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# Drought tolerant and Early-maturing Sorghum Technologies Demonstration for Food and Feed security in the selected AGP-II districts of Harari region and Dire Dawa Administration

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### ABSTRACT

Food for human and feed insecurity livestock is integrated systems that have been foe small holder farmers in Ethiopia in general and study area in particular. To reduce this problem this research was conducted with objectives of promoting and popularize improved lowland sorghum technologies and to create awareness through giving training and enhance stakeholders participation. A total of fifteen (20) trial farmers were selected from two potential sorghum growing kebeles of Dire Dawa administration and one from Harari region rural areas. Four FRG having 60 farmers was established. Two improved sorghum varieties (Melkam and Dekaba) were replicated on the plot of 20mx20m. Training on which a total of 78 participants took part were organized at research sites. Lowland Sorghum varieties were evaluated based on their early maturity, yield, Disease tolerance, seed color, seed size, biomass, and stalk and food test. The yield performance of the improved varieties (Melkam and Dekeba) were 26.58 and 26.44 qt/ha at Dodota, 28.24 and 26.78 qt/ha at Bishan Bahe respectively. The average yield performance of Melkam somewhat higher than Dekaba at both location but statistically no significant difference between two improved varieties across the locations and the biomass/stalk was high which helps for livestock feed. Thus, Melkam variety preferred well for these benefits over dekeba. Therefore, it is recommended that government, nongovernment and other stakeholders should popularize to reach large small holder farmers in similar agro-ecology.

**Keywords:** Sorghum, Demonstration, Drought, Early-maturing, Melkam and Dekeba

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## Introduction

Sorghum (*Sorghum bicolor*) is one of the most widely grown cereal crops in Ethiopia. It is a staple food crop which the lives of millions of poor Ethiopians depend on. It has tremendous uses for the Ethiopian farmer and no part of this plant is ignored. 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 <sup>[1]</sup>. Sorghum is also the most widely cultivated and consumed cereals in Ethiopia. According to (CSA, 2008) <sup>[2]</sup>, it ranks third after maize and tef in total production, after maize in yield per hectare and after tef and maize in area harvested. Currently sorghum is produced by 5million holders and its production is estimated to be 4 million metric tons from nearly 2million hectares of land giving the national average grain yield of around 2 tons per <sup>[2]</sup>. In fact sorghum is not only drought-resistant, it can also withstand periods of water logging (Taylor, 2010) <sup>[5]</sup>. It is an essential to diet of poor people in the semi-arid tropics where droughts cause frequent failures of other crops. Sorghum contributes to the food security of many of the world's poorest <sup>[3]</sup>.

Sorghum is primarily a crop of resource-poor small-scale farmers and is grown predominantly in low-rainfall, arid to semi-arid environments. The crop is typically produced under adverse conditions such as low input use and marginal lands <sup>[4]</sup>. Its grain has slightly higher protein and lower fat than maize. In general, sorghum has about 95% of the nutritional value of maize. Moreover, sorghum (*sorghum bicolor*) is the fifth most important cereal globally and feeds around 500 million people. It is especially important for rural people in arid regions. It provides food for household consumption and produces amounts of fodder to support their livestock than other grains<sup>[6,7]</sup>. The criteria for selecting grain sorghum are, yield, maturity, stalk strength (stand ability), and disease resistance are all important <sup>[6]</sup>. Therefore, was developed to demonstrate and disseminate improved

sorghum varieties through participatory full package technology dissemination.

## Objectives

- ✓ To evaluate the productivity and profitability of technology under farmers condition.
- ✓ To create awareness among farmers, developmental agents, subject matter specialists and other participant stakeholders on improved sorghum production technologies.
- ✓ To build farmers' knowledge and skill of production and management of the enterprise
- ✓ To strengthen linkage among stakeholders

## Materials and Methods

This drought tolerant and early maturing drought sorghum varieties demonstration research was conducted in selected districts of Harari region and Dire Dawa administration.

### Site and farmers selection

Kebeles were selected purposively based on the potentiality, appropriateness of the area by considering lodging, slop's land escape, access to road, suit for repeatable monitoring and evaluation in progress of sowing to harvesting that is Dodota kebele from Erer Waldaya and Bishan Bahe from Biyo Awale were selected.

