Progress Report 2019

Melkassa Agricultural Research Center

Ethiopian Institute of Agricultural Research

Progress Report 2019

Organizing and Editorial Team

Shimelis Aklilu	Chairperson
Ahmed Ibrahim	Secretary
Daniel Bekele	Member
Endriyas Gabrekiristos	Member
Laike Kebede	Member
Mulate Zerihun	Member
Bedru Beshir	Supervisor

September 2020
Melkassa

Website: http://www.eiar.gov.et/marc/
Tel: +251 222250214
Fax: +251 222250213
P.O.Box: 436
Adama/Melkassa, Ethiopia

Table of Contents

Preface

Melkassa Agricultural Research Center (MARC) is undertaking large number of research activities on Crops (horticulture and field), Animal Science, Natural Resource Management, Agricultural Engineering and Agricultural Economics, Agricultural Extension and Communication, Plant Protection, Plant Biotechnology, Technology Multiplication, Seed Research and Climate and Geospatial. The center is mainly focuses on irrigated horticultural and dryland crops which are essential for income generation and food security. This Progress Report presents the progress of research activities conducted by MARC and collaborating research centersfor 2019 cropping calendar. Thus, the Progress Report need to be shared among the research communities. It is a key research commuinication document which annually produced to keep the track records of vital research activities conducted in cropping season. Thus it provides the highlights of the major results achieved under government and external funded projects of different research programs/deparments. Progress report documentation is well established tradition in research system to show the main achievement, status and constraints of planned research activities which need to be maintained and strengthened among research community. We keep of this tradition in strongly and timely update the main findings of the center for availing important information for any beneficiaries.

I am highly indebted to all researchers and support staffs for their contribution to this report a reality. My especial appreciation goes to research staffs who prepare their report on time and submited for compilation. I would like to express my heartfelt appreciation to the Organizing and editorial teamfor organizing the main achievement of the center in such well summarized document.

Bedru Beshir (PhD)
Center Director

Agricultural Economics Research Process

Mekonin Sime
E-mail: leul.simek@gmail.com; Phone: +251-911840458

S f fb di df : Agricultural Economics

kfd j rfi 2; Production Economics Research for Agricultural Investment and Smallholder Agriculture

kfd f j e; July 2018 to June 2021

Bd j j j rfi 2; Assessment of economic efficiency of irrigated farming in the CRV of Ethiopia: case of vegetables onion and tomato

Bd j j f j e; July 2018 - June 2021

P ckfd j f ; Document the level of technical efficiency of small-scale irrigated vegetable production in the central rift valley, identify, the main sources of technical inefficiency and its determinants; and make policy recommendations that enhance the economic efficiency of irrigated agriculture in the study area.

f f jc rfi: Tamirat Fikadu and Yared Deribe

S f fe c ; Tamirat Fikadu

Zfb g f ; January - December 2019

T b g h f

Ef jh ; Socioeconomic household survey data collected using multistage sampling, random sampling methods used to select households for major tomato and onion producing districts in the Central Rift Valley of Ethiopia.

M db j ; Central Rift valley of Ethiopia (Adamitulu Jidokombolcha, Dugda, Bora and Adama districts).

S f m

Survey was conducted and data collected from 214 households using structured questionnaire, data cleaning, and organization under way. Whereas, some descriptive analysis on irrigation farming practices for Onion and Tomato production data was analyzed. Results in table 1 revealed that the majority of farmer households used surface and ground water source of irrigation supply system, which is about 58.5% and 36%, respectively. The major type of water application and method of water abstraction of irrigation farming practices was furrow application and using Motor pump in the central rift valley of Ethiopia.

Table 1. Irrigation farming practices for Onion and Tomato production (N=214)

T df gj jhb j	**G f f d**	**f df)&***	**D rb j f f df**
Ground water	77	36	36
Surface water	125	58.5	94.5
Both	12	5.5	100
U f g b f b rjdb j			
Furrow application	212	99	99
Spring irrigation	1	0.5	99.5
Drip irrigation	1	0.5	100
N f i e g b f bc bd j			
Motor pump	209	98.2	98.2
By gravity	2	0.9	99.1
Using rope	2	0.9	100

rb g i f f fb ; Data cleaning, analysis and report writing

Bd j j j rfi 3; Analysis of production efficiency of farmers in smallholder maize farming system

Bd j j f j e; July 2018 - June 2021

P ckfd j f; To investigate the efficiency and productivity of maize producer farmers

f f jc rfi: Yared D., Adam B. and Tamrat F.
Sf fe c ; Yared Deribe
Zfb g f ; January – December 2019
T b g h f
Ef jh ; Panel survey
M db j ; Central Rift Valley (Shalla, AdamiTuluJidokombolcha, Dugda, Boset)
Sf m The first panel data about the maize producer farmers was collected before two years. Important contacts and arrangements were made to engage back the original participant farmers. Training and orientation were given for the data collectors. The survey and collection of the second panel data was performed during this budget year.
rb g if f fb : Future tasks include completion of entry of the second panel data, cleaning, merging of different panel and report compilation.

Bd j j j rfi 4; Analysis of the (seasonal) dynamics of the cost of production of important commodities (maize, common bean, onion and tomato) and technological options under smallholder in the CRV of Ethiopia
Bd j j f j e; July 2018 - June 2021
P ckfd j f0 ; To clarify to policymakers, smallholder farmers and commercial producers the concept of agricultural production costs, output responses to inputs and the use of resources to maximize profit and guide a successful business. To study and document input-output relationships (the cost and profitability) of production for priority agricultural commodities (maize, common bean, onion and tomato) under small-scale and commercial conditions
f 0 f jc rfi; Dereje M., Mekonen S., and Tamirat F.
Sf fe c ; Dereje Mersha
Zfb g if f ; January – December 2019
T b g h f
Ef jh 0 fb f ; Household plot level Survey
M db j ; ATJK, Shalla, Dugda, Bora, and Boset

Sf m
Farm plot-level data was collected from 33 maize, 31 common beans, 36 Onion, and 32 tomato-producing smallholder households. Data entry, cleaning, and data analysis finalized. Report writing is underway. Results of common bean gross margin analysis in figure 1 below indicate that the most important input used in the production of, common bean in the CRV was labor which accounted for 43.87% of costs followed by oxen (25.1%), seed (13.75%) and fertilizer (10.46%).

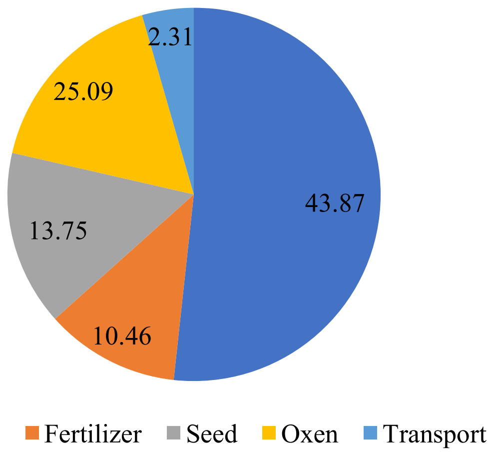


Figure 1. Proportion (%) of cost of common bean production

The results in Table 1 below also indicates that the productivity of haricot bean was about 19730 kg/ha in the study districts a bit similar to the national average (1719 kg/ha). On average, farmers obtained 30254.67 ETB/ha from common bean production with average benefit cost ratio of 3.57.

Table 1. Gross margin of common bean in the CRV 2019

Items	Mean	Std.	Minimum	Maximum
Yield (Qt/ha)	19.73	3.3	12	24
Price (Birr/qr)	1417.19	703.85	800	3600
Yield- Revenue	28422.9	14917.2	12800	86400
Straw-Revenue	1831.73	1191.66	160	4800
Total Revenue (Birr)	30254.67	14860.2	13880	87600
Labor	4760.72	2046.38	948	10835
Fertilizer	1102.2	399.71	200	1795
Seed	1352	514.6	400	1950
Oxen	2902.2	1097.8	200	4800
Tcost	8475.48	3275.53	1988	13835
Gross margin	21779.2	16563.5	5770	84256
RRI (%)	256.97			
BCR	3.57			
Return on labor	635.51			
Return to fertilizer	2744.93			
Return to seed	2237.77			
Return to oxen	1042.47			

rb g i f f fb : Finalize the report for the remaining three crops and publish the report.

h b j rfi 3; Value Chain Dynamics of High Value Agricultural Commodities
kf d f j e; July 2018 - June 2020
Bd j j j rfi 2; Value chain analysis of agro-chemicals: pesticides
Bd j j f j e; July 2018 - June 2020
P ckf d j f; Identification of major chain actors, functions and their relationship

- Mapping of local potential markets for agro-chemicals
- Assessment of the market demand and supply, price-scheduling mechanisms, and market determinant factors
- Identification of major challenges and opportunities to empower the agro-chemical value chains for mutual benefit of all chain actors

f f jc rfi: Etaferahu K., Tamirat F. and staff of crop protection and horticulture team
S f fe c ; Etaferahu Kassa
Zf b g f ; January – December 2019
T b g i f h f
Ef jh ; Qualitative and quantitative data collected using desk reviews (published/unpublished sources) and primary sources (questionnaires and checklists, group discussion (FGD), key informant interviews and expert consultation) followed by A standard method of value chain studies these includes a survey of end users (farmers), intermediaries (traders, processor) andimporters
M db j ; Dugda & Bora districts

S f m

Data collected from 2 districts from 180 farm households and a market survey from 30 chemical dealers and 5 importers collected. Data interred in the computer and cleaning, descriptive analysis done and write up is underway. Pesticide is used not only by farmers but major consumers whose primary occupation is farming.The table below show share of respondents' major occupation.

Table 1. Proportion of respondents by major occupation

Occupation	Frequency	Percent
Farmer only	158	86.34
Civil servant	5	2.73
Trader	16	8.74
Other (Mechanic, laborer, pool)	4	2.19

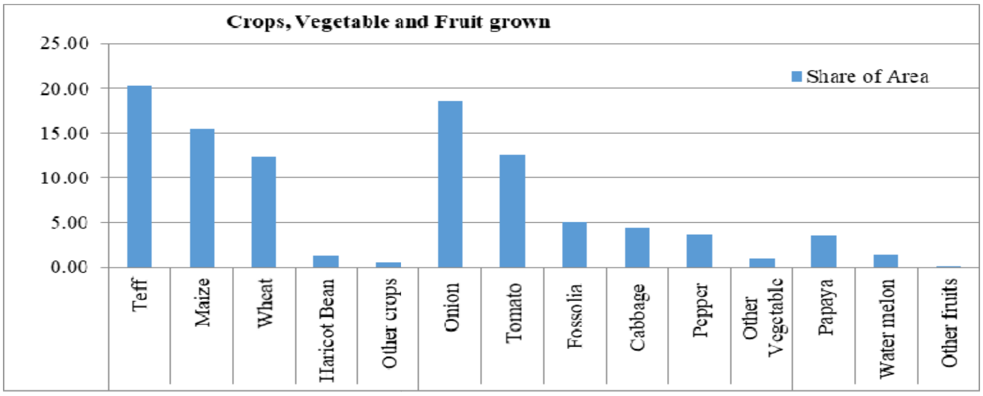


Figure 1. Types of Pesticide used by percentage of respondents

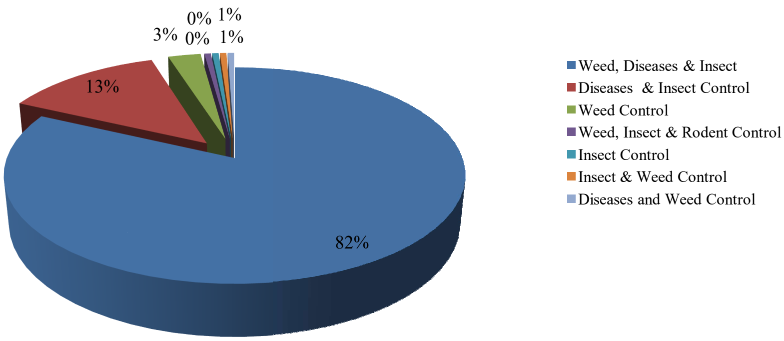


Figure 2: Perentage respondents used pecticides

- Overall, 96% of the respondents used Insecticides, 95% used fungicide for control of disease and 86% use herbicides on their farm in 2010 cropping year.
- Major pesticides used in the area are 2.4D, Agrolambacy, Celecron, Koside, DDT, Dimatot, Malatine, Mancolaxin, Mancozeb, Unizeb, Palace, Rodmill, round up, Stomp, Karatie…
- Major constraints are shown as in the fig. bellow.

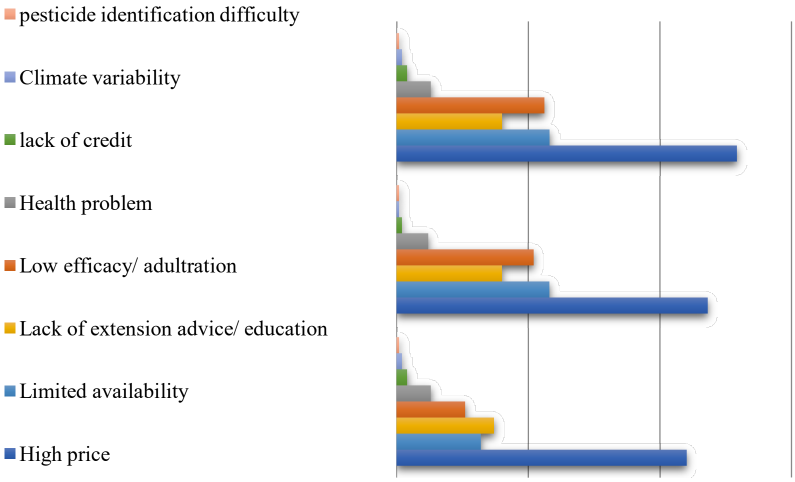


Figure 3: Major constraints on pesticides use efficiency

rb g i f f fb ; Data collection from importers, analysis and report

kfd j rfi 4; The baseline status of agricultural mechanization in KAFACI membercountries

kfd f j e; July 2017 - June 2019

Bd j j j rfi; The baseline status of agricultural mechanization in KAFACI member countries (Ethiopia)

Bd j j f j e; July 2010 - June 2019

P ckfd j f; To understand the status of agricultural mechanization in Ethiopia

f f jc rfi: Yared D., Bisrat G., and Amhed U.

S f fe c ; Yared Deribe

Zfb g f ; January – December 2019

T b g h f :

Ef jh ; Household survey and key informant interviews

M db j ; Oromia (Arsi, West Arsi, Bale, East Shewa, South West Shewa, West Shewa, Jimma), Amhara (West Gojjam, Central Gondar, North Gondar, East Gojjam), SNNP (Gurage, Hadiya, Sidama, Silte, Welayta), and Tigray (South Tigray, Central Eastern Tigray, North Western Tigray)

S f m

The progresses made during the budget year include finalization of the first phase of the baseline survey in Oromia and SNNP regions. The highlights of the results were reported during mid-term evaluation and to the delegates from KAFACI-RDA. During the second phase of the project, the data collection was performed in the selected districts and farmers in Amhara and Tigray regions.

N bk gj ej h

Unlike the state induced past mechanization attempts that came up with failures, some parts of the country are better mechanized since many years ago while the rest areas are still lagging far behind. Quite a few farmers found in acquiring farm machineries on individual purchases. However, the smallholder farmers access mechanization through the private hiring services. Investors, farmer cooperatives, youth groups, and individual farmers are the actors that provide mechanization hiring services.

The study finds that there is a large variation among regions and crop types on the level of access to mechanization and awareness. Overall, the farmers who accessed combine harvesting estimated at 14.42% whereas 14.96% for that of tractor plowing. Land tractorization is the highest for the production of wheat in contrast to other crops. Farmers in the Oromia region have a leading position in the uses of tractors (26.82%) and combine harvesters (28.48) (Table 1). Mechanization service users informed that the most pressing constraint in using mechanization hiring is the unavailability and the high price of the service.

Table 1. Application of mechanical power and level of mechanization in four regions and major cereal crops in Ethiopia

Mechanization practice	Proportion of farmers that have accessed				
	Overall	Oromia	SNNP	Amhara	Tigray
Tractor plowing	14.96	26.82	12.67	4.53	15.83
Tractor harrowing	2.85	7.0	4.0	0.41	0.0
Row planting	0.53	2.1	0.0	0.0	0.0
Chemical spraying	17.47	16.16	22.67	15.23	15.83
Combine harvesting	14.42	28.48	19.33	9.88	0.0
Threshing	2.59	8.7	0.0	0.82	0.83
Maize shelling	6.19	9.46	6.67	8.64	0.0
Pumping of irrigation water	2.27	3.01	4.0	0.41	1.67

The time when farmers started adoptions of mechanization hiring services is declared. It is true that some of the farmers started using tractor plowing, combine harvesting and maize shelling since more than 30 years ago. Despite variations in the adoption time, the general perspective indicates that majority has started using the services during the recent decade. The results are in line with the conclusions as reported in a related study.

Table 2/ Period since the mechanization practices adopted

Mechanical practice	Mean (years)	SD	Max
Tractor plowing	7.41	5.41	30
Harrowing	7.30	5.31	28
Planting/sowing	4.53	2.85	10
Combine harvesting	8.01	7.16	40
Mechanical threshing	2.38	1.57	8
Maize shelling	10.23	9.2	36
Pumping water	3.33	3.25	10
Improved storage	1.75	0.71	3

rb g i f f fb : Future activities include production of proceedings, research reports, and journals on the mechanization baseline information

kfd j rfi 5; Introduction of the high productivity variety in Solanaceae crop and development of customized cultivation technology (KOPIA)

kfd f j e; July 2017 – Dec. 2019

Bd j j j rfi 2; Assessment of pepper production, utilization, and marketing in selected zones and special district of SNPP and Oromia regions of Ethiopia

Bd j j f j e; July2017 – June 2019

P ckfd j f0 ; To assess production and marketing constraints and opportunities of pepper, to identify factors affecting the marketable supply of pepper

f 0 f jc rfi; Dereje M., Mekonnen S., and Yosef A.

S f fe c ; Dereje Mersha

Zfb g i f f ; January – December 2019

T b g h f

Ef jh 0 fb f ; Socioeconomic baseline survey of pepper producing farmers

M db j ; Selected pepper producing areas of SNNPR (Gurage, Silte zones and Hawasazuria) and Oromia regions (Bora and Dugda districts)

S f m

Data entry, cleaning, and data analysis finalized. Report writing is underway.

The survey results in table 1 below indicates that about 40.16% and 33.07% of sampled producers purchased seed from the local market and use their own saved seed for red pepper production, respectively. And also for green pepper production purpose about 43.18% and 38.64% of sample producers got the seed from private seed suppliers and local markets respectively.

Table 1. Sources of pepper seeds for sample respondents

S fe f f df)&*	Districts					
	Hawasa Zu (N=39)	Halaba (N=34)	Sankura (N=21)	Dalocha (N=33)	Total	t-value
Own saved	5.13	52.94	28.57	48.48	33.07	
Government extension	7.69	2.94			3.15	
Privet seed suppliers	17.95	14.71		6.06	11.02	
A gift from family/Neighboring	5.13	2.94			2.36	49.92***
Farmer seed exchange	10.26			3.03	3.94	
Local market	53.85	20.59	57.14	33.33	40.16	
Local seed producers		2.94	14.29	9.09	5.51	
Provided free by NGOs		2.94			0.79	

H ff f f df	Dugda (N=32	Hawasau Zu (N=12)	Total (N=44)	t-value
Government extension		16.67	4.55	
Privet seed suppliers	53.13	16.67	43.18	
Farmer seed exchange	3.13	8.33	4.55	
Local market	34.38	50.00	38.64	12.91*
Farmers groups/coops	3.13		2.27	
Local seed producers		8.33	2.27	
Research institutions	6.25		4.55	

The result in table 2 below shows that 37.8% and 21.95% of the respondents are using MarekoFana and Halaba varieties. From the total respondents of HawasaZuria (N=44) and Halaba special district (N=34) are using 72.73% and 88.24% of MarekoFana and Halaba varieties for red pepper production purpose respectively.

Table 2. Type of variety the sample households are using (for red pepper purpose) in %

	Districts						
Variety	Dugda (N=32	Hawasa (N=44)	Halaba (N=34)	Sankura (N=21)	Dalocha (N=33)	Total (N=164)	t-value
Halaba		6.82	88.24	9.52	3.03	21.95	
Local		2.27		14.29	27.27	7.93	
MarekoFana		72.73	11.76	66.67	36.36	37.80	301.47***
Not planted	32.00	11.36				22.56	
Tadale				9.52	6.06	2.44	
Unknown		6.82			27.27	7.32	

The result in table 3 below shows that 15.24% of the respondents are using Vigro/Becker variety. From the total respondents of Dugda district (N=32) are using 78.13% Vigro/Becker and 12.50% serened/shanti varieties for green pepper production purpose respectively.

Table 3. Type of variety the sample household using for green pepper purpose

	District						
Variety	Dugda (N=32	Hawasa (N=44)	Halaba (N=34)	Sankura (N=21)	Dalocha (N=33)	Total (N=164)	t-value
Vigro/Becker	78.13					15.24	
Unknown		2.27				0.61	
Halaba		4.55				1.22	
MarekoFana	3.13	4.55				1.83	
Melkashote	3.13					0.61	196.8***
Melkazala	3.13					0.61	
Mitmita		15.91				4.27	
Not planted		72.73	100.00	100.00	100.00	73.17	
Serened/Shanti	12.50					2.44	

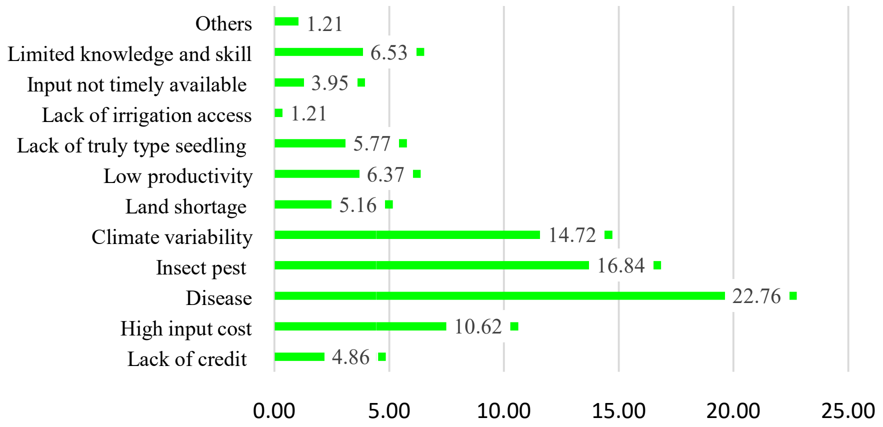


Fig. 1. Major Production constraints of pepper (%)

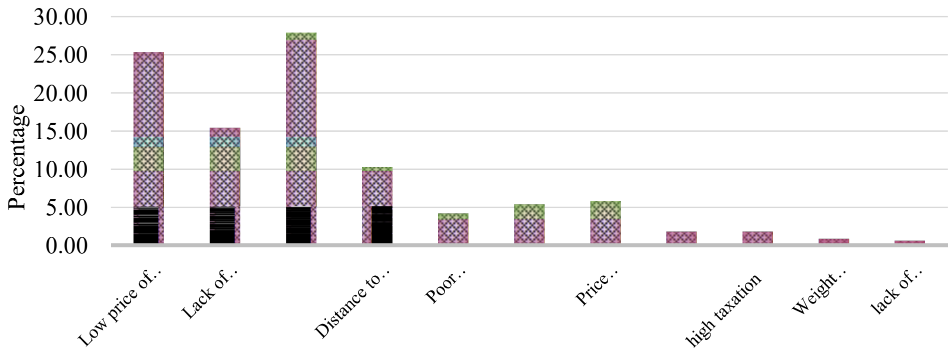


Fig 2. Major marketing constraints of pepper (in %)

rb g i f f fb : Finalize the report for the remaining parts and publish the report.

kf d j rfi 6; Harnessing Opportunities for Productivity Enhancement (HOPE) Phase II of Sorghum and Millets in sub-Saharan Africa and South Asia

kf d f j e; July 2018 - June 2021

Bd j j j rfi 2; Comparative analysis of yield and profitability of improved and local varieties of sorghum in major sorghum growing areas of Ethiopia

Bd j j f j e; July 2018 - June 2021

P ckfd j f; To study the productivity and compare the cost and returns of local and improved sorghum varieties, to clarify to policy makers, smallholder farmers and stakeholders that interplay sorghum verities production costs, output response to inputs and the use of resources to guide a successful farming.

f f jc rfi: Tamirat Fikadu and Etaferahu Kassa

S f fe c ; Tamirat Fikadu

Zf b g f ; January – December 2019

T b g h f

Ef jh ; Plot level survey and input-output relationship on the costs and returns associated with sorghum production.

M db j ; major sorghum growing areas AtsedeTsimbla, T/Adiabo, Raya Kobo, Shewarobit, Miesso and Fedis (East and west Harerge, North Shewa, East Wello and Shire zones)

S f m

Farm plot level data was collected from 180 sorghum producing smallholder households.

rb g i f f f b ; Data entry, analysis, and report writing

Bd j j j rfi 3; Farmers’ trait preferences, yield and profitability of improved over local varieties of sorghum for men and women sorghum farmers

Bd j j f j e; July 2018 - June 2021

P ckfd j f; To identify farmers’ trait preferences, yield and profitability of improved over local varieties of sorghum for men and women farmers

f f jc rfi: Etaferahu K., Tamirat F. and staff of sorghum team

S f fe c ; Etaferahu Kassa

Zf b g f ; January – December 2019

T b g i f h f ;

Ef jh ; Qualitative and quantitative data collected using desk reviews (published/unpublished sources) and primary sources (checklists, group discussion (FGD), key informant interviews and expert consultation).

M db j ; East and West Hararge, North Shewa, North and South Wollo, South and North West Tigray.

S f m

In the study area sorghum produced for both human consumption and its biomass for feed however the weight given for the grain objective is higher and ranging from 70-90% while the biomass took the minimum 10 and maximum 30% of the benefit. Final grain and biomass allocation share is shown in the figs. Bellow,

Across the different household types and districts; early maturity, draught tolerant, yield and injera making quality are the major traits preferred by farmers though the ranking among household types differ. The figers bellow illustrates the preference for the different traits and their percentage preference among the stated traits.

