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On Farm Demonstration of Improved Sorghum varieties (*Soughum bicolor* L.) In Malle District of South Omo Zone, South Ethiopia

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Abstract
Sorghum is an important cereal crop in Ethiopia. However, sorghum yield is limited mainly due to the shortage and unpopular of improved varieties in specific areas with another factor. To alleviate this problem the field experiment was conducted during the 2023/24 growing season to demonstrate and promote improved sorghum variety at Malle District of South Omo Zone. Five agro-pastoralists were purposively selected because they are the leading producer of sorghum in the area. Two improved varieties of sorghum (Melkam and Dekeba) with local varieties were demonstrated with the full participation of agro-pastoralists. Eight sorghum grower agro-pastoralists were purposely selected and training was given to agro-pastoralists on sorghum agronomic practices to make full-package technology. The field visit was arranged by inviting different agro-pastoralists; eight females and eight male agro-pastoralists were participated. Data collected from the experiment fields and agro-pastoral preferences were analyzed through simple descriptive and preference ranking tools. The mean grain yield obtained from the demonstration field for each variety was 4250 kg/ha (Melkam), 3500kg/ha (Dekeba) and local variety (1000 kg/ha) in Malle District (Gento kebele). These improved varieties had yield advantage of 325% and 250% over local variety respectively. The agro pastoralists' preference result showed that, the Melkam variety was the best one or superior to the others by its medium plant height, stands strength (tolerance to lodging), long panicle length, disease resistance, early maturity, white seed color, head diameter, high high-yielding ability, and maximum thousand seed weight. Therefore, the Melkam variety was recommended for further scale-up.

Keywords: Agro-Pastoralists, Demonstration, Preference, Sorghum Varieties

Introduction
Sorghum (*Sorghum bicolor*) is an important cereal crop used by humans as a staple food grain in many semi-arid and tropical areas (Belay, 2017). Sorghum is a major food and nutritional security crop to more than 100 million people in the eastern Horn of Africa, owing to its resilience to drought and other production constraints (Gudu *et al*., 2013)[8]. Sorghum has actual nutritional value in principle, because of its content of protein, vitamins, fat-soluble (D, E, and K), and of B group (except for B12), as well as minerals, such as iron, phosphorus, and zinc. In particular, a recent study classifies sorghum genotypes as a source of vitamin E but highlights how the analyzed genotypes showed low contents of carotenoids (De Cardoso, L.M, 2015). In composition, sorghum grain compares favorably with some other cereals: it has a similar protein content to wheat but higher than maize and rice, while the essential amino acid composition of sorghum is comparable to maize or wheat due to the limited content of threonine, arginine and, especially, lysine (Abdulaziz, 2022). Sorghum is the fifth largest and most important cereal in the world agricultural economy, after wheat, maize, rice, and barley, and the second (after maize) in sub-Saharan Africa. In 2013, the global area cropped with sorghum was 42.3 million hectares and the worldwide production was 61.5 million metric tons; the USA, Nigeria, Mexico, India, and Ethiopia are the main producers (FAOSTAT, 2014). Sorghum is the third most important