Farmers were selected purposively based on their interest, innovation he/she has, land provision for this pre-extension demonstration, interest in cost-sharing, willingness to share experiences for other farmers, and studying their profile with the participation of DAs and community leaders. The selected farmers were grouped in form of Farmers Research Group (FRG) with the member of 15 farmers per kebeles in consideration of gender issues (women, men and youth). In the establishment of FRG in the study areas total of 4FRGs (2FRG/ kebele) from one PA 15 farmers and a total of 60 farmers were grouped in 4FRG at Harari and Dire Dawa. In the FRG 5 farmers were trial

farmers (3 male trial farmers and 2 female trial farmers) and 10 farmers worked with trial

farmers. Table 1: Summary of selected site and farmers with area coverage of the experiment.

District	PAs	No. of trial farmers	FTCs	Area covered
Biyo Awale	Bishan Bahe	10	1	20mx 20m for each plots
Erer Waldaya	Dodota	10	1	
	Total	20	2	

## Research design

Two improved treatment (Melkam & Dakaba) sorghum varieties and one local variety were planted side by side with equal plot size. Melkam and Dakaba varieties with local check were used as treatments. Farmers were used as replications. The plot size was 20mx20m and with the seed rate of 10kg/ha. The space between plant and row is 30cm and 75cm respectively. Shallow planting of 2-4cm depth and fertilizer application (100 kg NPS) and the planting date was at late June to early of July for rain-fed planting.

## Technology evaluation and demonstration methods/technique

The evaluation and demonstration of the trials were conducted on farmers' fields to create awareness about the sorghum varieties. The evaluation and demonstration of the trials were followed process demonstration approach by involving FRGs, development agents and experts at different growth stage of the crop. The activity was jointly monitored by FRGs, researchers, experts and development agents.

## Data Collection

Both quantitative and qualitative data were collected through personal field observation, individual interview, Focus Group Discussion by using checklist and data sheet tools. Types of collected quantitative data were number of farmers participated in FRG, yield performance, economic analysis and number of stakeholders participated on the training. While qualitative data were farmers' perceptions towards the new

technology and ranked using pair wise ranking and Matrix ranking.

## Data analysis

Quantitative data was summarized using simple descriptive statistics (Mean, Frequency and Percentage) while the qualitative data collected using group discussion and field observation and oral histories was analyzed using narrative explanation or PRA (Participatory Rural Appraisal) tools and argument. Finally, data from different sources was triangulated to get reliable information.

## Results and Discussion

### Training of farmers and other stalk holders

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 and journalists for the sake of publicity of the work done. Development agents, experts and farmers were participated on the training given on improved sorghum production and management, post-harvest handling and marketing information. Training was also organized for more awareness creation.

Among the training participant stakeholders, 78.2% were farmers. From those farmers, 42.6% are female farmers' participant. For the participants, 45 leaflets and 30 small manuals on the technology that are organized in Afaan Oromoo and English languages were distributed. During the training different questions, opinions and suggestions were

raised and reacted from the concerned bodies. Most farmers showed high interest towards improved sorghum technology production because of better yield and earned income by selling it for different stakeholders (neighbors' farmers and Non-Government Organizations).

Generally, all farmers were very interested to have the technology for their future production. Therefore, all concerned bodies were shared their responsibility for the future intervention and wider reach out of the technology.

**Table 2:** Type of profession and number of participants on the training at Bishan Bahe

No.	Participants	Bishan Bahe		
		Male	Female	Total
1	Farmers	35	26	61
2	DAs	5	3	8
3	District experts	4	2	6
4	Journalists	3	0	3
Total		47	31	78

Source: Own computation 2017/18

### Agronomic and yield performance

The following table describes the yield performances of the demonstrated sorghum varieties across the study site. The yield performance of the improved varieties (Melkam and Dekeba) were 26.58 and 26.44 qt/ha at

Dodota, 28.24 and 26.78 qt/ha at Bishan Bahe respectively. The average yield performance of Melkam somewhat higher than Dekaba at both location but statistically no significant difference between two improved varieties across the locations.

**Table 3.**Yield performance of improved elephant grass varieties across districts on Farmers land

PA	Varieties	N	Std. Deviation	Mean (qt/ha)	Maximum	Minimum
Dodota	Melkam	10	1.443	26.58	28.40	24.20
	Dhakaba	10	2.259	26.44	29.70	22.90
Bishan Bahe	Melkam	10	2.349	28.24	32.30	25.10
	Dhakaba	10	2.369	26.78	30.30	23.60
Total			2.181	27.01	32.30	22.90