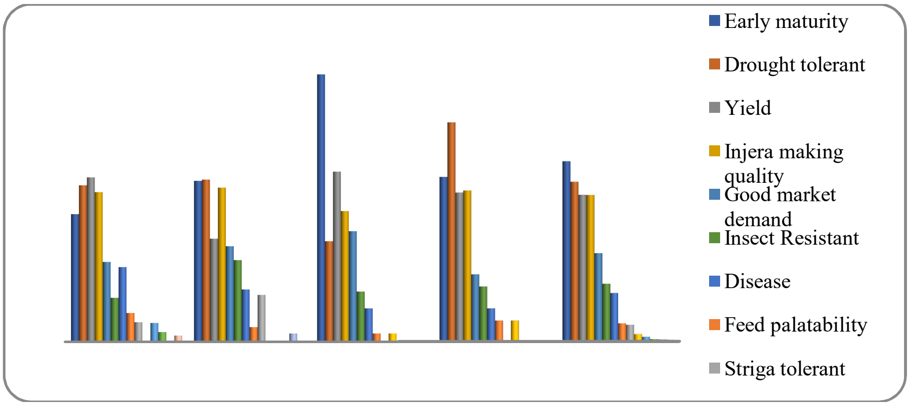


Figure 1. Trait preference across household type

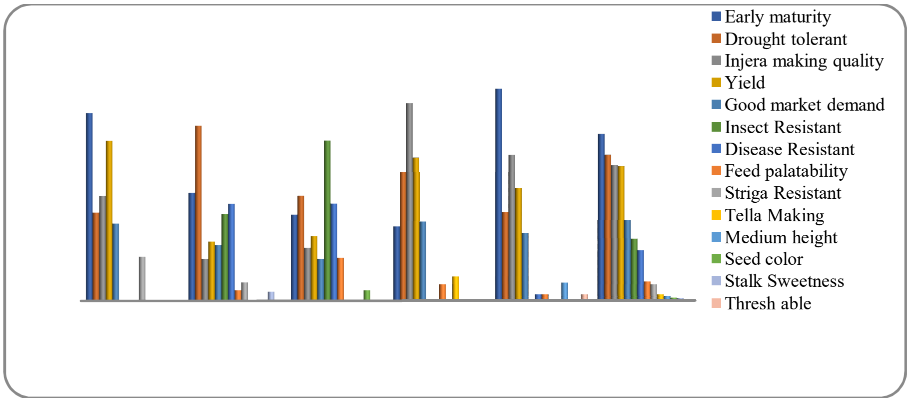


Figure 2. Trait preference across districts

rb g i f f fb ; refining the draft report and final submission.

Bd j j j rfi 4; Adoption monitoring to track year-to-year changes in uptake of improved variety developed for the target agro-ecologies

Bd j j f j e; July 2018 - June 2021

P ckfd j f; To track year-to-year changes and to generate information in uptake of improved variety

f f jc rfi: Etaferahu K., Tamirat F, and staff of sorghum team

S f fe c ; Etaferahu Kassa

Zfb g f ; January – December 2019

T b g i f h f

Ef jh ; qualitative and quantitative data will be collected using desk reviews (published/unpublished sources) and primary sources (key informant interviews, expert consultation and farm household survey will be employed to collect the necessary information). Spreadsheet will be developed for the target agro-ecologiesto track year-to-year changes in uptake of improved variety

M db j ; East and west Hararge, North Shewa, North and south Wollo, South and North West Tigray

S f m

- Desk review is undertaken
- Site selected and questioner prepared, sampling method selected

rb g i f f fb ; Data collection and analysis

Bd j j j rfi 5; Assessment of farmers' "willingness" "to pay" for improved sorghum seed

Agricultural Extension and Communication Research Process

Fitsum Miruts
E-mail: fitsummiruts@gmail.com; Telephone: +251 911079429

df ; Agricultural Extension and Communication (AEC) Research

kfd j rfi 2: On Farm Technology Demonstration

kfd f j e; July 2017 – June 2020

Bd j j j rfi 2; Pre-extension Demonstration of Improved newly realized common bean variety in the Central Rift Valley of Ethiopia

Bd j j f j e; July 2017 – June 2020

P ckfd j f ;To evaluate the performance of newly released common bean varieties with their production practices for increased production and create awareness and develop confidence among farmers, development agents, agricultural experts and policy makers

S f jc rfi f ; Belay R, Abebe. G, Bedru B., Berhanu A.

S f fe c ; Belay Roba

f j e g f ; January – December 2019

T c f # f 312:

Ef jh ; Demonstration plots
U fb f ; Improved common varieties (SER-119, SER-125, Awash-2 and Nasir as standard check)
M db j ; Adamitulu Jidokombolcha, Shala and Adama

Sf m

Based on the previous year's demonstration result and farmers' preference across the district, popularization of selected varieties was conducted through a cluster approach for wider demand creation of the technology/ varieties. The popularization was conducted at three districts (Adamitulu-Jidokombolcha, Shalla and Adama). Research site identification and farmers selection were done in collaboration with development agents. Accordingly, 10ha of land at Shalla, 6.55ha at Adamitulu-Jidokombolchaand 9ha at Adama with a total of 25.55 ha of land covered during this popularization. The popularization of the varieties was done in 45 farmers (39 men and 6 women). Training has been given for hosting farmers, experts, and DAs. Emergency and yield data recorded and analyzed. Three Field day have been conducted and extension materials have been distributed and lastly, farmers' preference through the pair-wise ranking of farmers selection criteria was done, and farmers compare the criteria and rank them in order of importance.

Table 2. Average yield results of common bean varieties accross location

District	Cluster kebeles	Area (ha)	Varieties yield (Qt/ha)			
			SER-125	SER-119	Awash-2	Nasir
Adama	GurajaFurda	9			20.2	
Shalla	Awara-Gama	5	24.4			
		5		23.2		
ATJK	Oda-Ashura	6.55				19.6

rb g i f f fb ; The selected varieties will be promoted to LSD

Bd j j j rfi 4; Popularization of improved Cowpea-Bole- in West Hararge
Bd j j f j e; July 2017 to June 2020
Pckfd j f ; To enhance seed availability and dissemination of improved variety of cowpea for increased production and create wider demand by reaching large number of users over wider area
Sf jcrfi f ; Belay R., Abebe T, Bedru B and Berhanu A
Sf fe c ; Belay Roba
f j e g f ; January – December 2019
T b g if h f
Ef jh ;Small pack (1 kg)
U fb f ; Cowpea bole variety
M db j : Mieso, Gumbi-Bordode

Sf m

The popularization of cowpea (Bole) and its production practices in west hararghe zone, Mieso and Gumbi-Bordode district have been conducted. Prior to the implementation of the activities, the workshop has been organized for one day to share responsibility for each other and for the successful accomplishment of the activities. Farmers, agricultural development workers, district seed enterprises, union, farmer's cooperatives, and MARC have participated. The popularization of Cow-pea (Bole) has been conducted on twenty-six (26) clustered farmers (18 men, 8 women). Cluster farm selected in collaboration with DAs. A total of 10 Ha which is located was covered in two kebeles (OdaKananiandOdarobakebeles).

Table 3. Number of farmers participated in popularization of cowpea by location

District	Kebele	Plan	Planted	Failed	Success	Remark
Gumbi Bordede	FugnanAjo	25	0		0	No rain at planting time
	Chitu Kora	25	0		0	
	Dire Kalu	25	25	3	22	
	Aneno	25	24	6	18	
Mieso	HaremeroDeyima	100	75	75	0	Late planted, shortage of rain,
	OdaKeneni	100	100	63	37	
	Torbeyo	50	49	0	49	

Table 4. Average yield performance

Cluster Kebele	Area (ha)	Yield in Qt/ha
Odaroba	5	128
Odakeneni	5	125
Average	10	24.2

rb g if f fb ; promotion of the activity to LSD

Bd j j j rfi 5; Popularization of QPM varieties with their associated management practices in central valley of Ethiopia

Bd j j f j e; July 2017 to June 2020

Pckfd j f ; to widely develop awareness and interest among stakeholders in maize production and utilization value chain and enhance seed availability and dissemination improved varieties of QPM for increased production

S f jc rfi f ; Belay R., Abebe T, Bedru B and Alemishet, L

S f fe c ; Belay Roba

f j e g f ; January – December 2019

T b g if h f

Ef jh ; Small pack (3 kg) seed dissemination

U fb f ; MHQ-138 and BHQ-548

M db j : Adama, Dugda, ATJK and Shalla

S f m

Farmer's preference and yield data were taken during the execution of the pre-extension demonstration of improved maize varieties. Based on the result, MHQ-138 was recommended by the farmers for further popularization in the central rift valley of Ethiopia. However, due to the unavailability of the seed of MHQ-138 QPM, the second early matured and higher yielder variety (BHQ-548) was popularized. The popularization of selected improved QPM and its production practices at the Central Rift Valley of Ethiopia Adama, Dugda, ATJK, and shalla District have been conducted. Small seed packs (3 kg) used to popularize for new varieties and demand was created through demonstration and field days. In this activity, three kg maize seeds were distributed to 300 farm households involving 60% women and 40% for men in the Central Rift Valley areas.

rb g if f fb ; Monitoring and evaluation of popularization activities

Bd j j j rfi 6; Pre-extension Demonstration of Improved Onion Production Technologies on farmers' Fields in the Central Rift Valley of Ethiopia

Bd j j f j e; July 2017 - June 2020

Pckfd j f ; To evaluate the performance newly released varieties of onion with their associated management practices for increased production and o create awareness on the newly released improved onion varieties with their recommended technology packages

S f jc rfi f ; Gadisa E, Fitsum.M, Jibicho G., Tasfa. B.

S f fe c ; GadissaEjersa

f j e g f ; January – December 2019

T b g if h f

Ef jh ; Demonstration plotsa
U fb f ; Improved Onion varieties (Nafis, Nasik red and Bombay red)
M db j ; Adamitulu Jidokombolcha, Dugda, Lume, Lode-Hetosa and Adama

S f m

Two onion varieties (Nafis and Nasik red) were demonstrated by using Bombay red as a check. The demonstrations were conducted at six districts (Adamitulu-Jidokombolcha, Dugda, AdamituluJidokombolchaDugda, Lume, Lode-Hetosa and Adama). Twenty-four farmers (2 female, 4 youth and 18 male farmers) have participated in this demonstration as a host farmer. The minimum demonstration area was 0.125 ha of land per person and about 5ha of land was covered. Module-based training was prepared and training is given for farmers and other stakeholders involved in the demonstration from the six districts in the 2012 production year. The summary of farmers, Extension agents, Development agents, and other stakeholders who participated in the demonstration was given below.

Table 5. Comositionand number of trainings participants, 2019

Participant	Male farmers	Female farmers	Total
Farmers	47	5	52
Agricultural Experts	7	1	8
Development Agents	9	1	10
Others	10	2	12
Total	73	9	82

Table 6. Comositionandb number of field dayparticipants, 2019

Participant	Male farmers	Female farmers	Total
Farmers	174	29	203
Experts and Development agents	13	2	15
Others	5	0	5
Total	192	31	223

During the field day, the program has got media coverage through OBN TV. Besides, Farmers tried to rank the demonstrated varieties (Nafis, Nasik red and Bombay red) as follows.

- Nafis variety- High yield than the other varieties, insect and disease resistance, and good pungency
- Nasik red variety - Full redness of the bulb color and price at the farm gate is good.

Generally, Nafis ranked first, Nasik red was the second and Bombay red was the least in almost all of the preference parameters at field visit.

Table 7/ Onion bulb yield in qt/ha, 2019

Districts	Average Yield in qt / ha		
	Nafis	Nasik red	Bombay red
Adama	379.3	337.5	302.1
A/T/J/K	186.5	223.5	163.9
Lume	310.9	266.7	223.8
Dugda	158.2	153.8	124.96

rb g i f f fb ; finalizing report

Bd j j j rfi 7; Pre-extension Demonstration of Improved Pepper and Chili Production Technologies on farmers' Fields in the Central Rift Valley of Ethiopia
Bd j j f j e; July 2017 – June 2020
P ckfd j f ; To increase the production of improved pepper and chilly varieties in the Central Rift Valley of Ethiopia and to create awareness on the newly released improved pepper & chilly varieties with their recommended technology packages

S f jc rfi f ; Gadisa E, Fitsum. M, Jibicho G., Tasfa. B.
S f fe c ; GadisaEjersa
f j e g f ; January – December 2019
T b g i f h f
Ef jh ; Demonstration plots
U fb f ; Mereko Fana, MelkaShote, Malka Awaze, Melka Dera, Melka Oli varieties were demonstrated
M db j ; Dugda and Lume districts

S f m
Four farmers (4 male) participated in the demonstration. Farmers prefer MalkeDera is the highest yield and Malke awaze is the next highest yield obtains at Adami Tulu JidoKombolcha, GarbiWedanaBoramo. Yield comparison in both GerbiWedanaBoramo and Edo Gojolakebele shows that MalkeDera is an outstanding variety in yield and Malke awaze is taken the second place. Even though MalkeDera gives the highest yield, Malke Awaze is preferred by the farmers due to its good market good price (Tables 8 and 9).

Table 8. composition of training participants on Hot pepper and Chilli, 2019

Participants	Male	Female	Total
Farmers	20	2	22
Experts and Das	14	1	15
Others	5	0	5
Total	39	3	42

Table 9. Field day on hot pepper and Chilli

Participants	Numberof participants		
	Male	Female	Total
Farmers	32	9	41
Experts and Das	6	1	7
Media	2	2	4
Experts and Das	16	0	16
Total	56	12	68

During the field day farmers, the perception was recorded. Farmers perceive that Melkadera variety has high yield and it is deep green fruit color that can have a high market price. Melka awaze was also put as a second preferred variety next to Melkadera. Melka awaze has good fruit size and fully ripen. The variety also has good resistance to insects and disease. Due to the early flowering stage and good vigorous in the field, Melaka oli is good.
rb g i f f fb ; yield data will be recorded and additional demonstration plots will be established in new locations.

Bd j j j rfi 8; Pre-extension demonstration of tomatoes technologies in the CRV of Ethiopia
Bd j j f j e; July 2017 - June 2020
P ckfd j f ; To increase the production of tomato in Central Rift Valley of Ethiopia and to create awareness on the newly released improved tomato varieties with their recommended technology packages
S f jc rfi f ; Gadisa E, Fitsum. M, Jibicho G., Tasfa. B.
S f fe c ; Gadisa Ejersa
f j e g f ; January – December 2019
T b g i f h f
Ef jh ; Demonstration plots
U fb f ; Gelilema, ARP-Tomato-D2 and Chali
M db j ; Adama, Lume, Dugda and Adami Tulu JidoKombolcha districts

S f m

Tomato varieties transplanted on 7 farmers in the last winter at Adama and Adami Tulu JidoKombolcha districts. Due to tomato bacterial late blight at Adama district (Malke-Hidakebele) and Adamitulu JidoKombolcha (Edo Gojola kebele) the seedling at main field was damaged. At a time, all parts of infected tomatoes were collected from field seen in laboratory of crop protection research team. The results of the examinat confirmed as there is bacterial leaf blight and in viral disease. After one to two weeks field travel the entire field infected and the farmers was decided to plant other crop.

rb g i f f fb ; seedlings will be transferred to demonstration plots

Bd j j j rfi 9; Pre-extension demonstration of cassava production and utilization in CRV of Ethiopia.

Bd j j f j e; July 2019 – June 2020

S f jc rfi f) *; Tigist G., Fistum M., Edosa E. and Mulat Z.

S f fe c ; TigistG.

f j e g f ; January – December 2019

T b g i f h f ;

Ef jh ; Demonstration plot

U fb f ; Qulle, Kello. Awassa-83, Chucho

M db j ; Adama, Dodota, Boset, Jeju

S f m

The demonstration was established in four weredaAdama, Jeju, Boset, and Dodota on 22 farmers (20 women and 2 men). Site and farmer selection was made in collaboration with DAs and district agricultural experts. Qulle, Kello, Awassa-4, and Chucho cassava varieties were used in the demonstration. Practical and theoretical training was given for farmers, experts, DAs about cassava crop management and practices. The demonstration field was monitored properly with the development agents and district experts. Food recipe preparation training was given for health extension, DAs, district experts, and farmers.

Table 10. Training on Cassava crop management and practice

Training participants	Men	Women	Total
Farmers	2	20	22
District Experts	4	0	4
DAs	6	1	7
Total	12	21	33

Table 11. Training on Cassava food recipe preparation and utilization

Training participants	Women	Men	Total
Health extension officers	4	0	4
District experts	0	3	3
Developmental agents	2	3	5
Women farmers	14	1	15
Total	20	7	27

rb g i f f fb ; Collect farmers' perception and finalize the report

Bd j j j rfi : ; Pre-extension demonstration of sweet potato production and utilization in CRV of Ethiopia.

Bd j j f j e ; July 2019 to June 2021

S f jc rfi f) *; Tigist G., Fistum M., Edosa E. and Mulat Z

Reported by: TigistG.

f j e g f ; January – December 2019

T b g i f h f ;

Ef jh ; Demonstration plot

U fb f ; Awassa-83, Kulfo, Barkume
M db j ; Adama, Adamitulu Jidokombolcha

S f m

Sweet potato varieties were demonstrated in two districts Adamitulu Jidokombolcha and Adama. Totally three kebele with three different varieties Awassa-83, Kulfo, Barkume varieties were planted in a farmer's field (16 women and 2 men). At the beginning of the demonstration practical and theoretical training was given to farmers, DAs, district experts on sweet potato production and management practices. In addition to this, training was provided for different stakeholders including health extension workers on sweet potato food recipe preparation and utilization. Farmers prefer Awassa-83 due to its test also it gives higher yield than kulfo and Barkume based on farmers' feedback.

Table 12. Training on sweet potato production and management practices

Training Participants	Men	Women	Total
Farmers	2	10	12
District experts	2	0	2
Development agents	2	2	4
U bm	6	12	18

Table 13. Training on sweet potato food recipe preparation and utilization

Training Participants	Women	Men	Total
District experts	0	2	2
Health extension	3	0	3
Developmental Agents	2	2	4
Women farmers	13	0	13
Total	18	4	22

rb g i f f fb ; Collect farmers' perception and finalize the report

kfd 3; Cluster based horticultural technology commercialization in selected areas of Ethiopia
kfd f j e; July 2017 – June 2020
Bd j j j rfi 2: Popularization of improved Avocado technologies in Ethiopia
Bd j j j rfi 3; Popularization of improved Mango technologies in Ethiopia
Bd j j j rfi 4; Popularization of desert Banana in the CRV of Ethiopia
Bd j j j rfi 5; Popularization of Papaya technology in the CRV of Ethiopia
P ckfd j f ; To enhance production and productivity of fruit crops (Avocado, Mango, Papaya and Banana) through wider scaling up of improved technologies and to enhance institutional and functional linkages with key players through joint actions and performances.
S f jc rfi f ; Fitsum M., Gadissa E., Bedru B., Wegayehu and Girma K.
S f fe c ; Fitsum Miruts
f j e g f ; January – December 2019
T b g i f h f
Ef jh ; cluster area
M db j ; Lume, Dugda, Sire, Jeju, Fentale, Efratanagidem, Adama, Bosset & Dodota

S f m

The popularization of fruit technologies is underway across the proposed districts. First, participants were selected in collaboration with district experts and kebele development agents. After participant selection practical and theoretical training was conducted on fruit management, production and protection technologies. A total of 3636 seedlings were distributed for 161 fruit growers to strengthen the fruit cluster areas. Currently, we have 14 fruit cluster areas (four clusters for avocado, three clusters for mango, for papaya we have five clusters and for banana two clusters).

Table 14. Fruit technology popularization participants and number of seedlings distributed

Numnerof Farmers	Fruit seedlings and number				
	Avocado	Mango	Banana	Papaya	Total seedlings
161	629	1684	0	1323	3636

rb g i f f fb ; cluster areas will be further strengthen

Farm Power and Field Machinery Research Program

Mubarek Mohammed
Email: mubamod@gmail.com; Phone +251912067213

S f fb di df ; Agricultural Engineering
h b 0db f fb ; Farm power and Field Machinery Research
kfd 2; Introduction of pre- and post-harvest technologies for increased production of citrus, mango, avocado and tomato
kfd f j e; July 2017 - June 2020
Bd j j 2/2; Evaluation and introduction of mechanical weeder in citrus and mango farms
Bd j j f j e: July 2017 - June 2020
P ckfd j f; To evaluate and introduce mechanical weeder in citrus and mango farms
S f jc rfi f) *; Ahmed Oumer & Tahir Tune
S f fe c ; Ahmed Oumer
f j e g f : January – December 2019
T b g i f h f
Ef jh ; Assessment, design, fabrication and comparative evaluation in T-test
U fb f ; Power operated offset rotary tiller and conventional method of weeding
M db j ; Melkassa

S f m

After visiting, the horticultural fields in the centre and in some parts of the country, power operated offset rotary tillers were selected as the option to address the issue. However, power operated offset rotary tillers compatible to existing tractor size was not obtained during the assessment. Thus, new design was developed (Fig 1); and repeated functional test was conducted, based on that several improvements were done especially on the power transmitting component.

Fig 1. The power operated offset rotary weeder during field evaluation

rb g i f f fb ; Comparative evaluation of the new power operated offset rotary tiller and the conventional method of weeding on citrus farm will be conducted starting from early April 2020 at Melkassa. After applying possible refinements on the prototype developed (based on the observations made and the feedbacks of involving stakeholders), the second trial will also be conducted.

kfd 3; Adaptation, development and promotion of small-scale mechanization technologies for root and tuber crops (onion and potato)
kfd f j e; July 2017 - June 2020
Bd j j 3/2; Adaptation, development and promotion of tractor driven tillage implement (ridger) for onion and potato seedbed preparation
Bd j j f j e: July 2017 - June 2020
Pckfd j f; To evaluate, adapt, develop and promote tillage implement (ridger/bed maker) for onion and potato
S f jc rfi f) *; Meseret Abebe and Tahir Tune
S f fe c ; Meseret Abebe
f j e g f : January – December 2019
T b g i f h f
Ef jh ; Assessment, improvement, design fabrication and field-testing using T-test in three replications
U fb f ; 40HP drawn four bottom ridger and Conventional method of ridging
M db j ; Melkassa, Dugda and Lode-Hetosa

S f m

Assessment of available ridger compatible to small horsepower tractor (40Hp) was conducted in the market and research institutes. However, ridgers, which match the output of such tractors couldn't be obtained. Thus, new design had to be developed. The ridger is designed to have four bottoms and by now, we have a functional porotype. Preliminary test was conducted, and promising result were obtained.Technology was tested at heavy soil such as kulumsa research center, from which technology require modification specially furrow opener part and hardened material should be used.

Table 1. Preliminary field test result for tie-ridger

Parameters	Ridge Spacing	Ridge depth	Furrow width	Ridge Width
Mode	63.0	19.0	55.0	13.0
Mean	63.2	19.0	54.9	12.5
Median	63.0	19.0	55.0	13.0
St. dev.	0.4	0.7	0.5	1.2
Co-eff. of var.	0.7	3.7	0.9	9.2
Max.	64.0	20.0	56.0	14.0
Min.	63.0	18.0	54.0	10.0
Field capacity	5.6 hr/ha			

Fig 2. Manufactured prototype of ridger

rb g i f f fb ; Further evaluation will be done at Melkassa, which is light soil up to June 2020. Based on the field findings and feedback from the stakeholders, refinements will be made if required.

Bd j j 3/3/ Adaptation, development and promotion of tractor driven potato planter
Bd j j f j e: July 2017 - June 2020
P ckfd j f; To evaluate, adapt, develop and promote tractor driven potato planter
S f jc rfi f) *; Eyob Hailu, Meseret Abebe and Tesfaye Asefa
S f fe c ; Meseret Abebe
f j e g f ; January – December 2019
T b g i f h f
Ef jh ; Assessment, improvement, design fabrication and field-testing using T-test in three replications
U fb f ; 40HP drawn three row planter and conventional method of potato planting
M db j ; Melkassa, Dugda and Lode-Hetosa

S f m

Assessment of available potato planter compatible to small horsepower tractor (40Hp) was conducted in the market and research institutes. However, potato planter which could match the output of such tractors was not obtained. Thus, new designed potato planter was designed with three rows, but the prototype what we generate is only for two rows, reason is for ease of fabrication process andthis technology is functional from field observation

Table 2. Performance evaluation of 4WT power driven potato planter.

Statistical parameters	Tuber spacing	Tuber depth	Furrow width	Furrow depth	Field Capacity
Mode	32	12	52	27	
Mean	43	12.8	51.7	27.7	
Median	45	13	52	27.5	9.2hr/ha
St.dev.	11.3	13	52	27.5	
CV	25.1	9.3	2.7	4.7	
Max	66	15	53	30	
Min	30	10	48	25	

rb g i f f fb ; Preliminary field test was conducted further field test and evaluation is expected to be completed by the end of June 2020.This will be done by comparing new potato row planter and the conventional method on thisoff-season using irrigation at MARC. Based on the field findings and feedback from the stakeholders, refinements will be made if required.

Bd j j 3/4; Adaptation, development and promotion of tractor driven onion trans-planter
Bd j j f j e: July 2017 - June 2020

P ckfd j f; To evaluate, adapt/ adopt, develop and promote onion planter/ trans-planter
S f jc rfi f) *; Meseret Abebe, Mubarek Mohammed and Ahmed Oumer
S f fe c ; Meseret Abebe
f j e g f : January – December 2019
T b g i f h f
Ef jh ; Assessment, improvement, design fabrication and field-testing using T-test in three replications
U fb f ; Self-propelled (12-15HP) onion trans planter and Conventional method of onion planting
M db j : Melkassa, Dugda and Lode-Hetosa

S f m
Assessment of available onion trans-planter (12-15Hp) was conducted in the market and research institutes. However, the machine could not be obtained. Thus, new design had to be developed based on design information available from rice trans-planter. The design has been completed; however, the manufacturing process hasstartedlatelyand, availing workable prototype and evaluation work is expected to be completed up toJune 2020.