cereal grain after Tef and Maize in Ethiopia both in area and production in Ethiopia. In Ethiopia, sorghum is produced for food, feed, and stalks for fodder and building material. Currently, sorghum is produced by more than 5 million holders and its production is estimated to be 51,692,525 quintals from 1,896,389 hectares of land. The average productivity of the crop is 27.26 quintals per hectare. It covers 14.96% of the total area allocated to grains) (CSA, 2018). Sorghum exhibits a wide geographic and climatic adaptation. It also requires less water than most cereals; hence it offers great potential for supplementing food and feed resources. Sorghum grows in a wide range of agro ecologies most importantly in the moisture-stressed parts where other crops can least survive and food insecurity is rampant (Tekle and Zemach, 2014). Sorghum in Ethiopia is grown in three major agro-ecologies. It is the major crop in the dry lowland environment which accounts for more than 60 percent of the cultivated land (CSA, 2018). As it is grown in diverse environments, the productivity of sorghum is constrained by several biotic and abiotic factors. The major constraints in the dry lowlands are drought, striga, low yield, and insects (Tesfahunegn, 2012) [9]. In Ethiopia, considerable achievements have been obtained in developing early maturing and drought-tolerant sorghum varieties and production management practices. According to Alemu *et al*, (2023) [2], since the establishment of the sorghum program more than 50 sorghum varieties have been released and the number of farmers growing improved lowland varieties reached 28 percent. The low level of improved sorghum variety adoption is attributed to the low availability of farmer-preferred varieties in sorghum variety generation and dissemination endeavors (Beshir and Sime, 2013) [3]. Sorghum is becoming a high-potential crop in the South Ethiopia region in general and South Omo Zone in particular. It is the dominant crop in the lowland areas of South Ethiopia, especially the South Omo Zone and Konso Zone. Sorghum production is increasing in the South Omo Zone of South Ethiopia, but there are several production constraints with this crop. Even though the crop is important in the target area, several factors constrained the productivity of sorghum in the target areas. This is associated with the lack of demonstration of improved varieties associated with edaphic and biotic factors that have been appreciated as one of the primary sources of lower sorghum production in the target areas. There was no trend of using improved sorghum varieties in the existing production system, so it was the bottleneck problem in the study area. Hence; there is needed to demonstrate the improved sorghum varieties to the target area is crucial for sorghum production and productivity. Therefore, this study was designed to promote and popularize fully packaged improved sorghum variety and to improve agro pastoralists' knowledge and skill of sorghum producers in the study area.

Materials and Methods

Description of the Study Area

The demonstration was conducted in the Malle District of South Omo Zone. The altitude of the District ranges from 1100 and 1200 meters above sea level. Generally, the average temperature of the district is 30 ˚C – 35 ˚C and the average rainfall is 800 mm/year. The main rainy season of the district is in April, May, June, July, August and September. The soil type of the district is silt and sandy soil.

Site and Agro Pastoralists' Selection

Malle District (Gento kebele) was purposively selected based on the potential area of sorghum production and accessibility for field monitoring and follow-ups. Finally, a total of five agro pastoralists' were selected to implement the demonstration of improved sorghum varieties.

Table 1: Summary of selected site and agro-pastoralists with area coverage of the experiment

District	Keble	No. of the trial agro-pastoralists	Area covered
Malle District	Gento Keble	Five agro-pastoralists	10m* 10m for each variety across each plot

Planting Materials and Design Used

Two improved sorghum varieties (Melkam and Dekeba) and one local check were replicated across five trial agro pastoralists'. 10m*10m plot size of land from individuals. Trial agro pastoralists' was used for each experiment/variety. Each variety planted at the plot Size: of 10mx10m, seed rate of 15 kg/ha, spacing 75cm*15cm (Between row and plant), Fertilizer rate: NPSB 100kg/ha, and Urea 100kg/ha were applied.

Technology Demonstration and Evaluation Methods/Technique

For the sake of enhancing efficiency and effectiveness, a participatory approach was followed. To this end, agro pastoralist trial members and other follower agro-pastoralists were encouraged to participate in different extension events organized at the trial site. These were mechanisms used to enhance agro-pastoralists to agro-pastoralists learning and information exchange such as training, field day, joint monitoring and evaluation like regular field visits by extension agents and extension counterparts, at different crop stages, etc.

Variety Preference Ranking

The variety preference ranking was conducted using group discussions. The agro-pastoralists were allowed to observe and set selection criteria at the maturity stage
of the crop. The selected criteria were plant height, stand strength (tolerance to lodging) panicle length, disease resistance, early maturity, seed color, head diameter, and high-yielding ability.

Yield advantage (%)

The yield advantage of improved maize technology over commercial is calculated in the following formula.

$$\text{Yield Advantage (\%)} = \frac{\text{Yield of improved variety} - \text{yield of local variety X100}}{\text{Yield of local variety}}$$

Data Collection and Analysis

Both qualitative and quantitative data were collected through supervision and follow up of the activity with the joint action of the stakeholders and analyzed. A data record sheet was developed to collect the data. Thus, field observation, contacting the target agro-pastoralists, and focus group discussion during the field visit were the data collection methods. Yield data and agro pastoralists' preference towards the variety were collected from the agro pastoralists' field. Finally, the collected data were analyzed using descriptive statistics, and preferences were analyzed using narrations and tables.

Results And Discussions

Mini-Field Day Participants

The Min-field day was organized for participating agro pastoralists' after commencing the trial. Multidisciplinary researchers crop extension discipline and other stakeholders (Offices of Agriculture and Natural Resource) actively participated by sharing their experience and knowledge about sorghum production technologies.

