' feedback.

4. Conclusion and Recommendation

It is indicated that the standard check (Melkassa-2) had shown better performance in grain yield than Melkassa-6Q. Thus, the cultivation of Melkassa-2 has been found more productive than cultivating Melkassa-6Q variety. Even though both varieties were found to be suitable in study locations, Melkassa-6Q is no longer replace the standard check (Melkassa-2), since it has less grain yield performance and less preferred than Melkassa-2 in overall farmers' preference evaluation criterion. Hence, Seed producer enterprises, cooperatives or seed producing farmers' groups and other responsible stakeholder should work for the adequate and quality seed supply of Melkassa-2 maize variety till the best performing maize variety that can be replace the existing Melkassa-2 variety is released by the national lowland maize research.

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