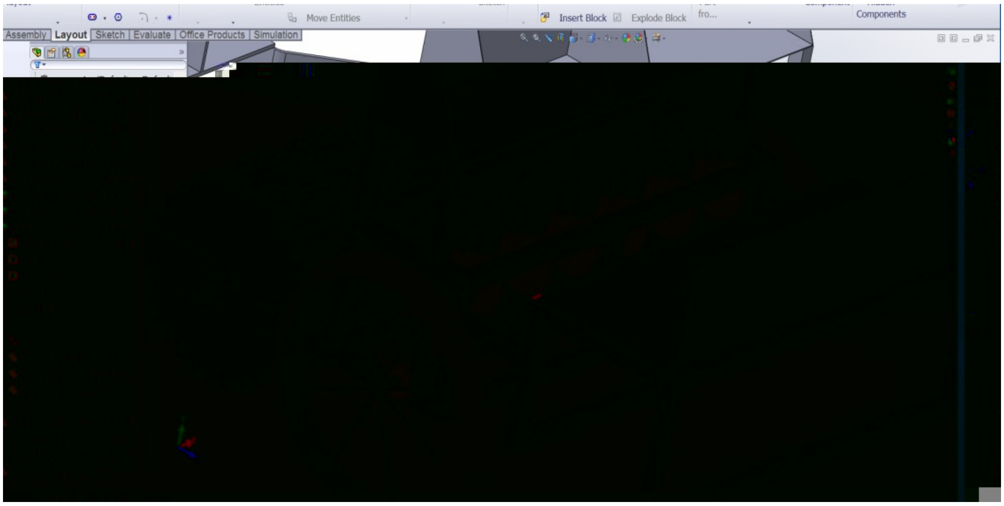


Fig 4: 3D model of onion trans planter

rb g i f f fb ; Manufacturing the technology and field evaluation of the new onion trans planter will be conducted until June 2020.

kfd 4; Increased production of rice crop through the introduction of pre-harvest and postharvest agricultural engineering technologies
kfd f j e; July 2017 - June 2020
Bd j j 4/2: Conduct farm mechanization survey in rice production
Bd j j f j e: July 2017 - June 2020
P ckfd j f; To study the farm operations at different stages of crop production, processing and storage
S f jc rfi f) *; Yared D., Bisrat G., Abiy S. Merhsa A. & Melese A.
S f fe c ; Bisrat Getnet
f j e g f : January – December 2019
T b g i f h f
Ef jh ; Stratified sampling
M db j ; Fogera, Libokemem, Dera.Guraferda & Somali

S f m : Survey, data input and report writing are completed.

rb g i f f f b : Fine tuning of the report

Bd j j 4/3: Introduction of power tiller with rotary till for rice cultivation and manual upland weeder

Bd j j f j e: July 2017 - June 2020

P ckfd j f; To evaluate and demonstrate rice power cultivator and manual upland weeder

S f jc rfi f) *; Mubarek M., Mersha A. & Tigist ,

S f fe c ; Mubarek Mohammod

f j e g f : January – December 2019

T b g i f h f

Ef jh ; RCBD in three replications

U f b f ; Walking tractor attached MBP and conventional method of ploughing (Maresha)

M db j ; Fogera, Libokemem and Dera.

S f m

The experiment was conducted for the past two main cropping seasons. Partial data analysis was conducted from which it has been observed that three times tillage frequency of 2WT attached implement showed better performance in terms field capacity, but for the case of 2nd and 1st time tillage it doesn't show any significant difference between conventional one.

Table 3. Performance evaluation result of 2WT power driven tillage implement versus conventional one for the case of three times tillage frequency

Location	Fogera		Libukemkem		Dera	
Treatment	Tractor	Conv	Tractor	Conv	Tractor	Conv
Till frequency	3	3	3			
Soil MC (%)	37.35	38.37	38.24	37.77	39.67	39
Soil BD(g/cm3)	1.057	1.057	1.057	1.057	1.057	1.057
Actual Furrow W(cm)	29.45	25.77	31.26	25.22	33.22	24.06
Theoretical width(cm)	40	30	40	30.9	40	31.5
No. of turn (ha)	340	388	320	397	301	416
Furrow Depth (cm)	18	16.56	19.44	18.78	21.33	20.1
Fuel con(l/ha)	9.8	0	10.3	0	9.7	0
Oper. time (hr/ha)	9.33	18.33	8.5	17.25	8	19.4
Oper. Dist(km)	34	38.8	32	39.7	30.1	41.6
Speed(km/hr)	3.64	2.11	3.76	2.3	3.76	2.14
TFC(ha/hr)	0.146	0.063	0.15	0.071	0.15	0.0674
AFC(ha/hr)	0.136	0.054	0.144	0.058	0.143	0.0515
Field efficiency (%)	93.15	86.3	96	81.69	95.33	76.4

rb g i f f f b : Data analysis and report writing will be finalized until June 2020

Bd j j 4/4: Introduction of mechanical rice trans-planter

Bd j j f j e: July 2018 - June 2021

P ckfd j f; To introduce and adapt mechanical rice trans-planter

S f jc rfi f) *; Mersha A., Bisrat G., Samirawit T., Tigist A. & Roman T

S f fe c ; Bisrat Getnet

f j e g f : January – December 2019

T b g i f h f

Ef jh ; T-test with three replications

U f b f ; Introduced mechanical rice trans-planting machine versus conventional method

M db j ; Fogera, Libokemem and Dera.

S f m

Assessment of existed mechanical rice trans-planting machine was conducted in the market, research institutes and other organizations, from that one appropriate technology was selected from market and it is on the process of acquiring the technology.

rb g i f f fb

Make avail transplanting machine before 2020 main cropping season (June 2020). Do comparative evaluation of the mechanical rice trans-planting machine versus conventional method or already trans-planting practice will be conducted by 2020 main cropping season. Based on the field findings and feedback from the stakeholders, fine tuning will be made. Further field evaluation, data analysis, demonstration and report writing will be done.

kfd 5; Enhancing tef, wheat and barley crops productivity in some selected areas of Ethiopia through pre-harvest technologies

kfd f j e; July 2018 - June 2020

Bd j j 5/2; Determination of appropriate tillage combination and/or frequency for some selected tef, wheat and barley crop growing areas

Bd j j f j e; July 2017 - June 2020

P ckfd j f; To determine appropriate tillage implements combination and frequency which enhance the crops productivity

S f jc rfi f) *; Amanuel Erchafo, Ahmed Oumer, Tesfaye Asefa

S f fe c ; Dereje Alemu

f j e g f : January – December 2019

T b g i f h f

Ef jh ; RCBD in three replications

Treatment: farmers practice, plowing harrowing, plowing+harrowing+compaction, twice plowing+compaction, plowing+harrowing+ridging+compaction (for teff), farmers practice, plowing+harrowing, plowing+harrowing+ridging, plowing+harrowing twice, plowing+harrowing twice (for wheat)

M db j ; Melkassa, Bishoftu and Kulumsa

S f m

The experiment carried out for last two main seasons at the stated locations. Preliminary two season data were analyzed, and the experiment reports shows that there is no significant difference b/n each treatment.

Table 4. Field report on appropriate tillage combination

O	U fb f	rb i fjhi)d *	T jl f i fjhi)d *	O / jmfi f rb	ffej h j f i (fi b	ffe rb j O /(fi b	rb rb j O /(fi b	Cj b L h(fi b	Z jfm L h(fi b
1	M+H	97.97a	8.20a	5.53	62.50ab	2.49 E+06a	3.16 E+06a	10498 a	4655.3 a
2	D+H	105.50a	8.50a	6.10a	58.88b	2.314E+06 a	3.098E+06a	9922.7 a	4565.3a
3	CONSN	89.733a	6.733a	4.10a	65.83a	2.619E+06a	3.162E+06a	9653.3 a	4087.4 a
4	M+2H	95.30 a	7.500a	5.401a	62.08ab	2.096E+06a	3.166E+06a	10384 a	4926.6 a
5	M+R+H	93.867a	7.7333a	5.4000a	60.27b	2.478E+06a	2.593E+06a	10403a	4873.7a
6	CV	8.61	13.34	15.51	2.82	11.11	9.76	11.07	14.76

rb g i f f fb ; Fine-tuning of report write up.

Bd j j 5/3; Development, evaluation and demonstration of small horsepower tractor driven seed drills for tef, wheat and barley crops

Bd j j f j e: July 2017 - June 2020

P ckfd j f; To develop, evaluate and demonstrate small horsepower tractor drawn/driven seed drill

S f jc rfi f) *; Bisrat G, Dereje A. & Ahmed Oumer

S f fe c ; Dereje Alemu

f j e g f : January – December 2019

T b g i f h f

Ef jh ; T-test

U fb f ; Improve multi crop row planting machine versus existed one

M db j ; Melkassa, Bishoftu and Kulumsa

S f m

Assessment of available multi crop planter was conducted in the market, research institutes and other organizations. However, appropriate technology for required power source that is up to 40 hptractors wasn't obtained. Thus, new design had to be developed. The design has been completed; and 100% of prototype manufacturing process is completed and some preliminary test and performance evaluation is done.

Table 5. Laboratory performance of seed metering unit at the exposed length of fluted type of metering unit = 11.5mm

Row	R1	R2	R3	R4	R5	R6	R7	R8	Overall
Mean(kg/ha)	124.65	127.16	125.64	127.56	124.08	126.03	125.51	127.3	125.99
SE	3.63	7.49	5.21	10.2	3.47	3.63	3.27	6.8	1.8

Table 6. Laboratory performance of fertilizer metering unit at the 5.5mm scoop depth

Row	R1	R2	R3	R4	R5	R6	R7	R8	Overall
Mean(kg/ha)	105	106	108	103	98.6	106	103	110	105
SE	2.38	2.77	6.39	4.95	2.59	7.96	4.12	2.55	1.54

rb g i f f fb ;Comparative evaluation of the completed multi crop planter and the conventional methods or already existed technologies will be conducted Based on the field findings and feedback from the stakeholders, refinements will be made.

Bd j j 5/ 4; Development, evaluation and demonstration of mechanical front/backpack seed drills for tef

Bd j j f j e: July 2017 - June 2020

P ckfd j f; To develop, evaluate and demonstrate mechanical and electrical driven tef seeders

S f jc rfi f) *; Ahmed Oumer & Tesfaye Asefa

S f fe c ; Tesfaye Asefa

f j e g f : January – December 2019

T b g i f h f

Ef jh ; RCBD

Ef jh ; RCBD with three replications

U fb f ;

Comparative evaluation of broadcasting tef sowing, two non-ground engaging front and back held manual tef drills along with other two private companies developed ones were conducted at Debrezeith Agricultural Research Center (DZARC) on 6x20m2 plot size area following standard test procedure.

Location: Melkassa and Bishoftu

S f m

Both front pack and backpacktef drilling machine technologies(prototypes) was generated and field assessment for both technologies was conducted based on treatment design for last two main seasons.Partial data analysis shows that except crop management issues, which is easier for row planting machine there is no significant difference in seed rate, field capacity,yieldandothe plant growth parameters between treatments.

rb g i f f fb

Finalizing data analysis and reporting will be expected to be done up to June 2020.

kfd 9; Development of farm power implements selection system for different farm size ranges under different agro ecologies

kfd f j e; July 2017 – June 2020

Bd j j 9/2; Development of farm power implements selection system for different farm size ranges under different agro-ecologies

Bd j j f j e: July 2017 - June 2020
P ckfd j f; To study and document the major crop enterprises, the critical farm window of operation time for the major crop production of the country (maize, tef, barley, wheat, sorghum)
S f jc rfi f) *; Mubarek, Tahir, Tesfaye, Samrawit Dereje, Amanuel
S f fe c ; Mubarek Mohammed
f j e g f : January – December 2019
T b g i f h f
Ef jh ; Survey
U fb f ; Interview of key informants
M db j ; Melkassa, Zeway, Werer, Humera, Arsi, Gojam, Addis Ababa and Major EIAR centers

S f m
Study sites based on agro-ecology and crop production potential were selected and further confirmation was made in association with the National Agricultural Investment Bureau. Questionnaire was developed, pretested and refined. Survey was done, from that two documents entitled with" Merits and demerits of mechanization technologies such as power units, implements in the major agro-ecologies by the Ethiopian mechanized farms" and "Mechanized farm's operation calendar in Ethiopia based on agro ecology and crop type" were generated and partial data analysis were done to generate model, which will predict machine selection for available resource such land and capital.

Table 8. Data analysis result to determine number of fleets or tractor for one farm

			Field Capacity(ha/hr)		Field Capacity(ha/day)		Field Capacity(ha/season)						
B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	5	1.7	6.5	0.8	7.4	5.9	51	0.74	37.7	224	1122	2.36	11.8
	4	1.4	6.5	0.67	7.4	4.98	51	0.74	37.74	188	940	2.8	14.1

Where;
A= Total area(ha), B=No of tractors, C=Number of disc plough bottoms, D=Operation width, E=Operation speed(m/hr), F= Covered area(ha/hr), G;=Working hour(hr/day), H=Covered area (ha/day), I= Available working days, J= Rate, K= Effective working days, L=Covered area/season/tractor, M= Covered area/season/no of tractors, N= No of tractor fleets, O=No of required tractor

rb g i f f fb ; Finalize data analysis and report writing

kfd 21; Demonstration of agricultural engineering technologies and capacity building of farmers, agro-pastorals, pastorals, development agents, experts, technology manufacturers andResearchers
kfd f j e; July 2017 - June 2020
Bd j j 21/2; Demonstration and participatory evaluation of pre-harvest mechanization technologies
Bd j j f j e: July 2017 - June 2020
P ckfd j f: To conduct frontline demonstration and scale out suitable technologies at some selected sites.
S f jc rfi f) *; Desseye B., Laike K., Alemayehu, Bilisuma, Melse, Mersha, Wariso, Musa
S f fe c ; Deseye Belay
f j e g f : January – December 2019
T b g i f h f ;
Ef jh b e U fb f ; Farmers from 30 districts were selected in association with the respective district offices

M db j ; Selected districts from different developed and developing regions Oromia, Tigray, Amhara, Debub and Somali etc.

S f m

Different Pre-harvest, agricultural engineering technology have been demonstrated in target wordas collaborated with Agricultural Office in Amahara, Oromia, Tegeray, SNNPP and Emerging Reigns, and Regional Mechanization Research Centers and non-Governmental Organizations

Table 9/ Performance of different tillage implements on wheat productivity in Negele-Arsi

Tillage implement	Field capacity (h/ha)	Plant population per ha	Weeding (h/ha-man)	Straw (kg/ha)	Yield (kg/ha)
MB	33.80±0.66	1,632,549.02±97.11	19.68±1.13	2,607.56±14.01	2,760.88±14.8
MB+TR	33.40±0.19	1,691,372.55±104.01	21.21±4.26	2,977.69±12.01	3,069.22±21.95
LM+TR	34.53±2.01	1,799,215.69±100.37	22.50±1.29	3,541.09±21.7	3,137.52±32.76
LM	31.40±3.67	1,673,137.25±128.4	23.33±0.56	2,931.99±8.15	2,611.05±27.46

rb g i f f fb ; Full report write-up to June 2020.

Bd j j 21/3; Batch production and distribution of selected implements and quality assurance

Bd j j f j e: July 2017 - June 2020

P ckfd j f: To batch produce and distribute selected pre-harvest implements to farmers

S f jc rfi f) *; Teshome Bullo

S f fe c ; Teshome Bullo

f j e g f : January – December 2019

T b g i f h f ;

Ef jh b e U fb f ; Farmers from 30 districts were selected in association with the respective district offices

M db j ; Selected districts from different developed and developing regions Oromia, Tigray, Amhara, Debub and Somali etc.

S f m

A total of 627, 802 and 903 various (17 kinds) pre and postharvest technologies were multiplied (Batch produced) and distributed to a number of districts in all regions of the country during 2009, 2010 and 2011 crop seasons. Some of the technologies multiplied were shown in Fig 6.

Demonstration and participatory evaluation will continue at different locations in the selected districts up to June 2020.

Figure 6. Multiplication (batch production) and Distribution pre-harvest technologies

rb g i f f fb ; Different types of mechanization technologies will be distributed to farmers and report write up.

Bd j j 21/4; Training of farmers, development agents, manufacturers and technology users on operation, use and manufacturing
Bd j j f j e: July 2017 - June 2020
P ckfd j f: To train farmers and manufacturers in the use and manufacturing of improved implements.
S f jcrfi f) *; Teshome B., Mubarek M., Laike K., Dereje A., Argachew A., and Mersha A
S f fe c ; Teshome Bullo
f j e g f : January – December 2019
T b g i f h f ;
Ef jh b e fb f
M db j ; Those districts were selected from various developed and developing regions such as Oromia, Tigray, Amhara, SNNP

S f m
Farmers, DAs, extension experts and technology manufacturers from more than 30 districts were selected in collaboration with the respective district offices and trainings were given on use, handling and manufacturing aspects of more than 17 proven pre- and post-harvest technologies. More than 6136 farmers, DAs, experts and manufacturers were trained. The share of female trainees was more than 26%..Generally, from each year the following end users were trained on the mechanization technologies operation, use and handling.

Table 11. Number of trainees on use, operation.and handling of mechanization technologies

Budget	Plan		Achieved	
year	M	F	M	F
2009	1361	583	1818	478
2010	1630	486	2722	656
2011	1662	600	1898	501
Total	4653	1669	6438	1635

rb g i f f fb ; Report writing

kfd 22; Enhancing Soil Productivity through Development and Introduction of Package of Improved Technologies for cereal crops (teff, wheat and rice) and Vegetables (tomato and pepper
kfd f j e: July 2019 – June 2022
Bd j j 22/2: Development and Performance Evaluation of Tractor Operated Plastic Mulch Laying and Removing Machine for vegetables (Tomato and pepper)
Bd j j f j e; July 2019 - June 2022
P ckfd j f; To develop and evaluate small horsepower tractor operated plastic mulch laying and removing machine for vegetables (tomato and pepper)
S f jcrfi f) *; Tamirat L, Dereje A, & Tahir T.
S f fe c ;Tamirat Lema
f j e g f : January – December 2019
T b g i f h f
U fb f ; Developed mulching machine versus conventional one
M db j ; Melkassa, Dugda, Adamitulu Jidokombolcha, and Holleta

S f m
Prototype development under process through design and computer added design software's.

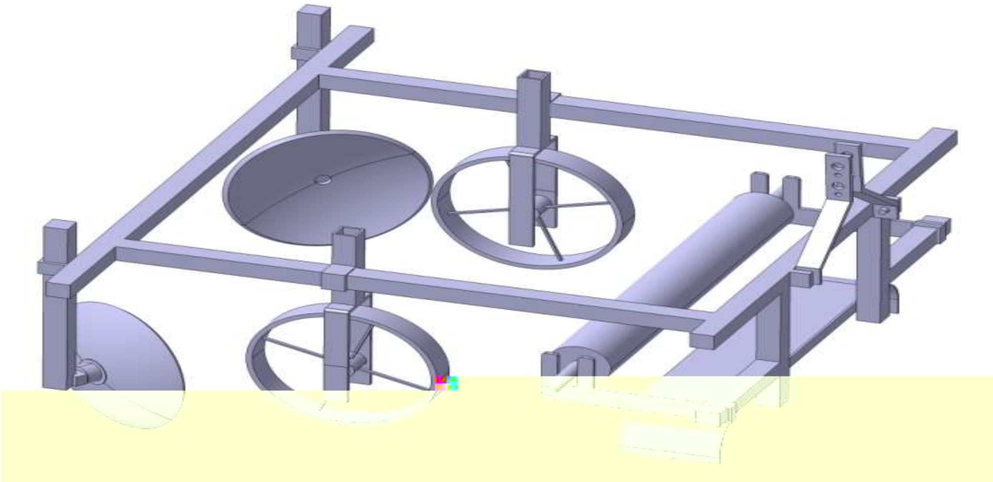


Fig. 8.3D Model of Tractor Operated Plastic Mulch Laying and Removing Machine

rb g i f f fb ; Prototype manufacturing process will be continued

Bd j j 22/3; Adaptation, development and evaluation of small horsepower operated land leveler for cereal crop (teff, wheat and rice) production.
Bd j j f j e: July 2019 - June 2022
P ckfd j f; To develop, adapt and evaluate small horsepower operated land leveler for cereal crop (teff, wheat and rice) production
S f jcrfi f) *; Dereje A., Bisrat G., Ahmed O., Tamirat L. Teshome B
S f fe c ; Dereje Alemu
f j e g f : January – December 2019
T b g i f h f
U fb f ; Developed land levelling machine versus conventional one
M db j ; Melkassa, KulumsaBishoftu, and Fogera

S f m
Prototype development is under process through design and computer added design software's.

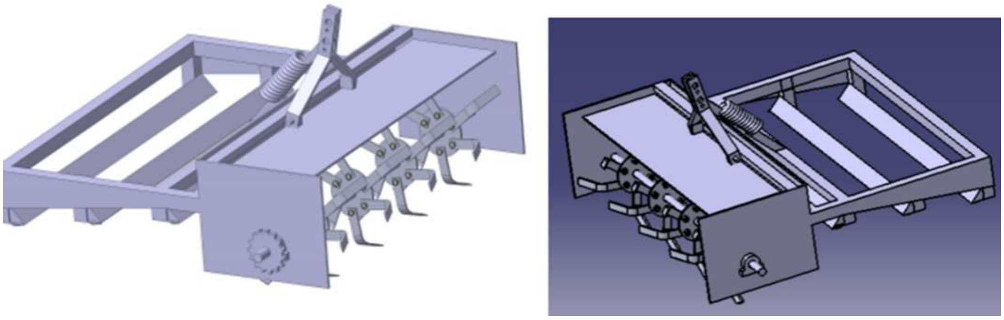


Fig 9. 3D model of small horsepower operated land leveler
rb g i f f fb
Farther computer software drawing refinement and prototype manufacturing process will be continued

Bd j j 22/4: Development and performance evaluation of small horsepower tractor driven Lime Spreader

Bd j j f j e: July 2019 - June 2022
P ckfd j f; To develop and evaluate small horsepower tractor driven lime spreader for cereal crop production on highly acidic affected soil
S f jc rfi f) *; Dereje A, Bisrat G., Tamirat L, Tesfaye A.
S f fe c ; Dereje Alemu
f j e g f : January – December 2019
T b g i f h f
U fb f ; Developed or improved lime spreader machine versus conventional one
M db j ; Melkassa, Kulumsa, Bishoftu and Fogera

S f m
Prototype development and manufacturing is under process through design and computer added design software's.

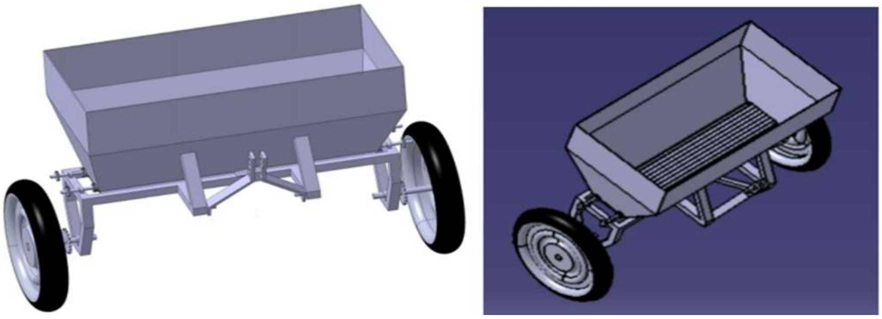


Fig 10. 3D model of lime spreader
rb g i f f fb
Farther computer software drawing refinement and prototype manufacturing process will be continued

kfd 23; Enhancing Coffee & Sorghum Productivity through Development and Introduction of Package of Improved Mechanization Technologies in Ethiopia
kfd f j e; July 2019 – June 2022
Bd j j 23/2; Assessment of farm mechanization technologies in coffee production
Bd j j f j e: July 2019 - June 2020
P ckfd j f; To collect data about existing practices and farming implements and machineries for coffee production from coffee growing farmers and different stake holders
S f jc rfi f) *; Mubarek M., Desseye B., Tahir T., Abiy S., Yared D.
S f fe c ; Mubarek Mohammed
f j e g f : January – December 2019
T b g i f h f
Ef jh ; Stratified sampling
U fb f ; Interview of farmers, key informants
M db j ; Jimma, Hararge, Sidama, Addis Ababa, Huru, Mizan and Yirgachefe

S f m
From major coffee production areas were sleeted and survey conducted. At the time of survey 80 small coffee producers, 19 large scale farm producers are interviewed, 10 bureau of district agriculture officials, 7 machine manufacturers and dealers and 17 unions/cooperatives were interviewed using structured questionnaires. Data coding is completed, and preliminary data analysis is done. From that the following analysis result was generated for one based on the agricultural operation.

Table 12. Level of work drudgery based on operation

Operations	Rank %	Rank	Frequency
Weeding	43.2	2	35
Pruning	32.1	6	26
holing/digging	48.1	1	39
Nursery	19.8	7	16
Uprooting	23.5	5	19
Stumping	24.7	8	20
Harvesting	44.4	3	36
Washing	--	--	--
Drying	27.2	4	22
Storage	19.8	9	16

rb g i f f fb

Further data analysis and interpretation will be done until June 2020.

Bd j j 23/3; Introduction and performance evaluation of well drilling machine at shallow aquifer for smallholder farmers

Bd j j f j e: July 2019 - June 2022

P ckfd j f; To minimize drudgery of de-hulling, loss of un-dehulled grain and add value to the product through designing, evaluating, promoting powered sorghum de-hulling machine with acceptable breakage.

S f jc rfi f) *; Mubarek M., Desseye B., Abiy S., Bisrat G., Tesfaye

S f fe c ; Mubarek Mohammed

f j e g f : January – December 2019

T b g i f h f

Ef jh ; T-test

U fb f ; Introduced or improved well drilling machine versus conventional one

M db j ; Melkassa, Kulumsa, Bishoftu, and Fogera

S f m

Existed manually and engine operated well drilling machines for shallow aquifer were assessed in Addis Ababa, around Dugda and Zeway and searched from different websites. From that it has been observed that sludge and auger methods are widely adapted in Dugda and AdamituluJidokombolcha area. Furthermore, the service provider stated thatrota-sludging works best in loose soil and soft geological formations

rb g i f f fb

Collect those technologies improve and evaluate them on the specified locations.

F f bnG efe kfd

kfd 24; Farm mechanization and conservation agriculture for sustainable intensification (FACASI-II)

kfd f j e; July 2017 – June 2019

Bd j j 24/2: Improvement of wheat seeders

Bd j j f j e; June 2017 - June 2019

P ckfd j f; To develop 2WT attached wheat seed drill suitable to CA practice

S f jc rfi f) *; Bisrat, Dereje A, Kefyalew Woldesenbet,

S f fe c ; Dereje Alemu

f j e g f : January – December 2019

T b g i f h f

Ef jh ; RCBD

U fb f ; Two-wheel tractor drawn tillage-cum-wheat planter and the conventional method of planting

M db j : Melkassa and Tiyo

S f m

Seed drill Prototype weremanufactured; calibration, preliminary evaluation and demonstration on field daywere undertaken.