Table 2: Participants in the field visit

Participants	Female	Male	Total
Researchers	-	2	2
DAS	1	1	2
Agro pastoralists'	8	8	16
Total	9	11	20

Agro Pastoralists' Trait Preference

To collect agro pastoralists' trait preference of sorghum, 16 agro pastoralists' (8 women and 8 male) were selected from different age and sex categories from the community participated in trait preference. Agro pastoralists' were let to observe and set selection criteria at the maturity stage of the crop as described; medium plant height, stand strength (tolerance to lodging) panicle length, Disease resistance, early maturity, seed color, head diameter, high-yielding ability were the main traits listed The result of demonstration sorghum varieties revealed that the newly released Melkam variety performed better than the local variety. Accordingly, the Melkam variety was preferred by agro pastoralists' because of its medium plant height, stand strength (tolerance to lodging) panicle length, disease resistance, early maturity, seed color, head diameter, and high yielding ability respectively.

Table 3: Direct matrix of sorghum varieties using different selection criteria by farmers (N= 16: 8 male and 8 female)

Varieties	PH	ST	PL	DR	EM	SC	HD	YD	TS	Rank
Dekeba	4(16)	4(16)	4(16)	4(16)	3(16)	4(16)	4(16)	4(16)	31	2
Melkam	5(16)	5(16)	5(16)	5(16)	5(16)	5(16)	5(16)	5(16)	40	1
Local	3(16)	1(16)	1(16)	1(16)	1(16)	1(16)	1(16)	1(16)	10	3

NB. PH, =plant height, ST= stand strength, PL= panicle length, DR= Disease resistance EM= early maturity, SC= seed color, HD= head diameter, YD =yield, TS= total score.

Note: 5 = Excellent, 4= Very good, 3= Good, 2= poor, 1= very poor

Table 4: The reason for variety ranking criteria by agro pastoralists'

Varieties	Agro pastoralists Rank	Reason for the preference
Dekeba	2nd	Very good plant height, very good stand strength (tolerance to lodging) medium panicle length, very good disease resistance, medium maturity, very good seed color, very good head diameter, and medium yielding ability.
Melkam	1st	Medium and good plant height, high stand strength (tolerance to lodging) log panicle length, high disease resistance, early maturity, white seed color, excellent head diameter, and high yielding ability.
Local	3rd	Very log plant height, low stand strength (tolerance to lodging) short panicle length, susceptible to disease, late maturity, black seed color, short head diameter, and low yielding ability.

The Average Mean Growth and Yield Performance of Demonstrated Varieties on Agro Pastoralists' Farm Field

In the study District, all agro-pastoralists use local varieties which are lower in productivity than improved varieties. Melkam and Dekeba varieties with local check were demonstrated at five agro pastoralists' fields for one year. Single plot design for each three varieties was used with recommended seed and fertilizer rates respectively. The result of the Sorghum varieties demonstration revealed that the newly released Melkam variety performed better in plant height, panicle length, grain yield, and thousand seed weight than the Dekeba and local varieties while the Dekeba variety performed better in plant height, panicle length, grain yield, and thousand seed weight than the local variety.

Table 5: The average mean growth and Yield Performance of demonstrated varieties on agro pastoralists' farm field

Varieties	Plant height (cm)	Panicle length. (cm)	Grain yield kgt/ha)	TSW(g)
Dekeba	127	23	3500	24
Melkam	176	31	4250	27.5
Local	238	26.6	1000	19.5

Table 6: Yield performance of improved sorghum varieties in Malle District at Gento kebele on Agro pastoralists' farm land

Location	Varieties	Participants (N)	Mean (kg/ha)	Std. Deviation	Minimum (kg/ha)	Maximum (kg/ha)
Gento kebele	Dekeba	5	3500	245	3180	380
	Local	5	1000	255	700	130
	Melkam	5	4250	253	3890	450

Table.7: Yield Advantage of the demonstrated varieties

Varieties	Average yield kgt/ha)	Yield difference(kg/ha)	Yield advantage over local check (%)
Dekeba	3500	2500	250
Melkam	4250	3250	325
Local	1000	-	-

In general, in the selected District keble in agro pastoralists demonstration field, Melkam (42.5 qt/ha) and Dekeba (35 qt/ha) varieties gave higher yield than local variety (10 qt/ha). These varieties had yield advantage of 325% and 250% over local variety respectively.