### Economic Analysis

**Table 4.** Financial analysis for bread wheat varieties across the districts

Financial analysis					
Location: Dodota			Location: Bishan Bahe		
Parameters	Varieties		Parameters	Varieties	
	Melkam	Dekeba		Melkam	Dekeba
Yield qt/ha(Y)	26	26	Yield qt/ha(Y)	28	26
Price(P) per quintal	1000	1000	Price(P) per quintal	1000	1000
Total Revenue (TR)=Y*P	26,000	26,000	Total Revenue (TR)=Y*P	28,000	26,000
<b>Variable costs</b>			<b>Variable costs</b>		
Seed cost	100	100	Seed cost	100	100
Fertilizer cost	1,418	1,418	Fertilizer cost	1,418	1,418
Labor cost	3,000	3,000	Labor cost	3,000	3,000
Total Variable costs(TVC)	4,518	4,518	Total Variable costs(TVC)	4,518	45,18
<b>Fixed costs</b>			<b>Fixed costs</b>		

Cost of land	2,000	2,000	Cost of land	2,000	2,000
Total fixed costs (TFC)	2,000	2,000	Total fixed costs (TFC)	2,000	2,000
Total cost (TC) =TVC+TFC	6,518	6,518	Total cost (TC) =TVC+TFC	6,518	6,518
Gross Margin (GM) = TR - TVC	21,482	21,482	Gross Margin (GM) = TR - TVC	23,482	21,482
Profit=GM-TFC	19,482	19,482	Profit=GM-TFC	21,482	19,482

### Farmers' Opinion/Perception

Farmers' in the study area selected the best performing improved sorghum varieties by using their own criteria. Farmers set these criteria after having know-how about the variety and using those criteria they could select the varieties at harvest time. The opinion of those farmers on varietal preference was collected from participants during variety demonstration. The

major criteria used by farmers were Early mature, yield, Disease tolerance, seed color, seed size, performance throughout growing stage, palatability of stalk feed, good nutritional value and food test. Therefore, most farmers selected both improved sorghum varieties to reuse on their farm for the future. The following table describes farmers' selection criteria and their perception (feedback) toward the varieties

**Table 5.** Ranks of the varieties based on farmers' selection criteria

Crop varieties	Farmers rank	Reasons
Melkam	1 <sup>st</sup>	Early mature, Good in yield, Disease tolerance, Good seed color, Good seed size, Very good performance throughout growing stage, Very good palatability of stalk feed, Very good nutritional value and food test
Dekaba	2 <sup>nd</sup>	Relative to early maturity, Good in yield, Relative to disease tolerance, Very good seed color, Very good seed size, Good performance throughout growing stage, Good biomass yield, Relative to good palatability of stalk feed, Relatively good nutritional value and food test

**Table 6.** Pair-wise ranking matrix result to rank variety traits

Code no.	Traits	Early maturity	Yield	Disease tolerance	Seed color	Seed size	Performance	Biomass	Nutritional test	Frequency	Rank
1	Early maturity		2	3	1	1	6	1	1	4	2 <sup>nd</sup>
2	Yield			3	2	2	2	2	2	5	1 <sup>st</sup>
3	Disease tolerance				3	5	6	3	3	3	3 <sup>rd</sup>
4	Seed color					5	5	7	4	1	7 <sup>th</sup>
5	Seed size						5	5	5	3	4 <sup>th</sup>
6	Performance							7	6	1	5 <sup>th</sup>
7	Biomass								7	2	6 <sup>th</sup>
8	Food test and Nutritional value									0	8 <sup>th</sup>

## Discussion

The trial farmers in the three locations are aware of the physical characteristics and field performance of all the maize varieties. The major variety selection criteria of farmers in the two locations were almost similar as a result preferred based on traits nutritional value, early maturity yield, seed color, performance, disease tolerance, palatability of stalk and biomass which are very important for livestock feed as shown table 6. Accordingly, the economic benefit of the sorghum was feasible as shown on table 4 that is 12964 birr and 14964 birr for Malkam in Dodota and Bishan Bahe respectively.

## Conclusion and Recommendation

Before introducing these improved varieties, different smallholder growers have been using the planting material which has been obtained from their local markets, lack of appropriate agronomic practices and a little attention was given to the crop production makes the study area below average for producers, but after this technology is introduced in the study area, these all system changed to improved technology like improved varieties, with full packages start from site preparation to storing. As a result, the yield of the improved varieties Melkam showed statistically significant difference at 10% probability level between two improved varieties across the location, biomass/palatability of the stalk for livestock feed, good in food test and other related criteria. Therefore, Malkam variety is recommended for further scaling up in similar agro-ecology to improve small holder farmers' livelihood improvement and livestock feed security.

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