Dbmjc b j

Transparent polythene bags were attached to each of the six seed and fertilizer delivery tubes. The seed drill was operated on a pre-measured 20 m travel distance with a sowing width of 100 cm, thus providing a 20 m2 area. After every 20-meter linear distance run, collected seeds and fertilizer through tubes in transparent polythene bag were removed and weighed separately with digital balance. This method is repeated by turning the knobs to either increase or decrease the opening of the fluted roller until the desired seed rate obtained. Once the desired rate is obtained; the knobs was fixed at the right position and the test was replicated three times (Table 13).

Table 13. Calibration of the two-wheel tractor attached seed drill

Unit row	Material	Replication			Mean	SD	CV	Minimum	Maximum
		1	2	3					
1	Seed	50	49	45	48	2.65	5.51	45	50
	Fertilizer	37	40	45	40.67	4.04	9.94	37	45
2	Seed	39	51	49	46.33	6.43	13.88	39	51
	Fertilizer	45	41	39	41.67	3.06	7.33	39	45
3	Seed	52	49	44	48.33	4.04	8.36	44	52
	Fertilizer	44	35	39	39.33	4.51	11.46	35	44
4	Seed	47	50	53	50	3	6	47	53
	Fertilizer	43	40	36	39.67	3.51	8.85	36	43
5	Seed	42	49	51	47.33	4.73	9.98	42	51
	Fertilizer	54	45	51	50	4.58	9.17	45	54
6	Seed	52	46	43	47	4.58	9.75	43	52
	Fertilizer	46	41	39	42	3.61	8.58	39	46

Ef b j jbm

After calibration of the 2WT attached seed drill farmer managed demonstration trial was conducted at two kebele (Shala Chebieti and Haro Bilalo) of Tiyo district. The performance of the seed drill was previously evaluated at different parts of the country through FACASI I and Giz project implementation, hence its performance is well Known. But it should be known that the performance of this 2WT attached seed drill will slightly varies from place to place due to soil type, moisture content and other topographical factors. The seed drill will perform best on optimum moisture content with average field capacity of around 6.47ha hr-1 and 13.81litre ha-1 fuel consumption. The moisture content, field germination, depth of planting and field capacity were recorded during field demonstration (Table 3, 4 and 5). the seed used for the trial average germinationrate of 99%.

Table 14. Field Capacity and Depth of Planting

Farmer Name	Depth of Planting(cm)	Total time taken 200m^{-2}	Field capacity(ha.hr^{-1})
TadeseTesfaye	4.16	8.07	6.73
Kemal Kedir	4.64	8.15	6.79
DeresseGirma	4.36	7.46	6.22
YaredAssefa	4.14	7.39	6.16
Average	4.30	7.75	6.47

ffe D m

Weeds are a major constraint in adoption of CA-based technologies. Conservation tillage influences weed infestation, and thus interactions between tillage and weed control practices are commonly observed in crop production. Different report show that zero tillage increases as well as reduces infestation of certain weed species in different crops. In rainy season when the weed problem is generally more, growing crops with zero tillage requires additional measures for effective weed control with application of herbicides in proper combination and sequence. Hencewe have applied CROPSTAR 750 WDG to control weeds, which have broad leaves in August 24, 2018 and Pallas 45OD for narrow leaf weeds in August 22, 2018.We have also applied REX®DOU in September 25, 2018 for controlling Yellow Rust.

I b f j h b e D Zjfm

When the crop is ready for harvest, we have collected different crop yield parameters such as crop height, number of tiller per a single plant, number of seed per tiller, tiller weight, grain and biomass with 1m2 sample area diagonally across the plot which were replicated five times. Moisture content of the seed and the straw during harvesting were also recorded. Data is being summarized and analyzed

Gjfm e b

Field day was conducted two times at TiyoWereda of two Kebele (Shala Chebiti and Haro Bilalo) by Ethiopian Institute of Agricultural Research of Melkassa Agricultural Research center Agricultural Engineering Research Process in collaboration with CIMMYT and Tiyo District Office of Agriculture. The first field day was conducted to create awareness on 2WT attached seed drill calibration, operation and routine maintenance by researchers and service providers and to observe the demonstration trial planted by 2WT-attached seed drill and conventional planting using animal and broadcasting.

rb g i f f f b ; Final report writing.

Bd j j 24/3: Conduct annual advisory meeting
Bd j j f j e; June 2017 - June 2019
P ckfd j f; To conduct annual small mechanization learning event
S f jcrfi f) *; Bisrat G., Dereje A., Teshome B.
S f fe c ; Dereje Alemu
f j e g f ; January – December 2019
T b g i f h f

National Advisory Meeting was held. The objective of the meeting was to review, provide oversight, guide implementation of small mechanization for Ethiopia, and build alliances for scaling out within country.

rb g i f f f b ; Final report writing.

kfd . 25; Baseline Survey on Agricultural Mechanization in Africa
kfd f j e; Nov 2018 – Dec 2019
Bd j j 25/2: Data processing, analysis, and reporting (publications and reports))
Bd j j f j e; Nov 2018 – Dec 2019
P ckfd j f; To make technical and policy recommendations for enhanced adoption of agricultural mechanization practices/
S f jcrfi f) *; Bisrat G., Yared D, Ahmed O.
S f fe c ; Bisrat Getnet
f j e g f : January – December 2019
T b g i f h f
Ef jh ; Non-stratified sampling
M db j ; Amhara, Oromia, SNNP, Tigray & Somali Regions

S f m

Feeding of questionnaire in computer was conducted partial data analysis were done.

Table 15. Constraints for not using mechanization/mechanical power

Reason not using	%
Unavailability of mechanization services	38.34
Price of services to high	24.87
Do not need	6.22
Do not know	12.95
Slope of the farm too step for mechanization	1.55
No road to entry	1.04
Plot is too small and fragmented	11.4
Other	3.63

rb g i f f fb

Fine-tuned report preparation.

Postharvest Handling and Processing Engineering Research Program

Laike Kebede
E-mail: laiketihitina@yahoo.com, Phone: +251911771891

kfd 2; Introduction of pre and postharvest technologies for increased production of some horticultural crops
kfd f j e; July 2017 – June 2020
Bd j j 2/2: Improvement and introduction of fruit harvesting technology for fruit growers
Bd j j f j e; July 2017 - June 2020
P ckfd j f ; To Improve and introduction fruit harvesting technology for fruit growers
S f jc rfi f) *; Tesfaye A., Dereje Y., Amanuel E.,
S f fe c ; Yonas Mulat
f j e g f : January – December 2019
T b g i f h f ;
Ef jh ; Simple performance evaluation using statistical average (Descriptive statistics)
U fb f ; Improved prototypes and existing fruits harvesters
M db j ; Melkassa

S f m
Two alternative designs were constructed to harvest papaya, avocado and mango based on fruit weight, size and tree height (Fig, 1). Field tests of avocado and mango harvester showed that, with the help of developed device fruits were harvested efficiently without damage at the rate of about 2-3 frits per minute (Table).

- Modified Papaya harvester: Weight of the original papaya harvester reduced from 3.3 to 2.2kg and operators found it very easy to handle and detach variable size papaya fruit from a tree height of 3-4 meters without imparting any mechanical damage to the fruit
- Avocado and mango harvester: With the developed device avocado and mango were harvested efficiently at the rate of about 2-3 frits per minute without damage

Fig.1. Fruit harvesters a) Improved papaya harvester b) mango and avocado harvesters

Table 1. Fruit weight, size and tree height

Parameters	Avocado		Papaya			Mango	
	Hass	Pinkerton	Bacon	MK	Keitt	Kent	Tommy
Tree height (m)	2.67	1.25	2.95	9.2	2.85	3.79	3.43
Fruit length (cm)	7.3	9.23	5.4	18.2	13.7	11.5	11.2
Fruit diameter (cm)	6.71	6.5	5.9	12.7	10.8	9.2	9.4
Fruit weight (g)	200	220	233	661	617	549	540

rb g i f f fb ; Activity is completed and overall research report will be prepared up to June 2020.
Bd j j 2/3: Introduction of evaporative cooling technologies for some tropical fruits
Bd j j f j e: July 2017 - June 2020
P ckfd j f ; To introduce evaporative cooling technologies for some tropical fruits
S f jc rfi f) *; Yonas M., Meskerem and Amanuel
S f fe c ; Yonas Mulat
f j e g f : January – December 2019
T b g i f h f ;
Ef jh ; CRD
U fb f ; Evaporative coolers made of charcoal and scoria walling materials
M db j ; Melkassa

S f m

Three kinds of storage structures made of charcoal, scoria and Rectangular Hallow Block as control were built and compared by watering the walls three times a day. The result indicated a significant difference among the structures in terms of temperature and humidity. Table 3 shows the marketable life with degree of spoilage of mango and avocado fruits in the three stores. Therefore, the result indicated that:

- The scoria and charcoal structures exhibited significantly higher humidity and lower temperature than the hollow block.
- A longer shelf life, delayed ripening was observed in the two structures than and hollow block. In addition, lower weight loss and spoilage were recorded in the charcoal and scoria structures than the hollow block, though the difference was insignificant. As a result two storage structures (scoria and charcoal wall) are selected.

Table 3. Degree of spoilage and shelf life of mango and avocado fruit under evaporative cooling structures after 15 days of storage

Structure	Avocado		Mango	
	Marketable life (days)	Spoilage (%)	Marketable life (days)	Spoilage (%)
Scoria	11	9.38	9	3.13
Charcoal	13	10.71	7	8.82
Hallow block	7	18.75	4	11.76

rb g i f f fb /

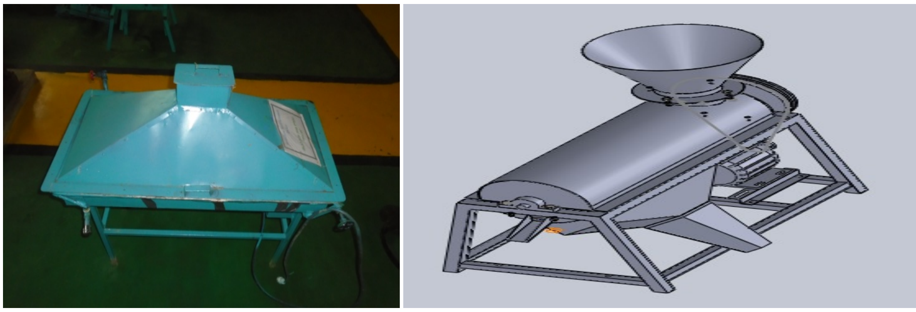
Further analysis and report writing of the three years result will be done till end of June 2020.

Bd j j 2/ 4: Introduction of semi processing technologies for some tropical fruits
Bd j j f j e: July 2017 - June 2020
P ckfd j f ; Introduction of semi processing technologies for some tropical fruits
S f jc rfi f) *; Abiy S., Friew K., Mulugeta T., Ahmed O.
S f fe c ; Abiy Solomon
f j e g f : January – December 2019
T b g i f h f ;
Ef jh ; Descriptive statistic
U fb f ; Improved technologies and existing methods
M db j ; Melkassa

S f m

- The available manual tomato seed extractor was modified and tested to be used for tomato seed and pulp separation.
- New mango pulper was designed and prototype was fabricated (Fig.2).

- Design, prototype fabrication and testing of batch type refractance window drier with polyethylene thin film transparent plastic is completed (Fig.2).



•

Fig. 2 Prototype refractance window(left) and mango pulper (right)

rb g i f f fb

Evaluation of the prototypes and preparation overall research results will be conducted in 2019.

kfd 3; Adaptation, development and promotion of small-scale mechanization technologies for root and tuber crops (onion and potato)

kfd f j e; July 2017 – June 2020

Bd j j 3/2: Adapt, develop and promote tractor driven onion harvester

Bd j j f j e: July 2017 - June 2020

Objective: To evaluate, adapt, develop and promote tractor driven onion harvester

S f jc rfi f) *; Meseret Abebe, Dereje Alemu, Dessye Belay.

S f fe c ; Meseret Abebe

f j e g f : January – December 2019

T b g i f h f

F f j f bm dfe f; Design development, fabrication and field evaluation using RCBD in three replications

U fb f ; Improved prototype and conventional method of onion harvesting

M db j ; Melkassa, Dugda and Lode-Hetosa

S f m

A multi-crop type (onion and potato) single row harvester compatible with the draft output of 15HP walk behind tractor was designed and manufactured (Fig. 3). Based on preliminary test result necessary refinement work were madeand the digger elevator had acceptable digging and elevating capability. Furthermore, design and fabrication of PTO powered onion vine topper attached to a small riding tractor was completed along with the design and manufacturing of 8-row onion under cutter harvester drawn by 40 hp tractor.

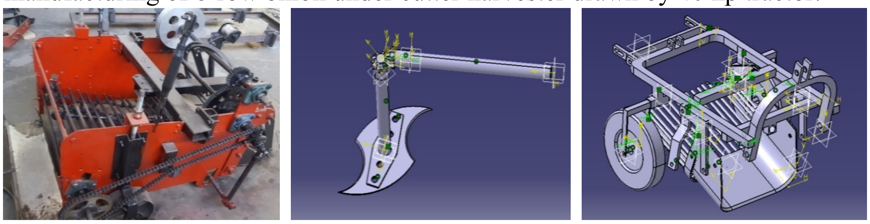


Figure 3. Two-wheel tractor attached potato harvester (left) and riding tractor attached onion topper (middle) and 8 row onion under cutter harvester (right)

rb g i f f fb ; Refining/further improvement of the prototype and final field evaluation of the 2nd prototype potato/onion digger attached to riding tractors.

kfd 4; Adoption, adaptation and development of tef, wheat and barley harvest and post-harvest technologies for major growing areas

kfd f j e; July 2017 – June 2020

Bd j j 4/2: Adaptation and improvement of storage technologies for wheat and barley crop

Bd j j f j e; July 2017 - June 2020

P ckfd j f ; to adapt and improve existing post-harvest technologies for wheat and barley crops

S f jc rfi f) *; Yonas L., Mulgeta T., Abiy S., Meskerem M.

S f fe c ; Yonas Lemma

f j e g f : January – December 2019

T b g i f h f

Ef jh ; RCBD

U fb f ; Metal silo, PICS bag and conventional method

M db j ; Kulumsa

S f m

Since quality and microbiology data were generated for wheat storage in metal-silos, PICS and jute bags placed at Kulumsa Agricultural Research Centre/KARC/ and other places by external fund project and secondly considering the relatively low grain postharvest loss in barley observed in previous assessment works, the activity was terminated during 2018/19 annual review program

Bd j j 4/3; Evaluation and development of appropriate reel mechanism to harvest tef crop

kfd f j e; July 2017 - June 2020

P ckfd j f; to evaluate and develop appropriate reel mechanism for harvesting tef crop

S f jc rfi f) *; Yonas L., Fitsum A., Eyob H.

S f fe; c ; Yonas Lemma

f j e g f : January – December 2019

T b g i f h f ;

Assessment and designnd

rb g i f f fb ; Completion of the prototype fabrication and evaluation work.
Bd j j 4/ 4; Evaluation and improvement of multi-crop thresher on tef, wheat and barley crop
Bd j j f j e: July 2017 - June 2020
S f jc rfi f) *; Yonas L., Fitsum A., Bisrat G., Tesfaye, Ahmed, and Amanuel, E.
S f fe c ; Yonas Lemma
P ckfd j f ; to evaluation and improve multi-crop thresher
f j e g f : January – December 2019
T b g i f h f
F f j f bmef jh ; CRD with three replications
U fb f ; Melkassa multi-crop thresher, Chinese multi-crop thresher (radial and axial types) and Indian Multi-crop thresher
M db j ; Melkassa, Kulumsa, Ada'a and Lume

S f m
A total of four threshers namely, Melkassa made cleaning type modified IITA thresher for tef, Chinese made axial cleaning type wheat, rice and barley threshers, Chinese made radial cleaning type rice, wheat and barley threshers and a new prototype cleaning type tef thresher acquired from Chinese were collected and their designs were thoroughly examined. In addition, performance evaluation was done on tef and wheat crop using same engine capacity at Melkassa, D/zeit, Arerti, Assella and Holeta. Accordingly, the Melkassa made and the Chinese radial type threshers performed much better than the rest on threshing efficiency (Table 5 & 6)/ However, their cleaning efficiency needs to be improved. Limitation identified on the promising Chinese made radial type thresher were fast wear and tear of the body due to the thin sheet metal used for construction. On the other hand, presence of blowing out grain were observed in using the new Chinese made tef thresher. Therefore, based on identified limitations observed during testing, further improvement on the selected wheat and barley thresher were made for tef thresher

Figure 5. New Prototype of tef thresher acquired from China

Table 5. Performance evaluation of modified IITA multi-crop thresher (Cleaning type) on tef

	Rpm			
Parameter	950	1050	1150	
Bishoftu (DZARC)				
Threshing time(minute)	3.68±0.33	3.4 8± 0.16	3.25±0.2	4.9
Capacity (kg/hr)	214±14.8	227 ±17.2	249.9±24.6	4.07
Grain/straw Ratio	0.49±0.02	0.48 ± 0.02	0.49±0.03	5.4
Cleaning efficiency (%)	99.3±0.3	99.7 ± 0.3	99±0.32	0.07
Threshing efficiency (%)	100±0.0	100 ± 0.0	100±0.0	0
Fuel consumption(ml)	39±10	48.3 ± 8.2	55.3±10	15.64
Feed rate(kg/hr)	654.7±56.9	695±33	740±55	4.47

Wakie Tiyo				
Threshing time(minute)	3.9±0.5	4.8 ± 0.35	5±1.06	17.33
Capacity (kg/hr)	206±15	209 ±3.9	203±6.5	18.24
Grain/straw Ratio	0.45±0.015	0.46 ± 0.04	0.46±0.005	4.33
Cleaning efficiency (%)	93±0.8	98 ±1.5	91±1.98	1.22
Threshing efficiency (%)	100±0.0	100 ± 0.0	100±0.0	0
Fuel consumption(ml)	61±17.5	80 ±5	77±7.5	5.63
Feed rate(kg/hr)	692±102	738±67.4	703±64.8	13.09

rb g i f f fb
Finalizing fabrication and evaluation of the improved tef thresher with a hybrid design feature.

Bd j j 4/5: Demonstration of walking tractor attached trailers for transportation of agricultural produces
Bd j j f j e: July 2017 - June 2020
P ckfd j f; to demonstrate walking tractor attached trailers for transportation of agricultural produces
S f jc rfi f) *; Yonas L, Teshome B. and Tesfaye A.
S f fe c ; Yonas Lemma
f j e g f : January – December 2019
T b g i f h f
Ef jh ; participatory evaluation and demonstration
U fb f ; none
M db j ; Melkassa

S f m
Demonstration and awareness creation of walk behind tractor attached trailer was conducted for 112 farmers. In the previous year. More ddemonstration and training was conducted for 38 male and 10 females around Melkassa
rb g i f f fb : The activity was completed.

Bd j j 4/6; Technical evaluation of harvest and post-harvest custom hire service in major tef, wheat and barley growing areas of Ethiopia
Bd j j f j e: July 2017 - June 2020
S f jc rfi f) *; Yonas L., Mulugeta T., Meseret A., Abiy s., and Tesfaye A.
P ckfd j f; to evaluate and train youth groups involving in tef, wheat and barley crops harvest and post-harvest custom hire service provision
S f fe c ; Yonas Lemma
f j e g f : January – December 2019
T b g i f h f
Ef jh ; Survey
U fb f ; Interviews, FGD
M db j ; Lume- Minjar Shankora, Ada'a, Sagure, Ginir, Dodolla and major mechanized areas of the country

S f m
Structured questionnaire was developed and pre-test survey conducted. The questionnaire was re-evaluated and edited according to the pre-test survey output. Survey data were collected. and compiled. Data analysis and report writing is on progress.

Out of 144 respondents lack of availability of machinery in time (29.2 %) followed by higher rate of costume hire service (20.1%) and presence of grain loss (14.6%) during harvesting and threshing were the major constraints reported by farmers.

rh g i f f fb

Based the result of the survey, trainings will be provided on technical and business management skill gaps for the different actors.

Bd j j 4/7; Development, Evaluation and Demonstration of powered multi- crop dehulling machine (target crop Sorghum) (26-02-20)

Pckfd j f: To minimize drudgery of dehulling, loss of un-dehulled grain and add value to the product through designing, evaluating, promoting powered sorghum de-hulling machine with acceptable breakage.

S f jc rfi f) *; Argachew A. Alemayehu (Mehoni); Laike K. & Bisrat G., MARC

S f fe c ; Argachew A.

f j e g f : January – December 2019

T b g i f h f

U fb f ; none

M db j ; Mehoni & MARC

S f m

The design and sketch of the dehuller has been drawn with Solid works software 2014.

rh g i f f fb

Fine tuning the design, and manufacturing of the dehuller will be done as per drawing at the workshop of the AIRIC (MARC). Then the prototype will be functionally tested in the upcoming season

kfd 6; Development of fish pre and post-harvest engineering technology

kfd f j e; July 2017 - June 2020

Bd j j 6/2; Assessment of existing fish feeding and smoking technology

Bd j j f j e: July 2017 - June 2020

Pckfd j f; To conduct assessment of existing fish feeding and smoking technology

S f jc rfi f) *; Mulugeta T., Friew K., Tahir T., Dereje Y. and Amanuel E.

S f fe c ;Mulugeta Tamir

f j e g f : January – December 2019

T b g i f h f

Ef jh ; Subjective assessment

U fb f ; none

M db j ; Melkassa, Sebeta-Hawas&AdamituluJidokombolcha

S f m

Major information on types of ingredients for fish feed processing, parameters for a extrusion processing of floating fish feed pellets, and desired fish feed quality characteristics were collected. Existing fish feed and fish smoking equipment assessed in fish producing areas. Appropriate technologies were selected for evaluation and further improvement (if deemed necessary). When using screw extrusion for fish feed pelleting, size reduction and mixing may be required to make them amenable to processing due to the wide range of chemical and physical properties of raw materials.

rh g i f f fb ; Revision of the preliminary assessment report.

Bd j j 6/3; Testing and improvement of a feed mill and feed mixing technology
Bd j j f j e:July 2017 - June 2020
P ckfd j f; To test and improve feed-mill and feed-mixing technology
S f jc rfi f) *; Bisrat G., Friew K., Seyoum W., Ahmed U., Mane A., Tesfaye A.T.
S f fe c ;Mulugeta Tamir
f j e g f : January – December 2019
T b g i f h f
Ef jh ; Assessment, design and evaluation in CRD
U fb f ; Available fish feed mixers and mills
M db j ; Melkassa, Sebeta-Hawas&AdamituluJidokombolcha

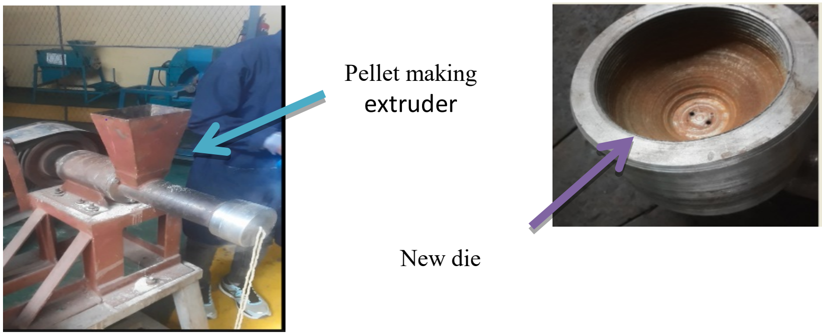
S f m
Available feed mixers and feed mills were assessed. Preliminary performance evaluation was conducted on availed promising feed mill and feed mix technology. Limitations of the identified equipments identified for further improvement. Design and prototype fabrication of an electric motor driven milling and mixing machine developed (Fig 8).

Fig 6. Newly developed feed milling (left) and mixing (right) equipment's
rb g i f f fb
To complete the activity in the budget year, final testing will be done with the right raw material formulation

Bd j j 6/4; Development of a floating feed pelleting equipment
Bd j j f j e: July 2017 - June 2020
P ckfd j f; To develop floating feed pelting equipment
S f jc rfi f) *; Laike K., Eyob H., Tesfaye A., Amanuel E.
S f fe c ; Mulugeta Tamir
f j e g f : January – December 2019
T b g i f h f
Ef jh ; CRD (Factorial) and D-optimal
U fb f ; different settings of temperature, screw speed and feed moisture of the extruder
M db j ; Melkassa

S f m
The application of extruder and extrusion processes was selected for producing low density (floating) pelleted fish feed from different ingredient (raw materials). As a result, a preliminary functional test was conducted with a single screw food extruder available at MARC (Fig. 7). The preliminary test showed that the selected pelleting equipment can

deliver pellets which can float on the surface of water. But it has some operational drawbacks such as staking of screw and barrel, restricted flow at the entrance section, motor not turning with the most likely cause due to a build up of hardened starch melt on the screw and in the barrel. As a result, Redesigning and modification works were done on the die and problems were rectified



Fig,7. Existing single screw feed extruder with modified die section

rb g i f f fb

Testing with the recommended fish feed ingredients will be done to complete the activity in the budget year

Bd j j 6/4/ Assessment and development of a stationary and mobile fish smoking equipment

Bd j j f j e: July 2017 - June 2020

P ckfd j f; To conduct assessment and development of a stationary and mobile fish smoking equipment

S f jc rfi f) *; Mulugeta T., Eyob H., Tesfaye A., Amanuel E.