Feedbacks from Agro Pastoralists

During the mine field day, agro pastoralists said, "The performance of the crop was interesting so that we will continue to plant this variety". Lack of improved variety was our major problems to popularize the technologies. Hence, the office of agriculture and rural development of their respective Districts should further disseminate and scale-up Melkam variety to a large number of agro pastoralists to increase production and productivity of sorghum in the target area.

Fig 1: Field status of the demonstrated varieties

Conclusion and Recommendations

Demonstration of improved sorghum was undertaken at Gento keble kebele with active participation and collaboration of Keble expert agents and agro-pastoralists. The findings of the study showed that the maximum mean grain yield obtained from the demonstration field for each variety was 42.5 qt/ha (Melkam), 35 qt/ha (Dekeba), and 10 qt/ha (local). The agro pastoralists' preference result showed that, the Melkam variety was the best one or superior to the others by its medium plant height, stand strength (tolerance to lodging) long panicle length, disease resistance, early maturity, white seed color, head diameter, high high-yielding ability and it had 325% of yield increment as compared to the local variety. This created greater awareness and motivated the other agro-pastoralists to adopt the improved Melkam variety and the host agro-pastoralists on demonstration also played an important role as a source of information and quality seeds for wider dissemination of the improved variety of sorghum (Melkam) for other nearby agro-pastoralists. The demonstration is a very important activity to enhancing the production and productivity of sorghum through improving the knowledge, attitude, and skill of agro-pastoralists. Therefore, the Melkam variety was recommended for further scaling up and the office of agriculture and rural development of the respective District should further disseminate and scale up the Melkam variety to a large number of agro-pastoralists in the target area and other similar agro-ecologies.

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Availability of Data

The data supporting of this research finding are available within the research article and its supplementary materials.

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Conflicts of Interest

No conflict of interest regarding the publication.

Reference

1. Teha A. Participatory demonstration of mid land sorghum technology through FRG system in Metta District of East Hararghe Zone. Int J Agric Ext Rural Dev Stud. 2022;9(2):47-55.
2. Alemu H, Begna F, Mariam WT. Pre-extension demonstration and popularization of improved sorghum

technologies in selected districts of Assosa Zone, Benishangul Gumuz Regional State, Western Ethiopia. 2023.
3. Beshir B, Sime M. Understanding farmers' improved sorghum variety selection criteria: the case of farmer research group approach in Habro District, West Hararghe. Research Report 102. 2013. Available from: http://www.eiar.gov.et
4. Central Statistical Agency. The Federal Democratic Republic of Ethiopia Central Statistical Agency agricultural sample survey. Report on area and production of crops. Statistical Bulletin No. 586. Addis Ababa: CSA; 2018.
5. De Morais Cardoso L, Pinheiro SS, da Silva LL, de Menezes CB, Carvalho CWP, Tardin FD, *et al*. Tocochromanols and carotenoids in sorghum (*Sorghum bicolor* L.): diversity and stability to the heat treatment. Food Chem. 2015;172:900-8.
6. Food and Agriculture Organization. FAOSTAT database. 2014. Available from: http://fao.org/faostat/en/#data [Accessed 16 August 2022].
7. Gebreyes BG. Determining the physicochemical compositions of recently improved and released sorghum varieties of Ethiopia. J Food Nutr Sci. 2017;5(5-1):1-5.
8. Gudu S, Ouma EO, Onkware AO, Too EJ, Were BA, Ochuodho JO, *et al*. Preliminary participatory on-farm sorghum variety selection for tolerance to drought, soil acidity, and Striga in Western Kenya. In: First Bio-Innovate Regional Scientific Conference. Addis Ababa: United Nations Conference Centre; 2013. DOI:10. [volume number missing].
9. Tesfahunegn GB. Effect of tillage and fertilizer practices on sorghum production in Abergele area, Northern Ethiopia. Momona Ethiop J Sci. 2012;4(2):52-69.
10. Yoseph T, Sorsa Z. Evaluation of sorghum (*Sorghum bicolor* (L.) Moench) varieties, for yield and yield components at Kako, Southern Ethiopia. J Plant Sci. 2014;2(4):129-33.