S f fe c ; Mulugeta Tamir

f j e g f : January - Decemeber 2019

T b g i f h f ;

Ef jh ; Assessment, design, construction and evaluation in CRD (factorial)

U fb f ; At different condition (smoking duration, temperature, relative humidity etc.) of the smoking chamber

M db j ; Melkassa

S f m

Existing smoking technology assessed

A stationary type fish smoking technology designed, built (Fig10) & functional test conducted. The result shown in table 7 and 8.Design& development of mobile type of fish smoking technology is underway

Table 7. Smoking by laying in a stationary smoker

Species	Trials	Fish weight (kg)			Smoking	
		Initial	Final	loss (%)	Time (min)	Temperature (°c)
koroso	1	0.231	0.186	19.5	34	65
koroso	2	0.157	0.135	14.1	34	65
koroso	3	0.151	0.133	11.6	34	65
koroso	4	0.121	0.104	13.8	34	65
koroso	5	0.103	0.082	20.6	34	65

Table 8. Smoking by hanging in a stationary smoker

Species	Trials	Fish weight (kg)			Smoking	
		Initial	Final	loss (%)	Time (min)	Temperature (°c)
koroso	1	0.211	0.1641	22.1	28	60
koroso	2	0.183	0.1153	36.9	28	60

koroso	3	0.172	0.1126	34.5	28	60
koroso	4	0.142	0.0921	34.9	28	60
koroso	5	0.195	0.1531	21.4	28	60

rlb g i f f fb : The work on the mobile type fish smoking technology is expected to be completed in the budget year

lkfd 7; Adaptation, evaluation and development of dairy production technologies
lkfd f j e; July 2017 – June 2020
Bd j j 7/2; Evaluation and development of animal feed chopper
Bd j j f j e: July 2017 - June 2020
P cklfd j f; To develop and evaluate engine driven chopper
S f jc rlfi f) *; Yonas M, Ahmed and Musa M.
S f fe c ; Yonas M,
f j e g f ; January – December 2019
T b g i f h f ;
Ef jh ; Assessment, design development, fabrication and comparative evaluation in CRD
U fb f ; Improved feed chopper and conventional method of feed chopping
M db j ; Melkassa, Sebeta-Hawas& Holeta

S f m

- Prototype manufactured
- On station observation evaluation done
- Participatory evaluation has been conducted with four farmers
- Feedback from farmers has been collected and incorporated and a fine tuning done.

rlb g i f f fb
Intensive evaluation will be conducted to complete the activity in the budget year.

Bd j j 7/3; Evaluation, adaptation and development of automatic milking machine for urban dairy producers
Bd j j f j e; July 2017 – June 2020
P cklfd j f; To evaluate, adapt and develop automatic milking machine for urban dairy Producers
S f jc rlfi f) *; Tamrat L. and Mulgeta T.
S f fe c ; Tamirat Lemma
f j e g f : January – December 2019
T b g i f h f
Ef jh ; Factorial
U fb f ; At different settings (motor RPM and suction pressure etc.) of the milking technologies, conditions of the environment and the animal
M db j ; Melkassa, Sebeta-Hawas& Holeta

S f m
Considering milk yield, quality of construction material, availability and cost of machine, weight and easiness of milking operation and ease of fabrication in a reverse engineering Turkey made double cow milking machine prototype having a milking can of 40 litters and driven by 1.5 hp electric motor was acquired from local market (Fig 12).
Then evaluation of the machine was made on the basis of, milking time, rate of milk harvest, Attachment and detachment of milking unit, completeness of milking and easiness of work. Preliminary performance evaluation conducted both on local and crossbreed cows showed that

The capacity ranges from 240–300 litters per hour against 60–75 litters per hour in manual methods.

Attachment and detachment of milking unit is very much easy.

- It can harvest completely (if there is a foamy in the teat cup that means the whole milk is harvested

Parts that need modification work were identified

Ufb d : made up of plastic so easily broken by cow's leg.

Mj f ; the tip of liner is difficult to fit to teats of local breed cows because it is designed for crossbred cows

f f fh rb : Each liner must have its pressure regulator valve for closing when teat is affected or contaminated

Fig.9. Double cow milking machine acquired for adaptation

rb g if f fb

So far efforts were made to overcome the identified problems but regarding liner, unable to get manufacturer who working on production of flexible rubber pipe (Liner). Therefore, it is recommended to do

- Modification especially on the teat cup to make more compatible to local cows.
- Think of local re-fabrication of the prototype

Bd j j 7/5/ Development/Introduction, evaluation and adaptation of milk churning equipment

Bd j j f j e: July 2017 - June 2020

P ckfd j f ; To assess, evaluate and develop milk churning equipment

S f jc rfi f) *; Tamirat L., Eyob H., Dereje Y., Mane A. and Mohammed T.

S f fe c ;Tamrat L., Mulgeta T. and Abiy S.

f j e g f : January – December 2019

T b g if h f ;

Ef jh ; Assessment, design development, fabrication and evaluation in CRD (Factorial)

U fb f : Improved prototypes and the existing milk churning devices at different settings of the prototypes and environmental conditions

M db j ; Melkassa, Sebeta-Hawas & Holetta

S f m

Two versions of milk churning devices were fabricated at AIRIC workshop (Fig.13). The first is an improved manually operated made from plastic jar and the other is an electric motor driven made from aluminum. Performance test of prototype churners were conducted at MARC. The third milk churning devices is electric motor driven, made of stainless steel and acquired from ELCA. Then performance evaluation of the churning technologies were conducted at Holleta Agricultural Research Center. A mixture of 50% and 70% Holstein-Friesian breed Yoghurt were used for testing. Result shown in Table 10.

The treatments were:

- Melkassa Hand Operated Milk Churner (MHMC)
- Melkassa Electric Motor Operated Milk Churner (MEMC)
- ELCA Electric Motor Operated Milk Churne (EEMC)

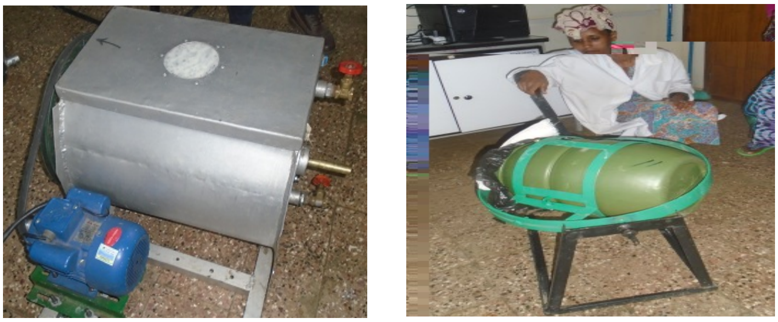


Fig 10. Milk churning devices stainless steel Electric Motor driven ELCA (left) Melkassa Electric Motor Operated (middle) and Melkassa Hand Operated(right)

rb g i f f fb

Final write-up to the end of the budget year

Animal Science Research Process

Kedir Shifa
E-mail: kedirsh01@gmail.com; Phone: +251911384487

Sericulture Research Program

S f fb di df ; Animal Science

h b ; Sericulture Research Program

kfd j rnfi 2; J f f - mj njdb j b e b gf g f jd m f fdi mhjf j F i j jb

kfd f j e; July 2018 - June 2022

Bd j j Uj rnfi 2; Collection and characterization of castor accession for high yield and disease resistance

Bd j j f j e; July 2018 – June 2022

P ckfd j f

M db j ; Melkassa, Jimma, Wondo Genet ARC & Arbaminch Bere Silk Producer Company

S f m

The promising or candidate varieties (K2 and S13) have been planted in all location along with the local check as per recommendation of National Variety Release Guideline. Field performance evaluation has been done on December 2019, by National Technical Release Committee. The assessment of these committee members will be presented tothe standing Committee and the decision will be known during that period.

rb g i f f fb ; The activity will be repeated for next year if the early assessment carried out by the National Technical Release Committee didn't satisfy decision makers for release.

Bd j j j rfi 4; Maintenance of mulberry varieties
Bd j j f j e; July 2018 - June 2022
P ckfd j f ;To maintain and observe mulberry germplasms/lines for future research works
S f jc rfi f) *; MARC (Kedir, Metasebia, Abiy & Aynalem) & Other Centers (Saba, Worku)
S f fe c ; Kedir Shifa
f j e g f ; January – December 2019
T b g h f
Planting and maintenance of mulberry germplasms is under progress as to the plan.
E f jh ; Un-replicated
U fb f : Different mulberry germplasms/lines are considered as treatment
M db j ; Melkassa, Jimma, Shewarobit

S f m

The entire available accessions or collections of mulberry were planted for maintenance and evaluated under field conditions for number of leaves/plant, date of maturity, fresh and dry leaf weight, plant height, disease and insect pest incidence and severity.

Table 1. Evaluation of mulberry germplasms/accessions for yield and yield forming characters

TREATMENTS	SC	PH	NL	NS	PB	INC	SEV	FLW	DLW
Sire town	11	2.80	619.00	8.3	19	36.5	50.00	350.00	87.5
Anno town	1	1.07	355.00	3.3	32	24.1	13.33	332.00	83.0
Tibe town	9	3.05	471.33	3.3	23	37.7	33.33	400.00	100.0
Shoboka town	6	3.27	1020.00	3.0	34	42.6	35.00	430.00	107.5
DembiGobu PA	7	3.48	957.67	1.7	60	36.8	25.00	470.00	117.5
Bako1	12	3.52	309.67	2.0	18	51.3	28.33	345.33	86.3
Bako 2	13	3.02	198.00	2.0	19	40.6	20.00	205.00	51.3
Ambo 1	5	2.27	481.00	1.7	14	47.4	15.00	290.00	72.5
Ambo 2	15	2.54	228.00	2.0	27	61.0	20.00	348.67	87.2
Agaro town	21	3.12	107.33	2.0	11	72.6	25.00	147.00	36.8
Dembi 1	26	3.52	172.67	2.0	9	40.3	23.33	392.00	98.0
Dembi 2	13	3.25	343.67	2.0	15	40.3	31.67	498.00	124.5
Bedele town	24	3.54	299.33	2.3	10	32.7	20.00	343.67	85.9
Arjo town	23	3.53	161.33	2.0	12	60.9	36.67	256.67	64.2
Nekemte 1	7	3.45	357.33	1.7	29	52.5	18.33	944.33	236.1
Nekemte 1	2	2.25	733.33	1.3	28	25.7	15.00	1200.00	300.0
Chingi	19	3.85	327.67	3.3	10	49.8	16.67	320.00	80.0
Cheri	15	3.03	345.33	1.3	16	41.0	11.67	297.00	74.3
Local	25	3.93	280.67	1.0	18	39.1	25.00	448.33	112.1
Debrezeit	6	3.30	510.67	1.3	19	47.1	21.67	435.00	108.8
M4	19	2.30	556.67	1.0	21	52.1	1.67	1450	362.5
M3	15	0.39	108.67	1.0	6	36.9	18.33	149	37.3
M2	17	0.21	151.00	1.5	7	23.6	0.67	122	30.5
M1	11	2.92	401.67	1.0	19	59.7	8.33	593	148.3
K-2	19	3.20	421.33	1.0	19	34.6	10.00	900	225.0
S-13	10	2.73	202.00	1.0	9	53.1	21.67	1054	263.5

rb g i f f fb ; All germplasms/lines of mulberry will be continued for the maintenance efforts at field level.

Bd j j Uj rfi 5; Maintenance of Castor varieties
Bd j j f j e; July 2018 - June 2022
P ckfd j f ; To maintain and observe selected castor germplasms/lines for future research works
S f jc rfi f) *; MARC (Kedir, Metasebia, Abiy & Aynalem) & Other Centers (Saba, Worku)
S f fe c ; Kedir Shifa
f j e g f ; January – December 2019
T b g h f
Planting and maintenance of castor varieties is under progress as to the plan.
Ef jh ; Un-replicated
U fb f : Different castorgermplasms/lines are considered as treatment
M db j ; Melkassa, Jimma, Shewarobit

S f m
Sevenselected castor germplasms/lines are maintained under field conditions and data collection under progress. In addition, more than 100 castor germplasm are maintained in seed form.

Table 2. Mean performance of castor varieties under maintenance at MARC in field condition

Name of Accessions	Stad Cont	Plant Height (Cm)	No. of Leaves/ Plant	No. of Diseased Leaves/Plant	Uniformity	Vigorosity	Primary Branches	Secondary Branches
Abaro	14	155.00	12.33	3.67	3	3	2.67	4.67
200355	18	193.33	18.67	5.00	3	3	5.00	6.67
208950/2	18	208.33	20.00	4.67	2	2	6.00	5.67
212534	20	190.00	17.67	5.67	3	3	3.33	5.00
219671	19	206.00	11.00	2.33	3	3	4.00	6.33
219647	19	232.67	11.33	3.00	3	3	6.00	7.33
Hiruy	21	210.00	19.33	4.67	2	3	6.67	8.67

rb g i f f fb ; All germplasm/lines of castor will be continued to maintenance at the field and store condition.

Bd j j j rfi 6; Maintenance of Eri-silkworm strains
Bd j j f j e; July 2018 - June 2022
P ckfd j f) *; To maintain available eri silkworm strains for future research and development works
S f jc rfi f) *; MARC (Kedir, Aynalem, Metasebia, Abiy) & researchers from other research centers (Saba, Worku, Mekonnen)
S f fe c ; Kedir Shifa
f j e g f ; January – December 2019
T b g h f
Nineeri-silkworm strains, which were obtained from India, Kenya and Vietnam maintained for future research and development efforts based on research activity in the past years.
Ef jh ; Un-replicated
U fb f : Different eri silkworm strains are considered as treatments
M db j ; Melkassa, Jimma, Shewarobit and Hawassa

S f m
All the available castor feeding eri silkworm strain are under maintenance at the laboratory conditions. These strains are also transferred to responsible centers. All the necessary data like moulting and feeding periods, mortality rate, number of eggs/laying, hatching percentage of the eggs, larval weight (gm), duration of life stages: Egg, Larvae, Pupae, total, percentage of silk produced (%), cocoon assessment, cocoon weight (gm), Single shell weight (gm), Single pupae weight (gm) are collected.

Table 3. Performance evaluations of Eri-silkworms maintenance at Melkassa

No	Eri Silkworm Strains	Hatchability %	Larval Weight (G)	Cocoon Weight (G)	Pupal Weight (G)	Shell Weight(G)	Shell Ratio (%)
1	Eri-3.4	49.25	6.760	2.66	2.15	0.35	13.15
2	Eri-Yellow	57	4.817	2.02	1.76	0.25	12.30
3	Eri-Green	56	4.060	2.41	2.03	0.29	12.00
4	Eri-Mixed	53.5	5.067	2.13	1.86	0.26	12.20
5	Eri-Zhingurgur	40.65	4.777	2.33	2.01	0.3	12.80
6	Eri-Arbaminch	44.5	5.497	2.37	2.19	0.33	13.90
7	Icipe plain blue	41	4.677	1.55	1.334	0.22	14.10
8	Icipe stripped	49.5	4.563	2.21	1.94	0.27	12.20
9	Eri -India new	49.5	5.740	2.79	2.39	0.39	13.90

rb g i f f fb ; Adaptable and disease resistant eri silkworm strains will continue to be maintained at laboratory level

Bd j j j rfi 7; Maintenance of Mulberry silkworm strains
Bd j j f j e; July 2018 - June 2022
P ckfd j f) *; To maintain available mulberry silkworm strains for future research and development works
S f jc rfi f) *; MARC (Kedir, Abiy, Metasebia & Aynalem) & researchers from other research centers (Edao, Saba, Dereje, Walelign)
S f fe c ; KedirShifa
f j e g f ; January – December 2019
T b g h f
Eight bivoltine and two multivoltinesilkworm strains, which were obtained from Korea, Kenya, China and Vietnam maintained for future research and development efforts based on research activity in the past years. Six hybrids are also maintained at similar manner.
Ef jh ; Un-replicated
U fb f : Different mulberry silkworm strains are considered as treatments
M db j ; Melkassa, Wondogenet, Jimma, Tepi, Alage and Arbamich

S f m
All the available mulberry feeding mulberry silkworm strains (8 bivoltine, 2 multivoltine and 6 hybrids) are under maintenance at the laboratory conditions. These strains are also transferred to responsible centers. All the necessary data like moulting and feeding periods, mortality rate, number of eggs/laying, hatching percentage of the eggs, larval weight (gm), duration of life stages: Egg, Larvae, Pupae, total, percentage of silk produced (%), cocoon assessment, cocoon weight (gm), Single shell weight (gm), Single pupae weight (gm) are collected.

Table 4. Performance evaluations of maintenance of Mulberry-silkworms at Melkassa

No	mulberry silkworm strains	hatchability %	larval weight (g)	cocoon weight (g)	pupal weight (g)	shell weight (g)	shell ratio (%)
	Bivoltine						
1	Kenya-2	72.8	1.800	1.68	1.43	0.27	16.1
2	Kenya-3	72.2	1.897	0.9	0.78	0.13	14.4
3	Kenya-4	67.8	1.847	0.89	0.75	0.141	15.8
4	Kenya-5	62.6	1.877	0.94	0.81	0.15	15.9
5	Korea-1	66	1.827	2.27	1.9	0.37	16.2
6	Korea-3	71.4	1.487	0.88	0.76	0.135	15.3
7	China-3 (GN2)	61.8	1.960	0.93	0.84	0.15	16.0
8	China-2	56.8	1.760	0.83	0.7	0.13	15.0
	Multivoltine						
1	Mult-yellow	71.6	1.263	0.61	0.53	0.08	13.1
2	Mult-white	72.5	1.347	1.55	1.37	0.21	13.5
	Hybrids						
1	China2 x Yellow	71	2.3	0.62	0.53	0.1	12.9
2	Kenya2 x Yellow	74.56	2.5	0.56	0.57	0.11	15.88
3	Kenya3 x Yellow	74.5	2.3	0.68	0.58	0.1	13.82
4	Kenya4 x Yellow	78.5	2.31	0.67	0.57	0.1	14.56
5	Kenya5 x Yellow	68.76	2.6	0.66	0.57	0.1	14.06
6	Korea1 x Yellow	72.8	2.3	0.6	0.53	0.1	14.98

rb g i f f fb ; All the available mulberry silkworm strains will continue and be maintain at laboratory level

Bd j j j rfi 8; Determination of spacing and plant density of mulberry plants for high leaf yield and better leaf quality
Bd j j f j e; July 2018 - June 2022
P ckfd j f :To determine the optimum spacing and plant density of mulberry plant for improved mulberry leaf productivity
S f jc rfi f) *; MARC (Metasebia Terefe, Tewodros Mesfin, Kedir Shifa, Abiy Tilahun, Aynalem Tsegaw) and collaborative centers
S f fe c ; Metasebia Terefe
f j e g f ; January – December 2019
T b g h f
One selected mulberry variety has been planted in all locations. Data Collection started.
Ef jh ; RCBD factorial with 3 replications
U fb f ; 12 combinations of intra and inter row spacing are considered as treatments.
M db j ; Melkassa, Jimma, Arbaminchand WondoGenet

S f m
The planned inter row and intra row combination for mulberry planting space or population density has been established. Data collection and entry are under progress

Table 5. Means of different agronomic parameters of mulberry in production seasons of 2019

Treatments	Plant Height (Cm)	No. of Leaves /Plant	Primary Branches	Secondary Branches	Disease Incidence %	Disease Severity %	Total Fresh Leaf Weight/Plant	Total Dry Leaf Weight/Plant
45cm x 90cm	208.34	278.22	7.00	24.56	11.09	20.56	610.67	242.45
45cm x60cm	238.89	283.78	6.78	37.89	4.31	11.11	730.67	253.78
45cmx75cm	227.78	227.22	6.00	23.22	6.07	11.11	686.67	245.78
60cm x60cm	237.22	280.89	8.22	18.22	6.35	12.56	803.33	296.00
60cmx 90cm	249.44	309.00	9.33	14.78	5.45	8.11	912.66	329.11
60cmx75cm	228.89	177.56	6.33	5.33	9.29	16.67	690.44	249.33
75cm x75cm	228.33	262.89	7.22	19.45	10.52	11.44	711.78	252.67
75cmx 60cm	184.45	142.33	6.56	10.78	10.71	12.78	477.11	191.56
75cmx90cm	188.33	142.44	6.11	11.89	10.65	17.22	498.00	197.56
90cm x60cm	216.67	276.11	6.11	21.67	9.23	13.34	727.56	266.89
90cmx75cm	232.78	237.33	8.22	19.00	7.63	6.67	799.11	284.00
90cmx90cm	232.78	329.44	8.44	13.78	7.06	8.33	910.89	340.22

rb g i f f fb : Continue the trial based on the plan.

Bd j j j rfi 9; Effect of different production seasons on the biology and performance of mulberry silkworms, *Bombyxmori (Bivoltine and multivoltine)*
Bd j j f j e; July 2018 - June 2022
P ckfd j f : To assess the role of different production seasons affecting growth, survival and productivity in multivoltineand bivoltine mulberry silkworm strains
S f jc rfi f) *; Abiy Tilahun, Kedir shifa, Metasebia Terefe, Aynalem Tsegaw and staffs from collaborative centers
S f fe c ; Abiy Tilahun
f j e g f ; January – December 2019
T b g h f
The trial is at its progressing according to its plan.
Ef jh ; CRD
U fb f ; Three production seasons are considered as treatments.
M db j ; Melkassa, Wondogenet, Arbaminch and Teppi

S f m
Silk productivity variables were evaluated in wet rainy, cold dry seasons and hot dry season at MARC for different silkworm strains. Data collection is progressing.

Table 6. Performance of Chinese strain (bivoltine mulberry silkworm) in d/t production seasons on grainage parameters at MARC

Seasons	Fecundity (no. of eggs laid per female oth)	Incubation in days	% hatchability
Wet rainy season	339±21a	8±0.5c	66±1.78a
Cold dry season	283±16ba	18±2a	56.8± 4.46b
Hot dry season	280±9b	12±1b	50.4± 2.18b

Table 7. Performance of Chinese strain (bivoltine mulberry silkworm) in d/t production seasons on larval parameters at MARC

Seasons	Larval mortality (%)	Larval Survival Rate (%)	Larval weight (g)	Larval period (days)	Total duration in days
Wet rainy season	55.1±4.5b	44.8±4.5a	2.29±0.02b	30±1b	55±1b
Cold dry season	53.8±5.2b	46.1±5.2a	1.97±0.07c	31±1.5a	64±2a
Hot dry season	66.0±2.7a	33.9±2.7b	2.50±0.03a	25±0.6c	50±1c

Table 8. Performance of Chinese strain(bivoltine mulberry silkworms in d/t production seasons on cocoon parameters at MARC

Season	Cocoon weight (g)	Pupal weight (g)	Shell wt (g)	shell ratio (%)
Wet rainy season	1.15±0.042a	0.978±0.032a	0.175±0.009a	15.17±0.29b
Cold dry season	0.79±0.014b	0.669±0.012c	0.124±0.003b	15.70±0.40ba
Hot dry season	1.07±0.008a	0.899±0.004b	0.179±0.004a	16.66±0.30a

rb g i f f fb : Repeate the experiment as per plan

Bd j j j rfi : ; Effect of different production seasons on the biology and performance of Eri-silkworms, *Samiacynthiaricini*
Bd j j f j e ; July 2018 - June 2022
P ckfd j f : To assess the role of different production seasons affecting growth, survival and productivity in multivoltine and bivoltine mulberry silkworm strains
S f jc rfi f) *; Abiy Tilahun, Kedir shifa, Metasebia Terefe, Aynalem Tsegaw and staffs from collaborative centers
S f fe c ; Abiy Tilahun
f j e g f ; January – December 2019
T b g h f
The trial is progressing well.
Ef jh ; CRD
U fb f ; Three production seasons are considered as treatments.
M db j ; Melkassa, Wondogenet, Arbaminch and Teppi

S f m
Silk productivity variables were evaluated in wet rainy, cold dry and hot dry seasons for different silkworm strains. Data collection is started and it will continue.

Table 9. Performance of eri silkworm in d/t production seasons on grainageparameters at Wodogenet

Seasons	Fecundity (no. of eggs laid per female oth)	Incubation in days	% hatchability
Wet rainy season	450±15a	13.0±1.5b	70.4±2.08ba
Cold dry season	469±17a	14.0±1a	80.20±3.02a
Hot dry season	366±23b	11.0±1.6c	64.2±2.70b

Table 10. Performance of eri silkworm in d/t production seasons on larval parameters at Wondogenet

Seasons	Larval mortality (%)	Larval Survival Rate (%)	Larval weight (g)	Larval period (days)	Total duration in days
Wet rainy season	1.0±0.22c	99.1±0.18a	5.91±0.04a	26±2.5c	69.8±0.2a
Cold dry season	5.5±0.35b	94.6±0.43b	6.40±0.34a	27±2b	50.2±0.2c
Hot dry season	9.2±1.32a	90.90±1.36c	3.64±0.14b	32±1.9a	60.8±0.2b

Table 11. Performance of eri silkworm in d/t production seasons on cocoon parameters at Wondogenet

Season	Cocoon weight (g)	Pupal weight (g)	Shell wt (g)	shell ratio (%)
Wet rainy season	2.07±0.06b	1.86±0.10b	0.179±0.024b	13.18±0.80a
Cold dry season	2.80±0.10a	2.44±0.08a	0.360±0.037a	12.80±1.12a
Hot dry season	2.94±0.06a	2.56±0.06a	0.380±0.005a	12.92±0.33a

rb g i f f fb : Continue the trial based on the plan.

Bd j j j rfi 21; Evaluation of cassava lines (*Manihot spp*) for their adaptability, leaf productivity and silk yield by using eri- silkworms
Bd j j f j e; July 2018 - June 2022
P ckfd j f : To evaluate cassava varieties for adaptability and leaf productivity as well as growth and silk yield of eri silkworms
S f jc rfi f) *; Kedir Shifa, Metasebia Terefe, Abiy Tilahun, Kedir Kebero, Aynalem Tsegaw and Researchers from collaborative centers
S f fe c ; Kedir Shifa
f j e g f ; January – December 2019
T b g h f
Different cassava varieties which may provide high rearing performance and feeding efficiency on eri silkworms when used as feed sources have been collected. The trial is progressing well.
Ef jh ; CRD
U fb f : Feeding of different cassava varieties considered as treatments
M db j ; Melkassa, Wondogenet, Jimma, Tepi and Arbaminch

S f m
Seven cassava lines were established well in MARC and collaborating centers. Feeding trial and data collection was started.

Table 12. Mean larval and cocoon performance of eri silkworms when fed on different castor varieties

Treatment	Maximum weight of a larva (g)	Cocoon weight (g)	Pupal weight (g)	Shell weight (g)	Shell ratio (%)
Qulle	2.290	0.174	0.153	0.021	11.745
191/0424	2.373	0.371	0.328	0.043	11.417
Chichu	2.216	0.417	0.367	0.047	11.464
Awc 2	2.258	0.600	0.514	0.091	14.587
Awc 3	2.060	0.397	0.349	0.048	11.967
Kello	2.126	0.474	0.423	0.051	10.768
Jimma Local	2.110	0.310	0.275	0.035	11.496

rb g i f f fb : Conducting of additional feeding trials as planned.

Bd j j j rfi 22; Study on the effects of nutritional supplementations of castor leaf with soya flour, cowpea flour and AmaranthusCreuntus L. seed powder on economic parameters of Eri-silkworms
Bd j j f j e; July 2018 - June 2022
P ckfd j f : To see the effect of nutritional supplementation of silkworm feed plant on the quality and quantity of Eri-silkworms (Eri-3.4) and to see the effect of silkworm feed supplementation on the biochemical constituents of eri-silkworms
S f jc rfi f) *; Abiy Tilahun, Kedir Shifa, Metasebia Terefe, Aynalem Tsegaw and agricultural and nutrition laboratory researchers
S f fe c ; Abiy Tilahun
f j e g f ; January – December 2019
T b g h f
Data inputs prepared and the experiment is started.
Ef jh ; CRD

U fb f : Supplementation of different feed types and concentrations considered as treatments
M db j ; Melkassa

S f m
Soya flour, cowpea flour and *Amaranthus Creuntus*seed powder were treated as feed supplementations and designed to see their effect on the growth and productivity of silkworms. Necessary data has been collected and data process is underway
rb g i f f fb : Conducting of feeding trials and carrying out nutrient analysis are the targets for the next year.

Bd j j j rfi23; Evaluation of management options for eri- silkworm diseases
Bd j j f j e; July 2018 - June 2022
P ckfd j f0 ; To evaluate the effect of lime and vim combination for the management of castor silkworm diseases
S f jc rfi f) *; Metasebia, Abiy, Kedir and Aynalem
S f fe c ; Metasebia Terefe
f j e g f ; January – December 2019
T b g h f
The experiment is stated. Data collection and entry initiated.
Ef jh ; CRD
U fb f : Lime, vim and combination of lime and vim
M db j ; Melkassa

S f m
Evaluation of lime and vim combinations were started for the management of eri silkworm diseases under laboratory conditions. Data were collected in respect of growth and cocoon characters (cocoon weight, shell weight and shell or silk ratio), larval weight, silkworm mortality, etc.

Table 13. Efficacy dust application of lime and vim combination on mortality of different instars on eri- silkworm diseases

Treatment	2^{ND} instars	3^{rd} instars	4^{th} Instars	5^{th} instars	Total mortality	Reduction in mortality in %
10%(vim)* 90%(lime)	4.3a	5.7a	8.3a	16b	34b	23.25
20%(vim)* 80%(lime)	4ab	4a	8.3a	12.3b	28.7bc	35.21
30%(vim)* 70%(lime)	3.7abc	5.7a	7a	13.3b	29.7bc	33
40%(vim)*60%(lime)	1.3c	6.3a	6.7a	10.7b	25bc	43.6
50%(vim) * 50%(lime)	2abc	4a	7a	11b	24c	45.8
100% (vim)	1.7bc	3.7a	8a	11.7b	25bc	43.6
100% (lime)	1.7bc	5.3a	8.3a	12.7b	28bc	37
UC (untreated control	4ab	5.3a	8a	26.7b	44.3a	-
LSD	2.6	3.5	3	7.3	9.9	-
CV	18	19	13	14	18.9	-

rb g i f f fb : Continue to run the experiment, collect and analyze data.

Bd j j Uj rfi 24; Demonstration and scaling up of proven silk production technologies as income generating activity
Bd j j f j e; July 2018 - June 2022
P ckfd j f ;

1. To scale up better sericulture technologies for wider impact
2. To create awareness and develop confidence among silkworm producers, development agents, agricultural experts and policy makers for wider dissemination

S f jc rfi f) *; Abiy Tilahun, Kedir Shifa, Metasebia Terefe and Aynalem Tsegaw
S f fe c ; Abiy Tilahun

f j e d f fe; January – December 2019

T b g h f

A popularization efforts of sericulture technology by this project involved provision of trainings, demonstrations, supervision and advisory services, exhibitions, mass medias, production guidelines and leaflets to the wider society at different parts of the country. Thus, it benefited different target groups or individuals in terms of income generation and job creation and produced model female and male farmers in the country. Therefore, this activity established a good momentum to the future sericulture scaling up efforts.

Ef jh ; none

U fb f : none

M db j ; Shebedino, Hawasa zuria, Sodo Zuria, Damot Sore and Arbaminch Zuria

Sf m

Popularization of silk production technologies was initiated to effectively transfer silk production knowledge and technologies to users and to create awareness about the technology among different stakeholders (Governmental and non-governmental bodies, buyers, processors, producers including farmers and town residents, women, youth and elderly groups, etc.). Several approaches and tools are used to effectively popularize silk production technology to stakeholders such as training, demonstration among the different stakeholders for wider impact. Training and demonstration were carried out for selected farmers, DAs and other stake holders involved in the scaling up process on different silk production techniques viz. silkworm rearing, feed plant growing and post cocoon harvest management. Therefore, in this budget year technologies such as improved silkworm strains, silkworm rearing techniques and improved silkworm feed plants were demonstrated for several beneficiaries to create awareness about the technologies. Training were provided to more than 150 beneficiaries on silkworm rearing, mulberry and castor feed plants growing and silk processing technologies for farmers, DAs and experts ofMeirab Abaya, Wolaitasodo and Shebedino areas, with emphasis on silkworm egg multiplication and silk fiber processing. In collaboration with icipe, we have also provided trainings form more than 900 youth and women groups in Gamo and Wolaita zones. Additionally, awareness is created to several visitors by providing them the required information that came to our center to visit our technologies at different times. Supervision and advisory services were provided to some producers by direct visiting of production sites and other means of communication. Moreover, Participation was carried out in some exhibitions and workshops to create linkage and awareness for wider impact among different groups of stakeholders. Therefore, appropriate silk production information was shared and important silk production guidelines and leaflets were multiplied and distributed during such programs.

Table 14. Location and number of farmers targeted under the silk production demonstration

Zone	District	Kebele	Number of selected farmers
Sidama	Shebedino	Howolso	10
	Hawassa Zuria	Hawalawondo & Alamura	5
WolaitaSodo	Sodo Zuria	Bosa Kacha	6
	Damot Sore	Sunkele	5
Gamo	Mirab Abaya	Ugayehu	10
Total			36

rb g if f fb : demonstration of improved silk production will be continued.

Bd j j j rfi 25; Multiplication of improved Castor Varieties

Bd j j f j e; July 2018 - June 2022

Pckfd j f ; To multiply and distribute high yielding castor varieties

Sf jcrfi f) *; Abiy, Metasebia, Kedir, Aynalem and researchers from respective centers

Sf fe c ; Abiy Tilahun

f j e g f ; January – December 2019
T b g h f
By this activity, castor seeds were multiplied and distributed as the research system is the mainorgan to supply initial seeds of castor to silkworm rearers' at different parts of the country. Thus, ithas benefited several target groups or individuals in terms of feed plant seed supply. Therefore, this activity showed the way for future technology multiplication efforts by private investors, community groups and government bodies.
Ef jh ; un-replicated
U fb f : none
M db j ; Melkassa, Jimma, Wondogenet, Hawassa, Tepi, Shewarobit and Arbaminch

Sf m
Seeds of castor varieties were multiplied and distributed to users to increase silk production and productivity. About 500 kg of castor seed were multiplied at Melkassa. Out of these, more than 400 kg of castor seeds were provided for small scale and commercial farmers to enhance their silk production.
rb g if f fb : improved varieties of castor will be multiplied and distributed for the users as to the plan

Bd j j j rfi 26; Multiplication of improved Mulberry Varieties
Bd j j f j e; July 2018 - June 2022
P ckfd j f ;To multiply and distribute high yielding mulberry varieties
S f jc rfi f) *; Metasebia, Kedir, Abiy, Aynalem and researchers from respective centers
S f fe c ; Metasebia Terefe
f j e g f ; January – December 2019
T b g h f
Several amounts of mulberry cuttings were multiplied and distributed as the research system is the main organ to supply initial seeds to at different parts of the country. Thus, it benefited several target groups or individuals in terms of feed plant seed supply. Therefore, this activity showed the way for future technology multiplication efforts by private investors, community groups and government bodies.
Ef jh ; un-replicated
U fb f : none
M db j ; Melkassa, Wondogenet, Hawassa, Shewarobit, Alage and Arbaminch

Sf m
Seeds of high yielding mulberry varieties multiplied and distributed to users. Mulberry cutting of 24000 were multiplied in Melkassa. Out of these, 22,600 mulberry cuttings were provided for small scale and commercial farmers to enhance silk production.
rb g if f fb : improved seeds of mulberry planting materials will be multiplied and distributed for the users according to the plan

Bd j j j rfi 27; Multiplication of improved Eri-Silkworms
Bd j j f j e; July 2018 - June 2022
P ckfd j f ; To multiply & distribute disease free high yielding erisilkworm eggs to users
f j e g f ; January – December 2019
S f jc rfi f) *; Abiy Tilahun, Kedir shifa, Metasebia Terefe, Aynalem Tsegaw and staffs from collaborative centers
S f fe c ; Abiy Tilahun,
T b g h f
By this activity, several amounts of eri silkworm eggs/larvae/ were multiplied and distributed to different parts of the country. Thus, it benefited several target groups or individuals in

terms of erisilkworm seed supply. Therefore, this activity showed the way for future technology multiplication efforts by private investors, community groups and government bodies.

Ef jh : none

U fb f : none

M db j ; Melkassa, Alage, Wondogenet, Hawassa, Arbaminch, Jimma, Tepi&Shewarobit

Sf m

Seeds of healthy and high yielding erisilk worms were multiplied and distributed to users that increased silk production and productivity. More than 6000 laying eri-silkworms were multiplied in Melkassa. Out of which, more than 5000laying were provided for small scale and commercial farmers to enhance silk production.

rb g if f fb : Seeds of healthy erisilkworms will be multiplied and distributed for the users

Bd j j j rfi 28; Multiplication of improved mulberry Silkworms

Bd j j f j e; July 2018 - June 2022

Pckfd j f ; To multiply & distribute disease free high yielding mulberry silkworm eggs to users

kfd f j e; Jan 2018 – Dec 2019

Sf jcrfi f) *; Abiy Tilahun, Metasebia Terefe, Kedir Shifa, Aynalem Tsegaw and staffs from collaborative centers

Sf fe c Abiy Tilahun,

f j e g f ; January – December 2019

T b g h f

By this activity, several amounts of mulberry silkworm eggs/larvae/ were multiplied and distributed to different parts of the country. Thus, it benefited several target groups or individuals in terms of eri silkworm seed supply. Therefore, this activity showed the way for future technology multiplication efforts by private investors, community groups and government bodies.

Ef jh : none

U fb f : none

M db j ;Melkassa, Alage, Wondogenet, Hawassa, Arbaminch, Jimma, Tepi & Shewarobit

Sf m

Seeds of healthy and high yielding mulberry silkworms were multiplied and distributed to users that increased silk production and productivity. About 3000 laying mulberry silkworms were multiplied in Melkassa. Out of which, morethan 2000laying were provided for small scale and commercial farmers to enhance silk production.

rb g if f fb : Seeds of healthy mulberry silkworms will be multiplied and distributed for the users

kfd j rfi; Enhancing productivity of beekeeping and marketing
P **kfd f j e;** July 2017 - June 2021
Bd j j j rfi 2; Identification, characterization and evaluation of honeybee flora in East shewa and Western Hararghe zones
Bd j j f j e; July 2017 - June 2021
P ckfd j f ;

- To identify, document, and prepare flowering calendar of nectar and pollen sources (bee forages) to recommend the necessary seasonal colony management practices in different agro- ecologies of Ethiopia
- To collect, identify and recommend adaptable and high yielding bee forages (herbs and shrubs) in different agro- ecologies of Ethiopia

S f jc rfi f) *; Kedir Shifa, Metasebia Terefe, Abiy Tilahun and Aynalem Tsegaw
S f fe c ; Kedir Shifa
f j e g f ; January – December 2019
T b g h f
By this investigation, bee flora species of trees, shrubs and herbs of honey bee importance including their floral period have been identified in consultation with individual farmers, key informants and agricultural experts through questionnaires and transect walks. This will help to properly identify bee flora species for future intervention for different environments.
Ef jh : none
U f b f : none
M db j ; East Shewa and Western Hararge zones

S f m
Questionnaires and data collection sheets have been developed at national level. Identification of the respective zones, districts, kebeles and respondents has been done. The survey work has been conducted in two selected zones. The farmers interviewing were carried out in both zones. The group interviewing of informants (model beekeepers, development agents, and district bee technician or beekeeping experts) from each kebeleis carried out.

Table 1. Selection of district with respective kebelesat different agro ecologies

Region	Zones	District	Kebele
Oromia	East Shewa	Ginbichu	Lemlem, Chefe, Girmi
		Lume	Tede, Ejere, Dungigibekele
		Adama	Mukiye, Wonji, Kechema
		Ada'a	Godino, Bekejo, Kerfe
	West Hararge	GemechisTul	Kunisegeria, Sire gudo Welargi,
		Doba	Bureysa, LubudekebRekefafura, Bekelchebiftu, Ifaaman, Lenchawedesa

Table 2. Flowering calendar of some of the common bee flora source plants in E-Shewa and West Hararghe zones

Local name	Scientific name	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug
AdeyeAbeba	Adeyo (Biden spp.)	x	x										
Bahrzaf	Eucalyptus spp	x	x	x					X	x			
Tensa/Wanbella									X				
Grawa	Vernoniaamygdalina	x							X				
Tufo/mech	Guizotiascabra/ abyssinica								X				
Wanza/Wedesa	Cordiaafricana								X				
Makanisa	.								X				
Besana	Macrostachyussyzygium								X	x			
Reji	Vernoniaspp								X				
Kenchib									X				
Keryoo									X				
Sesa	Sapiumellipticum								X				
Wendebyo									X				
Buna-Bunna	Coffeaarabica L.								X				
Turunba									X				
Gerare	Acacia spp.								X				
Bedesa									X				
Sedisa	Vica spp.												

rb g i f f fb ; The identification and characterization of honey bee flora and determination of floral calendar of bee flora

Bd j j j rfi 3; Demonstration of Beekeeping Technologies In East Shewa and West Hararge Zones, Ethiopia
Bd j j f j e; July 2017 - June 2021
Pckfd j f0 ; To demonstrate beekeeping technologies and to develop beekeepers and DAs capacity-applying beekeeping technologies
S f jcrfi f) *; Metasebia Terefe, Kedir Shifa, Abiy Tilahun and Aynalem T.
S f fe c ; Metasebia Terefe
Zfb g f ; January – December 2019
T b g h f
By this promotion effort, improved beekeeping technologies are being demonstrated. Model farmers are identified at selected sites. Training was given and regular follow up /supervision/ was provided. This will help to create awareness and increase the number of beneficiaries in the technology and increase production of honey and other bee products in selected districts or target locations.
Ef jh ; none
M db j ; Eastern Showa

S f m
In East Shewa Zone, the sites have been selected based on accessibility and potential and convenience of the sites to disseminate the technology package. Group of farmers (one group consisting of 5–6 beekeepers) has been established from each kebeles. Farmers from Adamawereda (Mukiye, Kechema and Adulala kebeles) and Adeawereda (Gudinokebele) are selected. Different Beekeeping materials like bee veil, tuta, guant, queen excluder and modern hive are dispatched for the selected farmers. Theoretical and practical training have been provided for more than 50 stakeholders (farmers, DAs and experts) on several subjects including (General beekeeping, beeswax preparation, comb foundation sheet preparation, Centrifugal Honey Extractor application, etc.). Regular follow up and technical supports have been provided of demo farmers.
rb g i f f fb ; Training and follow up demonstration efforts will be conducted as planned

Feeds and Nutrition Research Program

Aklilu Mekasha
E-mail: mekashaaklilu@gmail.com; Phone: +251923731128

kfd j rfi; Improving Feed Quantity and Quality in Different Production Systems of Ethiopia
kfd f j e; Jue 2016 – July 2020
Bd j j j rfi; Forage sorghum National Variety Trial (NVT) in the CentralRift Valley areas of Ethiopia
Bd j j f j e : July 2018 - June 2020
P ckfd j f ; to evaluate performance of selected potential forage sorghum collections at different locations (NVT
S f jc rfi f) *; Aklilu Mekasha
S f fe c ; Aklilu Mekasha
Zfb g f ; January - Decemeber 2019
T b g h f ; completed
Ef jh : RCBD
U fb f ; ETSL 100292, ETSL 101479, IS 25434, ETSL 101646, ETSL 100900, ETSL 101575, ETSL 101179, ETSL 100428, ETSL 101566 IS38331and check variety chelenko.
M db j ; Melkassa, Negelle Arsi, Mieso, Kulumssa

S f m

Ten promising sorghum genotypes identified from landraces were under evaluation for two years at Melkassa, Negelle Arsi, Mieso and Kulumssa. Two candidate genotypes with best performance in terms of Invitro Organic Matter Digestibility and less stalk thickness (fiber) were selected for further studies at Melkassa, Mieso and Negelle Arsi. At Kulumssas, however, all the genotypes showed low performance across years indicating environmental limitations.

Table 1. Forage dry matter performanceof ten forage sorghum land races evaluated for two years at different locations.

Mb e bdf	N frhb b			Ofhfmfi B j			N jf			L m b		
	2018	2019	mean	2018	2019	Mean	2018	2019	Mea	2018	2019	
FUTM2113: 3	5.50	6,70	2.75	4.90	5.20	5.05	3.20	4.40	3.80	1.20	0.60	0.90
FUTM21258:	2.40	3.89	3.15	5.30	6.20	5.75	6.00	3.20	4.60	2.20	1..60	1.10
JT 36545	4.20	2.50	3.35	6.70	5.20	5.95	4.50	3.70	4.10	1.20	0.50	0.85
FUTM212757	6.40	5.20	5.80	5.20	5.10	5.15	5.20	6.70	5.95	0.50	1.80	1.15
FUTM211: 11	3.20	5.10	4.15	3.79	5.90	4.85	6.20	5.70	5.95	1.50	3.00	2.25
FUTM212686	5.60	3.20	4.40	6.70	8.90	7.80	5.70	6.80	6.25	0.05	2.10	1.08
FUTM21228:	8.15	7.80	7.98	5.51	8.01	6.76	7.39	6.56	6.98	2.00	0.90	1.45
FUTM211539	7.20	6.20	6.70	4.70	6.80	5.75	8.90	7.40	8.15	1.00	0.60	0.80
FUTM212677	3.48	5.20	4.34	3.70	8.90	6.30	5.10	6.10	5.60	2.00	0.20	1.10
JT49442	11.48	11.40	11.4	8.44	11.9	10.2	7.63	11.5	9.61	3.10	1.00	2.05
Di frfi l	15.30	15.61	15.4	16.27	13.0	14.6	14.00	13.1	13.5	3.40	2.80	3.10
MIE	2.40	3.00	2.70	4.00	3.20	3.60	4.00	3.50	3.75	0.40	1.00	0.70

rb g i f f fb ; Best performing two genotypes(IS38331 and ETSL 100428 will be promoted to VVT during the upcoming season around Melkassa, Negelle Arsi and Mieso,

kfd j rfi; Improving Feed Quantity and Quality in Different Production Systems of Ethiopia
kfd f j e; July 2015 – June 2020
Bd j j j rfi; Evaluation of alfalfa (Medicago sativa L.) varieties for forage yield and quality under supplemental irrigation (Partially supported by AGP).
Period: June 2018 - July 2020

P ckfd j f ; To evaluation and verify recently introduced alfalfa cv supersonic for yield and quality for registration in Ethiopia
S f jc rfi f) *; Aklilu Mekasha
S f fe c ; Aklilu Mekasha
Zf b g f ; January - Decemeber 2019
T b g h f ; completed
Ef jh : RCBD
U f b f ; Alfalfa var.Supersonic and 1089/check
M db j ; Melkassa, Negelle Arsi, Mieso

S f m
One alfalfa variety introduced from Australia by a private company was under evaluation for adaptation and evaluation at Melkassa for two years. During the reported year performance data was submitted to the Ministry of Agriculture, and technical committee has evaluated the crop on field. Verdicted is expected on fat of the variety to be passed by the standing committee of the National variety release at the end of the year.

Table 2. Performance of candidate alfalfa variety supersonic at different cutting in Melkassa

Variety	Cutting cycle	Plant height (cm)	Number of tiller/m2	Leaf/stem ratio	DM %	GFY (ton/ha	DMY (ton/ha)
Candidate	1	67.3	274.5	1.53	38.87	7.75	3.01
variety	2	70.8	348.75	3.28	11.27	25.00	2.82
Supersonic	3	95.5	482.5	1.43	16.92	20.34	3.44
	4	81.5	382.25	0.90	14.84	15.56	2.31
	5	62.0	312.5	1.25	22.93	10.13	2.32
	mean	75.4a	360.1a	1.7a	21.0a	15.8a	2.8a
Check	1	61.0	325.25	1.62	39.52	7.00	2.77
variety 1089	2	69.8	329.5	1.43	11.56	19.25	2.22
	3	100.0	411.75	0.95	19.15	22.50	4.31
	4	70.3	346.75	1.10	23.83	15.28	3.64
	5	68.5	452.75	1.12	15.74	14.06	2.21
	mean	73.9a	373.2a	1.2a	22.0a	15.6a	3.0a

rb g i f f f b ;Decision of the standing committee of the Ministry of Agriculture is expected.

kf d j rfi; Forage seed crop husbandry techniques development for elite pasture crops in EthiopiaProject period: Improving Feed Quantity and Quality in Different Production Systems of Ethiopia
Project period: Completed
Bd j j j rfi; Production of basic and pre-basic seeds of cultivated forage crops for promotion and pre-demonstration activities (partially supported by AGP-II) (31-05-19).
f j e: July 2015 - June 2020
P ckfd j f ; To multiply seeds of selected forage crops for promotionand pre-demonstration activities.
S f jc rfi f) *; Aklilu Mekasha
S f fe c ; Aklilu Mekasha
Zf b g f ; January - Decemeber 2019
T b g h f ; completed
Ef jh : un-replicated single plots for each variety
U f b f ; Lablab (Doli-I, Doli-II), cow pea (Adulala, Melka), Mulato-II, and Elephant grass
M db j ; Melkassa

S f m

Seeds of different released and registered varieties of legumes lablab (var. Doli-I, var. Doli-II), and cow pea (var.Adulala, var. Melka), and clones of grasses (Mulato-II, and Elephant grass) were under production for distribution to various end users at Melkassa for two years.

Table 3. Seed/ and clone of different forage crops multiplied over the project activity period at Melkassa

D		Wb jf	V j	3127	3128	3129	312:
Mbc rbc							
	-	Doli-I	Kg	90	100	250	200
	-	Doli-II	Kg	110	115	290	1500
D fb							
	-	Adulala				100	80
	-	Melka				80	75
	-	Temesgen		50	140		
		Mulato-II	Root splits	100000	150000	500000	120000
Frfi i b h b			Cane cut	100000	90000	100000	100000
Brgrgb			Kg	-	-		
jhf fb			Kg	-	-		

rb g i f f fb ;Completed. But since seed production and distribution are continuous activities of the research system, new activities will be initiated for the coming two years.

kf d j rfi; Forage seed crop husbandry techniques development for elite pasture crops in Ethiopia Project period: Improving Feed Quantity and Quality in Different Production Systems of Ethiopia

kf d f j e: July 2015 – June 2020

Bd j j j rfi; Pre-extension Demonstration of Selected Forage Technologies among Smallholder Farmers in the Mixed Crop/Livestock Farming System of the CRV of Ethiopian promising (AGP-II)

P ckf d j f ; To demonstrate and promote production and utilization of recommended and released forage crops to farmers.

S f jc rfi f) *; Aklilu Mekasha

S f fe c ; Aklilu Mekasha

Zf b g f ; January - Decemeber 2019

T b g h f ; completed

Ef jh : un-replicated single plots

U f b f ; mulato-II

M db j ; Lume and Dugda,

S f m

Rooted splits (clones) of the forage grass variety mulato-II was under distribution as part of the pre-extension demonstration to farmers in two districts (Dugda and Lume) for four years

Table 4. demonestirating participants by districts

	3127		3128		3129		312:	
District	Male	Female	Male	Female	Male	Female	Male	Female
Lume	10	5	2	2	0	0	0	0
Dugda	10	5	1	0	3	0	4	0

Table 5. Planting materials distributed to farmers

Planting materials	Unit	/2008/9	2009/10	2010/11	2011/12
Crop variety					
Lablab	kg	110	115	290	1500
Cowpea		50	140	100	80
Mulatto-II	Root splits	100000	150000	50000	100000
Elephant grass	Cane cut	20,000	90000	5000	10,000
Pigeon pea	Kg	-	-		6

rb g i f f fb ; Completed. But since pre extension demonstration is a continuous activity of the research system, new activity will be initiated for the coming year.

kfd j rfi; Improving Feed Quantity and Quality in Different Production Systems of Ethiopia
Project period: July 2015 – June 2020
Bd j j j rfi;.Variety verification trial (VVT) of short to medium duration Pigeon pea (Cajanuscajan (L.)for forage yield in the CRV of Ethiopian
f j e: July 2018 - June 2020
P ckfd j f : To identify best forage yielding Pigeon pea line that can be used for subsequent verification trials
S f jc rfi f) *; Aklilu Mekasha
S f fe c ; Aklilu Mekasha
Zfb g f ; January - Decemeber 2019
T b g h f ; the activity is to be extended
Ef jh : Unreplicatedplots of 10 m x 10 m
U fb f ; A candidate variety and dursa/check
M db j ; Melkassa

S f m
A candidate pigeon pea genotype identified as superior genotype over years and across different location - was promoted to verification trial at Negelle Arsi, Melkassa and Mieso- at both on-station and on-farmers' field. However, sinceweevil is a major problem of storage pest of the crop, we lost substantial amount of seeds. We have limited access to cold rooms, and chemical treated seeds deteriorated in quality of germination. As a result we faced fail at some of the sites and hence failed to satisfy the requirements of variety release.

Table 6. Candidate Variety verification across location

Variety	Melkassa				Mieso				Negele Arsi			
	2017	2018	2019	mean	2017	2018	2019	Mean	2017	2018	2019	mean
JDFB 12280	42.3	28.56	27.2	32.69	41.5	61.5	7.72	36.9	26.0	31.2	19.7	25.6
Dursa (Check)	15.5	16.78	43.6	25.31	18.4	17.2	26.8	20.8	19.2	25.2	18.8	21.1

rb g i f f fb ;will be repeated for one more year.

kfd j rfi; Improving Feed Quantity and Quality in Different Production Systems of Ethiopia
kfd f j e; June 2015 - July 2020
Bd j j j rfi 2: Forage sorghum Post harvest handling and processing
Bd j j f j e; Junly 2018 - June 2020
P ckfd j f : To identify/develop and demonstrate forage sorghum post-harvest processing and handling techniques that promotes sustainable systems of feed conservation, utilization and marketing
S f jc rfi f (s): Aklilu Mekasha
S f fe c : Aklilu Mekasha
Zfb g f ; January - Decemeber 2019
T b g h f
The experiment was fully executed as planned and data collected
Ef jh ; RCBD
U fb f ; crops for silage such as Sorghum, pigeon pea; silos such as fertilizer bag, PVs tube, plotline bag.
M db j ; Melkassa

S f m

Four choppers made in collaboration with the agricultural Mechanization (based on design of previous year's market assessment and prototype of multipurpose chopper cum grinder purchased). Twenty-four farmers evaluated silage quality of sorghum and maize ensiled in different low cost materials used as silo. the judgment scales were 1, 2, 3, 4, 5, representing verbal description of 1= very poor, 2= poor, 3= good, 4= very good, 5= Excellent, respectively.At the same time as a follow-up of last year's low cost containers evaluation for silage and hay making farmers choices were packaged and demonstrated to farmers

Table 7. Farmers (n=24) judgment of silage quality of sorghum and maize ensiled in different containers used as silo

	Politian tube	PVC	Bucket	Fertilizer bag
Sorghum sole	2.9	3.1	1.7	4.0
2/3 sorghum+ 1/3 pigeon pea	2.6	1.3	1.7	1.9
Maize sole	3.1	3.3	1.3	3.4
2/3 Maize + 1/3 pigeon pea	2.7	2.0	1.1	2.9

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

Table 8. Farmers relative choice (%) of post-harvest use option

Post-harvest use options	District		
	Adama	Mojo	Boset
Green feed	40	100	50
Silage	0	0	0
Hay	60	0	50

rb g i f f fb ; The activity will continue as planned for one more year.

kf d j rfi; Improving Feed Quantity and Quality in Different Production Systems of Ethiopia

kf d f j e; July 2015 - June 2020:

Activity title Evaluation of Sorghum × drummondii for forage yield and quality in the semiarid areas of Ethiopia

S f jc rfi f : Aklilu Mekasha

S f fe c : Aklilu Mekasha

Zf b g f : January - Decemeber 2019

T b g h f : The experiment was executed as planned

Ef jh ; RCBD

U f b f ; Four Genotypes (ILRI 6688, ILRI 15974, ILRI 536,ILRI 13333)

M db j ; Melkassa, Negelle Arsi, Mieso.

S f m

The genotypes were established at Makassa to increase seeds since we obtained them in small amount. Yet sufficient seeds have been collected for the upcoming multi-location studies for adaptation and yield.

Table 9. amount of seed produced by genotype

Genotype	Amount of seed (gm)
ILRI 6688	26
ILRI 15974	42
ILRI 536	39
ILRI 13333	52

rb g i f f fb ; The activity will continue as planned for two more years

kfd j rfi; Improving Feed Quantity and Quality in Different Production Systems of Ethiopia

kfd f j e; July 2015 - June 2020

Bd j j j rfi: Evaluation and verification of improved Brachiaria Grass Cultivars for registration in Ethiopia (AGP-II)

Bd j j f j e; July 2018 - June 2020

P ckfd j f ; To evaluation and verify cv Basilisk, Piatã, and Xaraes for yield and quality to register in Ethiopia.

S f jc rfi f ; Aklilu Mekasha

S f fe c : Aklilu Mekasha

Zf b g f ; January - Decemeber 2019

T b g h f : The experiment was executed as planned at both.

Ef jh ; RCBD onunreplicatec 10 x 10 m plot area

U fb f ; two candidate varieties Barchiaria varieties var. Piata , var.Basliks and var., withmulato-II /check

M db j ; Melkassa and Gidara

S f m

The three Brachiaria grasses were introduced from BRazile via Beca ILRI up in Kenya/ Nairobia. They have been under evaluation for adaptation and yield at Melkassa and Gidara with supplementary Irrigation. Data have been collected as planned on all parameters proposed for performance evaluation. The collected data will be summarized and submitted to the Ministry of Agriculture for VVT.

Table 10. Field performance evaluation of three Brachiaria varieties at Melkassa and Gidara

Location	Variety	# of cutting	Plant height (cm)	# tillers/m2	Yield (ton/ha)
	Piata	4	173.75	308.25	29.57
Melkassa	Basliks	3	101.80	321.00	25.48
	Xares	4	192.25	293.5	12.98
	Mulato-II	1	152.5	294.25	17.77
	Piata	3	148.5	301.75	22.19
Gidara	Basilks	3	99.00		

Sf m

Seeds of promising unreleased/unregistered genotypes of pigeon pea, Brachiaria grasses, sorghum, lablab, and cowpea were maintained and increased for sake of germplasm perpetuation, and continuity of research activities.

Table 11. Accessions of forage crops maintained

Crop	# of accessions
Cowpea	8
Lablab	3
Brachiaria	4
Napier grass	3
Pigeon pea	6
Desmodium	1
Sudan grass	4

rb g if f fb : completed

kfd j rfi; Linking Cattle Nutrition to Human Nutrition: Exploring Forage Values of Sorghum in Ethiopia

kfd f j e: October 2016 - September 2020

Bdj j Uj rfi: Evaluation of promising dual purpose sorghum genotypes for forage/ stover yield and quality species

f j e: October 2016 - September 2018

Pckfdj f : to asses nutritional quality and yield of promising dual purpose genotypes harvested atdifferent sages

Sf jcrfi f) *; Aklilu Mekasha

Sf fe c : Aklilu Mekasha

Zfb g f : January - Decemeber 2019

T b g h f

the experiment was completed

Ef jh ; RCBD

U fb f : 9 sorghum varieties under three groups (Local farmers, sweet, grain and stay green introgressed)

M db j : Melkassa, Mieso, Negelle Arsi,

Sf m

The result showed that there is considerable variation among the sorghum genotypic grouping (groups (Local farmers, sweet, grain and stay green introgressed) at booting stage, dough and physiological maturity for percentage of green leaves, brix value, and dry matter yields

Table 12. performance of dual purpose improvrd grain sorghum varieties of different groups

U fb f	T bhf.J			T bhf JJ			T bhf.JJJ		
Variety group effect	Green leaf (%)	Brix value (%)	DM yield (ton/ha)	Green leaf (%)	Brix value (%)	DM yield (ton/ha)	Green leaf (%)	Brix value (%)	DM yield (ton/ha)
Sweet .sorghum varieties	87.01 bc	8.95 a	6.08 b	77.49 a	14.23a	10.15 b	75.74 a	16.40 a	18.14 a
Normal grain sorghum varieties	95.852 a	6.58 b	2.59 c	85.25 a	11.70ab	5.04 c	82.56 a	14.80 ab	7.99 b
Stay-green introgressed varieties	93.86 ab	6.39b	2.70 c	85.64 a	9.99 b	4.84 c	79.87 a	12.82 b	8.59 b
Local farmers' variety	77.33 c	9.26 a	9.68 a	70.83 a	12.49 b	14.15 a	69.78 a	13.80 ab	18.42 a
CV	13.54	41.94	42.44	20.83	31.76	44.81	18.35	26.67	35.34
Location effect									
Negelle Arsi	98.77 a	5.84b	5.02ab	85.23 a	11.97	11.a	91.53 a	11.56 b	18.90 a
Melkassa	87.40 b	6.83 b	6.11 a	82.60 a	12.61 a	8.20 b	74.71 b	19.77 a	9.05 b
Mieso	79.36 c	10.70a	4.66 b	71.58 a	11.7 a	6.10 b	64.73 c	12.04 b	11.92 b

Figures with the same alphabetical letters in a column are not significantly different from each other at 5% probability level/

Table 13. Effect of variety and row proportion of intercropping sorghum with pigeon pea on component (sorghum, pigeon pea) crops total dry matter yields during the 2nd year. Table data only for internal use.

	Ofhf mfi B j			**N frhb b**			**N jf**		
Treatment	Sorghum leaf+ stover yield (ton DM/ha)	Pigeon pea leaf yield (ton DM/ha)	Total DM Yield (ton/ha)	Sorghum leaf+ stover yield (ton DM/ha)	Pigeon pea leaf yield (ton DM/ha)	Total DM Yield (ton/ha)	Sorghum leaf+ stover yield (ton DM/ha)	Pigeon pea leaf yield (ton DM/ha)	Total DM Yield (ton/ha)
Chelenko sole	10.05 A	-	10.05 A	10.45 A	-	10.45 A	11.89 A	-	11.89 A
Melkam sole	4.38 CD	-	4.39 CD	2.79 DE	-	2.79 CD	3.83 D	-	3.83 D
Tsigab sole	-	2.02A	2.02 E	-	0.92 A	0.92 DE	-	0.87 A	0.87 E
Dursa sole	-	1.46B	1.46 E	-	0.45 B	0.45 E	-	1.01 A	0.77 E
Chelenko + Tsigab 1:1	4.45 CD	0.74 C	5.21 C	5.89 C	0.13 BC	6.01 B	6.34 C	0.44 B	6.77 C
Chelenko + Tsigab 3:1	7.55 B	0.20 D	7.76 B	6.79 BC	0.04 C	6.82 B	8.75 B	0.24 BC	8.92 B
Chelenko + Durssa 1:1	5.15 C	0.51 CD	5.65 C	4.64 CD	0.11 BC	4.75 BC	5.80 C	0.23 BC	6.03 C
Chelenko x Durssa 3:1	7.70 B	0.11 D	7.83 B	9.06 AB	0.06 C	9.12 A	10.87 A	1.00 C	10.97 A
Melkam x Tsigab 1:1	1.70 E	0.76 C	2.44 E	1.93 E	0.12BC	2.04 DE	1.91 E	0.37 BC	2.28 DE
Melkam x Tsigab 3:1	2.48 DE	0.32 CD	2.81 DE	2.32 DE	0.06 C	2.38 DE	3.24 DE	0.14 C	3.38 D
Melkam x Durssa 1:1	1.45 E	0.37 CD	1.84 E	2.01 E	0.13BC	2.14 DE	2.70 DE	0.26 BC	2.96 D
Melkam x Durssa 3:1	2.45 DE	0.25 D	2.68 DE	2.33 DE	0.06 C	2.40 DE	2.96 DE	0.18 BC	3.14 D

Figures with the same alphabetical letters in a column are not significantly different from each other at 5% probability level

rb g i f f fb ; completed

kf d j rfi: Linking Cattle Nutrition to Human Nutrition: Exploring Forage Values of Sorghum in Ethiopia

kf d f j e: October 2016 - September 2020

Bd j j j rfi: Determination of optimum plant population/ seed rate for growing sorghum as forage

f j e: October 2016 - September 2018

P ckf d j f : to identify optimum seed rate that maximizes forag yield and quality of different sorghum varieties/ genotypes

S f jc rfi f) *; Aklilu Mekasha

S f fe c ; Aklilu Mekasha

Zf b g f ; January - Decemeber 2019

T b g h f : The experiment was completed

Ef jh : RCBD

U f b f : two sorghum varieties(melkam, chelenko, local) and five seeding rates (12.5kg, 25kg,50kg,75kg and 100kg/ha)

M db j : Melkassa, Mieso, Negelle Arsi

S f m

The results showed variation in the number of green leaves per plants, the stalk circumferences, stand count or the number of plants per unit area but no difference in the number of days to reaching booting stage, number of dry leaves, brix value, and leaf to stem ratio and the green forage yields.

Table 14. Effect of different seeding rate on forage yield and yield attributes of sorghum.

Tffe b f	Eb d j h	T b e d	rb i f jhi	H ff rfibg &	T brh dj d gf f df	Mfbg0 f	H ff g bhf jfm	E g bhf jfm
23/6 l h	100.70 a	82016 c	219.63 a	88.54 a	6.57 a	0.48 a	41.56 a	7.66 b
36 l h	99.59 a	130881 c	207.85 ab	86.19ab	5.69 b	0.47 a	43.60 a	8.47ab
61 l h	99.63 a	257992 b	210.59 ab	82.67ab	5.63 b	0.47 a	50.46 a	9.84ab
86 l h	98.26 a	340477 b	201.30 ab	82.26ab	4.58 c	0.46 a	50.46 a	9.62ab
211 l h	101.67 a	574609 a	192.63 b	80.67 b	4.28 c	0.55 a	51.30 a	10.48 a
Wb jf								
N frhb	77.60 b	129195 C	138.02 c	97.86 a	5.53 a	0.61 a	25.82 c	3.99 b
di frfi l	112.31 a	246276 b	254.91 a	77.06 b	5.74 a	0.35 c	54.21 b	11.02 a
M dbm	110.00 a	456114 a	226.27 b	77.27 b	4.78 b	0.50 b	62.39 a	12.63 a
) b hj* M db j								
Ofhfmfi B j	115.22 a	560000 a	213.02 a	84.00 a	4.25 c	0.50 a	44.02 b	8.39 b
N frhb b	95.51 b	38763 c	213.71 a	81.96 a	6.40 a	0.46 a	58.11 a	11.36 a
N jf	89.18 c	232822 b	192.47 b	86.24 a	5.40 b	0.50 a	40.29 b	7.90 b
DW	6.65	50.17	15.31	10.5	16.17	26.17	32.36	39.59

Plan for the next year: completed

kfd j rfi: Linking Cattle Nutrition to Human Nutrition: Exploring Forage Values of Sorghum in Ethiopia

kfd f j e: October 2016 - September 2020

Bd j j j rfi: Intercropping dual purpose sorghum with pigeon pea to improve fodder, grain yield and quality of available feeds from sorghum based cropping systems

f j e: October 2016 - September 2018

P ckfd j f : to identify compatible varieties of sorghum and pigeon pea for increased yield and quality, and to identify row proportion of intercropping different sorghum and pigeon pea varieties for increased yield and quality

S f jcrfi f)): Aklilu Mekasha

S f fe c : Aklilu Mekasha

Zfb g f : January - Decemeber 2019

T b g h f ; The experiment was completed

Ef jh : RCBD

U fb f : two sorghum varieties melkam, and chelenko; two pigeon pea varieties (Tsigab, Dursa) two cropping systems (1:1 and 3:1)

M db j ; Melkassa, Meso, Negelle Arsi

S f m

The result showed variation among the treatments in terms of sorghum (leaf + stem) dry matter yield, edible pigeon pea leaf dry matter yield, and total dry matter yield from the inter crop (sorghum + pigeon pea).

Plan for the next year: completed

kfd j rfi: Linking Cattle Nutrition to Human Nutrition: Exploring Forage Values of Sorghum in Ethiopia

kfd f j e ; October 2016 - September 2020

Bd j j Uj rfi: On farm evaluation of efficiency of various alternative sorghum based forage systems

f j e: October 2018 - September 2018

P ckfd j f ; to demonstrate alternative ways of improving availability of feeds in sorghum based cropping systems and to asses economic and biological feasibility of different forage sorghum business models for increased yield and quality of available feeds

S f jcrfi f)): Aklilu Mekasha

S f fe c : Aklilu Mekasha
Zf b g f : January - Decemeber 2019
T b g h f : The experiment was done as planned
Ef jh : on farmers choice / five farmers participated
U f b f : combination of various previous out puts of the different activities including chopper, sorghum varieties, harvesting a dn utilization aspects.
M db j : Lume, Adama and Boset

S f m

Several options of different out puts including hand or machine chopping, early or late sorghum varieties, harvesting at one of the booting, dough or physiological maturity, dense or spares planting population, hay or silage making etc., were provided to the farmers. Accordingly farmers did the combination of the different choices of options. On farm field days involving neighboring farmers, development agents and experts at district or zone level and researchers both from the center and head office were conducted. Following this a consultation workshop was conducted along the forage sorghum value chain to strengthen the demonstration and prescaling up of the outcomes of the research project.

Table 15. Farmers' land size, crop variety and amount off seeds distributed to the farmers across the different districts for the on farm demonstration of sorghum based forage technologies in 2019.

Ej jd	Ob f g i f gb f	Mb e j f	D b jf	B g ffe	Di f
M f	Yetimwork	1.5 ha	Chelenko	16 kg	
			Melkam	8 kg	1
			Pigeon pea	1 kg	
	Zewdnesh	0.125ha	Chelenko	6 kg	1
			Melkam	9 kg	
			Pigeon pea	1 kg	
C f	Weybe	0.5 ha	Melkam	10 kg	
			Pigeon pea	1 kg	1
	Solomon	0.75 ha	Melkam	15 kg	
			Pigeon pea	1 kg	
Beb b	Ayele	0.25 ha	Melkam	5 kg	1
			Pigeon pea	1 kg	
	Megra	0.5 ha	Melkam	10 kg	Failed
			Pigeon pea	1 kg	Failed
Ofhfrfi B j	Ibrahim	Failed	-	-	-

rb g i f f fb ; more farmers selection, training and on farm demonstration will be done in the upcoming season too.

kf d j rfi: Linking Cattle Nutrition to Human Nutrition: Exploring Forage Values of Sorghum in Ethiopia
kf d f j e: October 2016 - September 2020
Bd j j Uj rfi: Seed multiplication for on-farm demonstration of forage technologies
f j e: October 2018 to September 2020
P ckf d j f:To multiply/ increase selected varieties of the forage crops to have sufficient seeds for upcoming on farm demonstration
S f jc rfi f) *: Aklilu Mekasha
S f fe c ; Aklilu Mekasha
Zf b g f ; January - Decemeber 2019
T b g h f : The experiment was done as planned
Ef jh ; un replicated plots of different size
U f b f ; different sorghum varieties/ genotypes.
M db j ; Melkassa, Mieso ,Negele Arsi

S f m

Different sorghum varieties were sown at Mekassa, MiesoaandNegelle Arsi on small plots according to suitability of the area for the varieties. At Melkassa since birds were major problems, we got some amount seeds of the early varieties from Mieso and that of the late maturing varieties from Negelle Arsi. The collected seeds were used for the on-farm trials conducted at Lume, Adama and Boset. These seeds are small in amount and meant for small number of farmers. To reach out to others additional means of sourcing seeds will be considered by involving various stakeholders along the sorghum value chain.

rb g i f f fb : The activity will continue for one more year in the next season

JJ/ B j bnO j j

kf d : titleAssessment and characterization of feed resourcesEthiopia

E b j : July 2019 – June 2022

Bd j j Title:Farmer's management practices, economic trade-offs and nutritive values of sorghum biomass use for livestock feed in major sorghum growing areas of Ethiopia

f j e: October 2016 - September 2020

Objective: to generate information on farmers' innovations on management and utilization of sorghum biomass for livestock feed across the three major sorghum growing agro ecologies (i.e. highland, intermediate and lowland) of Ethiopia and to evaluate effect of cultivars and plant population densities at planting on feeding values (i.e. dry matter intake, digestibility, and milk yield and composition) in lactating cows

Bd j j f j e: July 2019 – June 2022

S f jc nfi f) *; Asheber Tegegn

S f fe c : Aklilu Mekasha

Zf b g f ; January - Decemeber 2019

T b g h f ; The experiment was executed as planned

Ef jh ; varies with activities

U fb f ; varies with specificactivities

M db j ; East Hararge, North Welo, North Gonder and Melkassa.

S f m

As a PhD thesis, the student has done the household survey and palant specimen collection as planned during the reporting year. The household survy was conducted in different districts from East Hararghe, North Welo and North Gonder Zones. Plat secimens of local sorghum genotypes grown by farmers were also collected from Hararge and Gondar Zones. However, due to the outbreaks of locust, the student was unable to get specimens to sample in North Welo Zones.

Plan for the next year: The Activity will continue as planned on data summarization, laboratory analysis and feeding trials as planned.

Climate, Geospatial and Bio-metrics Process

Olika Desalegn
E-mail:oldkb2012@gmail.com; Tel: +25124574050

kfd j rfi; Characterization of frost and chilling risk profile for sustainable vegetable crops production

kfd f j e; July 2019 – June, 2022)

Bd j j j rfi; Identification of critical periods of frost and chilling events and assessing its predictability

Bd j j f j e; July 2019 – June 2022

Pckfd j f; To identify critical periods of frost and chilling events and assessing its predictability

S f jc rfi f : Yasin Mohammed, Oliqa Desalegn and Eshetu Zewdu

S f fe c ; Yasin Mohammed

Zfb g f ; January - Decemeber 2019

T b g i f h f

- Historical climate data collected , Quality of the data checked , Climate indices identified and Characterized impacts of frost in terms of its frequency, severity, and total number of frost days per years.

M db j : Central Rift Valley of Ethiopia

S f m

The extent of crop damage depends on several factors, such as the dropped night temperature, the ration of the frost event and the state of development of plants exposed to low temperatures, while frost risk also varies according to the local topographic, morphological and geographic features. Chilling refers to nonfreezing temperatures (0–12°C) that are common during the growing season in temperate regions and can substantially compromise plant productivity. The following boxplots shows the monthly distribution of precipitation, minimum temperature (TN), maximum temperature (TX) and diurnal temperature(DTR)

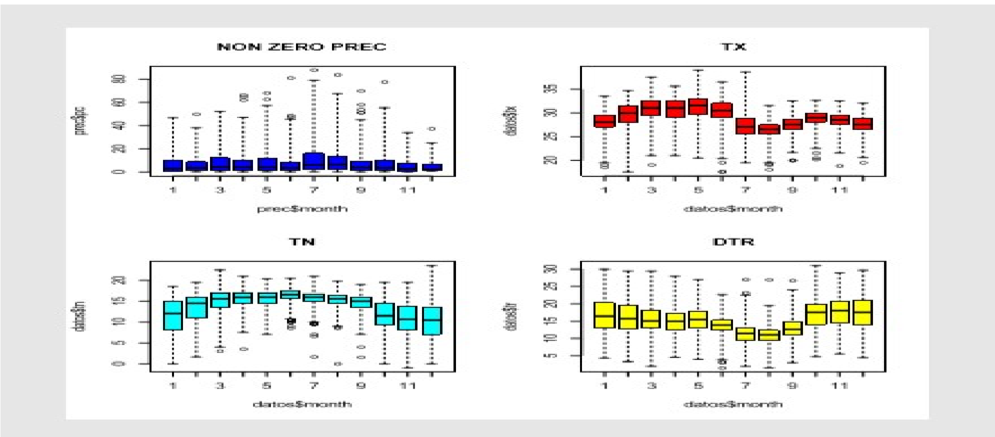


Figure 1: Temperature and precipitation monthly distribution from 1980-2018 at Melkassa

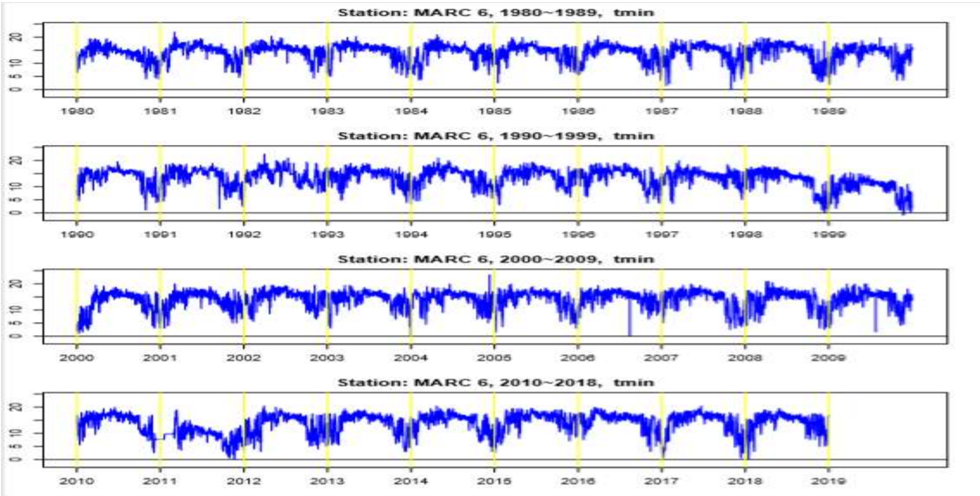


Figure 2: Time sires analysis of minimum temperature at Melkassa

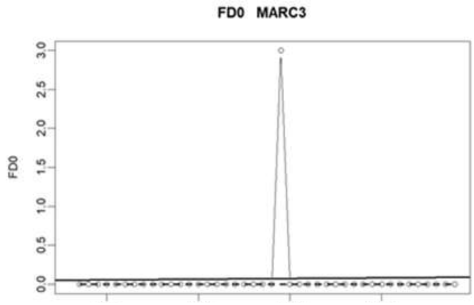


Figure 4: Number of frost day when minimum T<2ºC at Melkassa

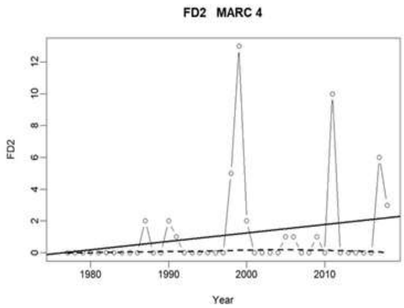


Figure 3: Number of frost days when daily minimum t < o^{o} C at Melkassa

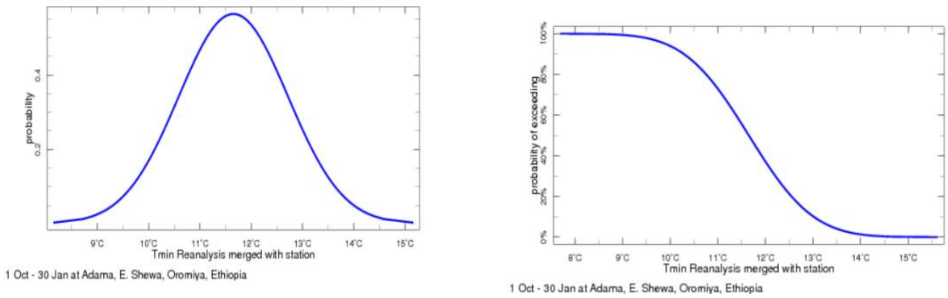


Figure 5: Minimum tempreture normal disterbution and pobability of exceedence of tmin at Adama district

nb g i f f fb ; Characterization of frost will continue in terms of its frequency and severity.

Bd j j 3; Assessment of the frost and chilling risk profiles for vegetable crop production
Bd j j f j e; July 2019 – June 2022
P ckfd j f; To assess the frost and chilling risk profiles for vegetable crops production
S f jcnfi f : Yasin Mohammed, Oliqa Desalegn and Eshetu Zewdu
S f fe c : Yasin Mohammed
Zfb g f : January - Decemeber 2019
T b g i f h f

- Questionnaire development underway
- The survey sites identified

M db j : Central rift valley of Ethiopia

S f m

Questionnaire development is underway to assess the frost and chilling risk profiles for vegetable crops production.

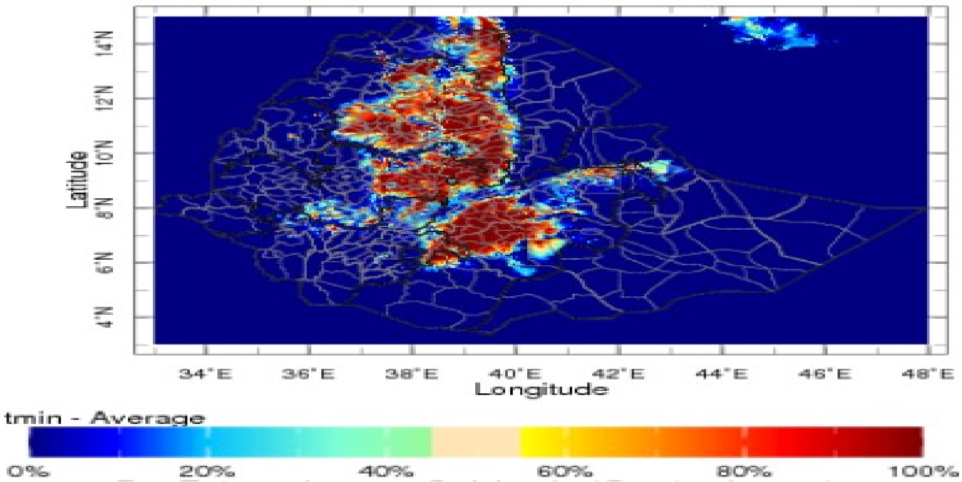


Figure 6: Probability of non-exceeding 10 degree-Celsius in Oct 1- Jan 30 long year data

rb g i f f fb

Will conduct the pre- survey workshop and survey in identified sites

kfd 3: Improving agro-meteorology observation Station for enhanced data quality and quantity

kfd f j e; July 2017 – June 2020)

Bd j j j rfi: Strengthening and improving agro-meteorological observation stations of EIAR

Bd j j f j e; July 2017 – June 2020

P ckfd j f; This project generally aims to improve agrometeorological observations of EIAR station for the provision of qualitative agro-climatic information to the research and development systems

S f jcrfi f : Eshetu Zewdu, Yasin Mohammed and Olika Desalegn

S f fe c : Eshetu Zewdu

Zfb g f : January - Decemeber 2019

T b g i f h f

To improve the standards of agrometeorological data observation stations of Ethiopian Institutes of Agricultural Research (EIAR), different activities were done by the climate and geospatial team of MARC in the past one year. The whole work is targeted to keep the quality and quantity of agromet data that aimed to support the agricultural research system through the provision of raw or synthesized climate and weather data/information/. Accordingly, technical (calibration and maintenance of instruments), and physical capacitation (strengthen of fences and clearance of obstacles surrounded the station) were done. In addition, training for technical personnel and observers were given to higher their knowledge of meteorological instruments and methods of observation.

Ef jh : WMO standard

M db j : All EIAR Research Centers and sub-centers

S f m

Climate data is one of the basic requirements in agricultural research program that demanded qualitatively and quantitatively. Therefore, to collect and provide qualitative climate and weather information, stations were equipped with new calibrated and maintained instruments. Meteorological station at Metu sub research center were rehabilitated and upgraded to first class met station. Data from automatic weather stations (AWS) at Miesso and Humera were inspected and data were collected. In addition, agromet data documentation and archive are continually done. Meteorological instruments were purchased from national Meteorology Agency and solar radiation cards were printed and distributed for respective stations. Activities which were done from January 01, 2019 to December 31, 2019 are supported by tables, graphs and photos which are presented below.

Table 3: Instruments provided for selected EIAR weather observatory stations during report period

Instruments	Quantity	List of weather stations
Thermometer for air temperature	6	D/Zeit, Alem Tena, Asosa, Haru and Ambo
Soil thermometer	4	Ambo
Sunshine card	3000	Ambo,Tepi,Jimma,D/zeit,and Kulmsa, Worer
New Station	1	Metu sub center
Stevenson screen	1	Tepi ARC

Figure 7: Rehabilitated agromet stations at Metu

Figure 8: Agromet observer training on Meteorological Instruments and methods of observation

rb g i f f fb ; New project is proposed and approved to continue the improvement of agromet stations of EIAR, that both the technical and physical capacitation of stations will continue in the coming three years (July, 2013 to June, 2015). New station installation in newly established EIAR centers and sub- centers will be done.

Bbd j j 3; Establishing phonological garden to collect crop growth and developmental data for cropping system model (CSM) application

Bd j j f j e; July 2017 – June 2020

Pckfd j f; To conduct phonological observation and analysis for major crops in EIAR research centers

S f jc rfi f : Eshetu Zewdu and Yasin Mohammed

S f fe c ; Eshetu Zewdu

Zfb g f ; January - Decemeber 2019

T b g i f h f

To collectct crop growth and development (phenology) data of sorghum, maize and common bean, field experiments were undertaken at Melkassa, Miesso and Dehera research testing sites. The growth and development data were used to calibrate and validate cropping system models. Using the growth and development data's, photothermal based genetic coefficients were estimated for each cultivar/variety and made ready for crop modeling application and EDACAP agro advisory platform launched by EIAR and MoA.

Ef jh : Randomized Complete Block Design (RCBD) with four replications was used for maize and sorghum with six rows of 7m long with 75 cm spacing between rows and 25 cm space between plants. Whereas, for common bean, each plot consisted of 8 rows of 10 m length with 40cm and 10 cm spacing between rows and between plants, respectively.

U fb f : Five common bean, maize and four sorghum released varieties were grown during JJAS (main season) to evaluate the performance of each cultivars under a given environment using cropping system model. Recommended management practices were used during experimentation.

M db j : Miesso, Dhera and Melkassa

S f m

Modelling is becoming a state of the art, particularly in crop improvement and climate-crop interaction research. However, crop modelling requires long term (historical) crop data (grain and biomass) for major crops and varieties, both of which are lacking in most crop research programs. In view of this, to overcoming the gap, the CGRD has started strengthening the phonological garden at selected EIAR experimental site (Melkassa, Miesso, Dhera) since 2017. Maize, sorghum and common bean crops were used as a starter crops in this new dimension of agro-climate research.

Five released varieties of common bean, maize and sorghum were grown during JJAS growing season and crop growth and development related data were collected. The resulting multiple data collected from this activity will serve as a building block for the database building, across EIAR research centers, which is a prerequisite for enhancing crop-climate modeling and yield gap analyses. The locations are Melkassa, Dhera and Miesso.

Figure 8. Phonological garden at Melkassa, Dhera and Meiso

Based on the observed phenological data, cultivar specific photothermal requirement of crops were estimated. The following table shows estimated cultivar specific coefficients for five sorghum, maize and common bean varieties. Soil, weather and management data obtained from each sites were used to estimate the GCs.

Table 4: Estimated Genetic Coefficients for sorghum cultivars

Genotype	Genotype specific coefficient parameters										
	P1	P2	P2O	P2R	PANTH	P3	P4	P5	PHINT	G1	G2
ESH-1	265.3	102	13.12	169.3	617.5	356.4	80.28	541.1	49	8.233	6.275
ESH-2	250.5	102	13.68	253.1	617.5	141.2	82.14	553.4	49	11.98	5.43
Teshale	333.6	102	13.71	277.9	617.5	362.7	90.88	545.8	49	2.266	5.558
Melkam	348.2	102	13.33	112	617.5	388.2	81.64	530.8	49	0.106	6.324

Table 5: Estimated Genetic Coefficients for maize cultivars

Cultivar Name	ECO#	P1	P2	P5	G2	G3	PHINT
		2	**3**	**4**	**5**	**6**	**7**
BH140	IB0001	222.5	0.189	961.6	880.9	11.11	75
BHQP542	IB0001	238.1	0.810	941.6	857.9	16.46	75
Melkassa-2	IB0001	151.1	1.751	871.2	444.5	16.30	75
Melkassa-4	IB0001	149.7	0.719	865.7	875.2	15.04	75
Melkassa6Q	IB0001	155.2	1.633	873.6	968.7	15.91	75

Productivity of each crop variety during specific growing season were also evaluated. The below table indicated that the dry matter and yield productivity of common bean during 2011 main season.

Sf df e djj e jh3121h jh fb

2/ D mj b B b i.2

Growing season length: 97 days

fdj jbj e jhh jh fb 684/3 bj

Dry Matter Productivity 1.45 kg [DM]/m3 [rain] 14.5 kg [DM]/ha per mm [rain]

Yield Productivity 0.76 kg [grain yield]/m3 [rain] 7.6 kg [yield]/ha per mm [rain]

F b b jbj e jhh jh fb 541/8 FU

Dry Matter Productivity 1.93 kg [DM]/m3 [ET] 19.3 kg [DM]/ha per mm [ET]

Yield Productivity 1.01 kg [grain yield]/m3 [ET] 10.1 kg [yield]/ha per mm [ET]

Ub jbj e jhh jh fb 353/2 F

Dry Matter Productivity 3.43 kg [DM]/m3 [EP] 34.3 kg [DM]/ha per mm [EP]

Yield Productivity 1.80 kg [grain yield]/m3 [EP] 18.0 kg [yield]/ha per mm [EP]

3/ D mj b B b i.3

Growing season length: 93 days

fdj jbj e jhh jh fb 684/3 bj

Dry Matter Productivity 1.39 kg [DM]/m3 [rain] 13.9 kg [DM]/ha per mm [rain]

Yield Productivity 0.77 kg [grain yield]/m3 [rain] 7.7 kg [yield]/ha per mm [rain]

F b b jbj e jhh jh fb 528/1 FU

Dry Matter Productivity 1.91 kg [DM]/m3 [ET] 19.1 kg [DM]/ha per mm [ET]

Yield Productivity 1.06 kg [grain yield]/m3 [ET] 10.6 kg [yield]/ha per mm [ET]

Ub jbj e jhh jh fb 342/6 F

Dry Matter Productivity 3.44 kg [DM]/m3 [EP] 34.4 kg [DM]/ha per mm [EP]

Yield Productivity 1.91 kg [grain yield]/m3 [EP] 19.1 kg [yield]/ha per mm [EP]

4/ D mj b B b i Nfrhb

Growing season length: 100 days

Precipitation during growing season 573.2 mm [rain]

Dry Matter Productivity 1.69 kg [DM]/m3 [rain] 16.9 kg [DM]/ha per mm [rain]

Yield Productivity 0.75 kg [grain yield]/m3 [rain] 7.5 kg [yield]/ha per mm [rain]

Evapotranspiration during growing season 443.9 mm [ET]

Dry Matter Productivity 2.18 kg [DM]/m3 [ET] 21.8 kg [DM]/ha per mm [ET]

Yield Productivity 0.97 kg [grain yield]/m3 [ET] 9.7 kg [yield]/ha per mm [ET]

Transpiration during growing season 276.3 mm [EP]

Dry Matter Productivity 3.51 kg [DM]/m3 [EP] 35.1 kg [DM]/ha per mm [EP]

Yield Productivity 1.55 kg [grain yield]/m3 [EP] 15.5 kg [yield]/ha per mm [EP]

5/ D mj b Ef f

Growing season length: 100 days

fdj j b j e j h h j h fb 684/3 bj

Dry Matter Productivity 1.69 kg [DM]/m3 [rain] 16.9 kg [DM]/ha per mm [rain]

Yield Productivity 0.75 kg [grain yield]/m3 [rain] 7.5 kg [yield]/ha per mm [rain]

F b b j b j e j h h j h fb 554/: FU

Dry Matter Productivity 2.18 kg [DM]/m3 [ET] 21.8 kg [DM]/ha per mm [ET]

Yield Productivity 0.97 kg [grain yield]/m3 [ET] 9.7 kg [yield]/ha per mm [ET]

U b j b j e j h h j h fb 387/4 F

Dry Matter Productivity 3.51 kg [DM]/m3 [EP] 35.1 kg [DM]/ha per mm [EP]

Yield Productivity 1.55 kg [grain yield]/m3 [EP] 15.5 kg [yield]/ha per mm [EP]

6/ D mj b Ob j

H j h fb rfi h i: 97 days

fdj j b j e j h h j h fb 689/1 bj

Dry Matter Productivity 1.63 kg [DM]/m3 [rain] 16.3 kg [DM]/ha per mm [rain]

Yield Productivity 0.73 kg [grain yield]/m3 [rain] 7.3 kg [yield]/ha per mm [rain]

F b b j b j e j h h j h fb 539/7 FU

Dry Matter Productivity 2.20 kg [DM]/m3 [ET] 22.0 kg [DM]/ha per mm [ET]

Yield Productivity 0.99 kg [grain yield]/m3 [ET] 9.9 kg [yield]/ha per mm [ET]

U b j b j e j h h j h fb 371/3 F

Dry Matter Productivity 3.62 kg [DM]/m3 [EP] 36.2 kg [DM]/ha per mm [EP]

Yield Productivity 1.63 kg [grain yield]/m3 [EP] 16.3 kg [yield]/ha per mm [EP]

rb g i f f fb

The project is reinitiated and the experiment will continue from July, 2012 to June, 2015.

Bd j j 4; Agro-climatic resource characterization of research centers and their mandate areas (production systems)

Bd j j f j e; July 2017 – June 2020

P ckfd j f; To spell out a sort of agro climatic information for tactical and strategic planning to reduce production risks under a given environment

S f jcrfi f ; Eshetu Zewdu, Yasin Mohammed and Olika Desalegn

S f fe c ; Eshetu Zewdu

Zfb g f ; January - Decemeber 2019

T b g i f h f

Agro climate data manipulation and analysis completed for four stations: Melkassa, Worer, Miesso, and Zeway

M db j ; EIAR Research centers

T e j f

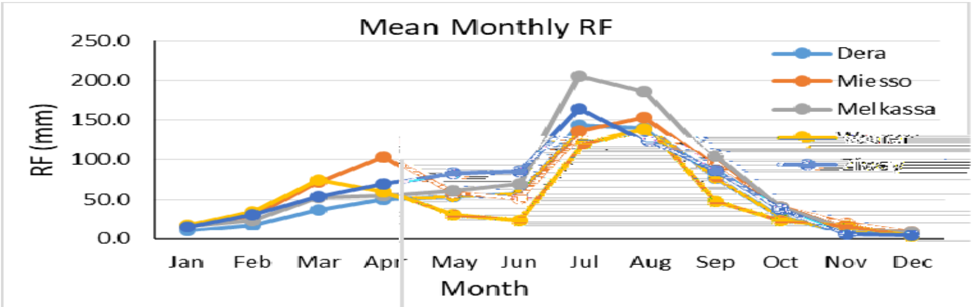
The study sites are parts of the dry land agro-ecosystem found in the central rift valley of Ethiopia in which most agricultural research trials for moisture stress dry lowland regions been conducted. The central rift valley is characterized by a bi-modal rainfall pattern which received rains two times a year during the short rainy season from March to April (locally known as belg) and long rainy from June to September (known as Kiremt). The amount of annual and seasonal rainfall, onset, cessation, LGP is characterized. In addition, trend and variability of annual and seasonal rainfall is depicted in tables below.

Table 6: Estimated Genetic Coefficients for common bean varieties

Cultivar	CSDL	PPSEN	EM-FL	FL-SH	FL-SD	SD-PM	FL-LF	LFMAX	SLAVR	SIZLF
Name	1	2	3	4	5	6	7	8	9	10
Awash-1	12.17	0	28.61	4.5	11.47	26.86	20	0.97	322.1	138.4
Awash-2	12.17	0	29.48	4.5	7.891	26.64	20	0.97	252.6	135.3
Awash Melka	12.17	0	34.48	4.5	10.54	24.21	20	0.97	275.1	144.5
Deme	12.17	0	34.48	4.5	10.54	24.21	20	0.97	275.1	144.5
Nasir	12.17	0	28.67	4.5	10.25	28.22	20	0.97	345.7	163.7

Table 7. Selected agro-climatic characteristics of the meteorological stations

Station	Lat. (Deg)	Long. (Deg)	Elevation (m)	Period of Record	Major AEZ
Melkassa	8.24	39.40	1550	1977-2017	Sub moist lowland
AdamituluJidokombolcha	7.05	38.29	1640	1971-2017	Semi arid mid highland
Worer	9.40	40.07	750	1965-2017	Arid lowland
Meiso	9.20	41.11	1470	1965-2017	Arid lowland/Moist lowland/sub moist lowland
Dhera	8.33	39.32	1680	1982-2017	



Graph 1 Monthly rainfall distribution pattern of the study sites

Table 8: Mean annual and JJAS (Kiremt) rainfall and Temperature (maximum and minimum) of the study districts

	Annual RF			JJAS RF		
Station	Mean	SD	CV (%)	Mean	SD	CV (%)
Dera	629.9	141.8	22.2	418.3	120.2	28.3
Miesso	785.2	206.4	26.0	438.3	118.5	26.8
Melkassa	824.5	161.0	19.3	564.0	133.2	23.3
Worer	596.0	136.6	22.7	334.0	112.7	33.4
AdamituluJidokombolcha	761.7	159.2	20.7	461.1	108.9	23.4

Table 9: Trend and variability of rainfall and temperature (maximum and minimum) during June to September (Kiremt) in the study districts

	Rainfall					Max temp		Min temp	
Station	Mean	SD	CV (%)	p-value	Slope	p-value	Slope	p-value	Slope
Dera	629.9	141.8	**33/3**	0.78	-0.56	0.01	-0.01	0.13	0.02
Miesso	785.2	206.4	**37/1**	0.24	-1.84	0.18	0.00	0.80	0.00
Melkassa	824.5	161.0	**2: /4**	0.02	4.79	< 0.0001	0.02	0.45	0.01
Worer	596.0	136.6	**33/8**	0.80	0.45	0.01	0.01	0.02	0.02
AdamituluJidokombolcha	761.7	159.2	**31/8**	0.71	-0.82	0.00	0.02	0.00	0.04

Table 10: Trend and variability of rainfall and temperature (maximum and minimum) during June to September (Kiremt) in the study districts

	Rainfall					Max temp		Min temp	
Station	Mean	SD	CV (%)	p-value	Slope	p-value	Slope	p-value	Slope
Dera	629.9	141.8	**33/3**	0.78	-0.56	0.01	-0.01	0.13	0.02
Miesso	785.2	206.4	**37/1**	0.24	-1.84	0.18	0.00	0.80	0.00
Melkassa	824.5	161.0	**2: /4**	0.02	4.79	< 0.0001	0.02	0.45	0.01
Worer	596.0	136.6	**33/8**	0.80	0.45	0.01	0.01	0.02	0.02
AdamituluJidokombolcha	761.7	159.2	**31/8**	0.71	-0.82	0.00	0.02	0.00	0.04

P f -Df b j b e Mf h i gh j h f j e

Table 11: Onset, Cessation and LGP of the study sits

	Onset of rainy Season			Withdrawal of rainy Season			Length of rainy Season		
Station	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV
Dera	182 (30-Jun)	17.5	9.5	269	19.9	7.3	86.3	27.3	31.2
Miesso	185 (2-Jul)	17.2	9.2	273	19	6.7	88.1	23	26.0
Melkassa	179 (27-Jun)	13.2	7.3	275	11	3.9	95.9	17	17.1
Worer	192 (10-Jul)	14.8	7.2	256	10	3.8	64	17	26.7
AdamituluJidokombolcha	177 (25-Jun)	18.8	9.9	262	13	4.8	84.7	23	26.4

rb g i f f fb

kfd 4; Managing Dry Spell Risks through Optimization of Precipitation use Efficiency (PUE) for the Major Rain-fed Crops under Smallholdings in Semi-arid Climate, Ethiopia (44-10)

kfd f j e: July 2017 – June 2020)

Bdf f f j rfi 2: Characterization and Understanding of Humid Lowland-Intermediate Altitude and Moisture Stressed Cereals Growing Climate in Ethiopia

Pckfd j f; To Characterize and Understand local Climate of Humid and Dry Lowland Major cereals growing areas

Sf jcrfi f : Girma Mamo, Eshetu Zewdu, Yasin and Olika

Sf fe c : Girma Mamo

Zfb g f : January - Decemeber 2019

T b g i f h f

Climate extremes (dry spells at 5 ,7, 10 and 14 days) were done for Melkassa, Miesso, AdamituluJidokombolcha, Jima, Dhera and local climate of humid and dry lowland major cereals growing area were characterized and understood.

M db j : Melkassa, Zway, Meiso, Dherha

Sf m

The dry spell risks (apart from drought) are becoming a time bomb in crop production. However, dry spell risks and management has not received wider attentions so far be it in research or within extension system. In order to address this problem, particularly by keeping eyes on climate change, the CGRD has picked this new dimension of research, in which optimization of precipitation use efficiency (PUE) for the major rain-fed (sorghum, maize and chickpea) grown under smallholder farming in semi-arid climate has been started. The use of in-situ rainwater harvesting is becoming the center of such an adaptation responses.

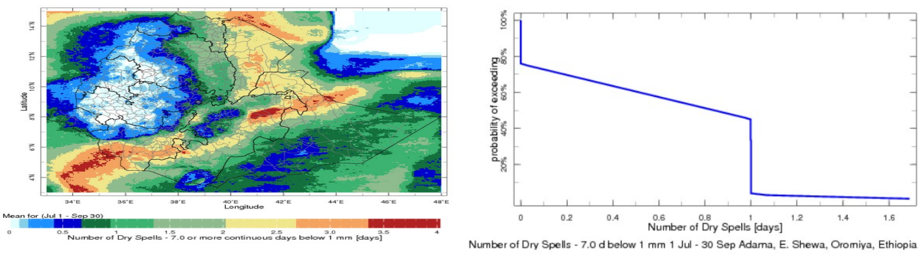
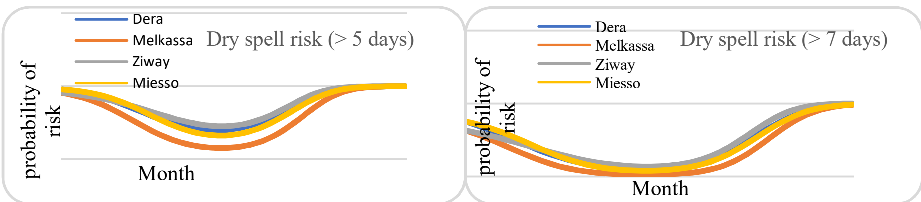


Figure 9: Chance of 5, 7, 10 and 14 and more days dry spell risk at Adamitulu Jidokombolcha, Meiso, Dehera and Melkassa stations



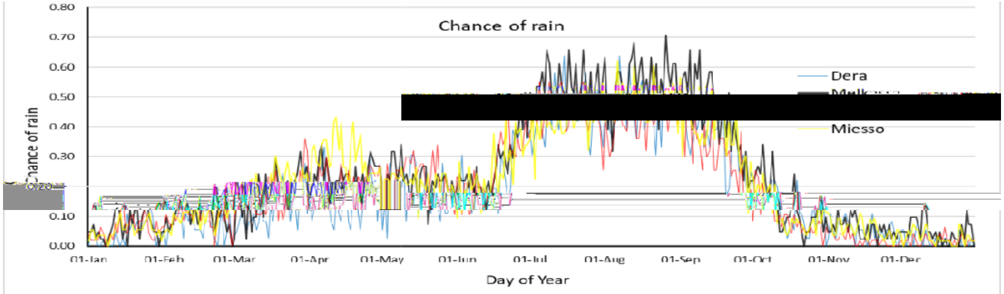


Figure 10: Chance of rain at Adamitulu Jidokombolcha, Meiso, Dhera and Melkassa stations (based on historical rainfall data)

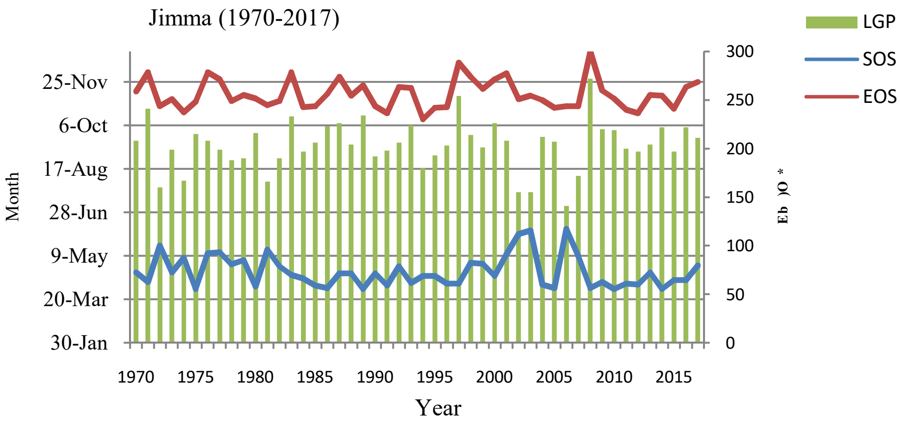


Figure 11: Seasonal rainfall characteristics of Jima station (based on historical rainfall data)

The following are list of start of season (SOS), end of season (EOS), length of growing season (LGP), numberof rainy days in a year (NRDs(ann)) and number of rainy days in months (NRDs(MS)) of Jima and Melkassa respectively.

Table 12: Trend and variability of seasonal rainfall characteristics at Jima stations

Statistics	Kendall's tau	Sen's slope	p-value	Alpha
SOS	-0.14	0.29	0.17	Not Significant
EOS	-0.05	-0.05	0.65	Not Significant
LGP	0.07	0.19	0.49	Not Significant
NRDs(ann)	0.14	0.18	0.17	Not Significant
NRDs (MS)	0.15	0.19	0.14	Not Significant

Table 13: Trend and variability of seasonal rainfall characteristics at Melkassa stations

Statistics	Kendall's tau	Sen's slope	p-value	Alpha
SOS	-0.08	-0.06	0.5	Not Significant
EOS	0.09	0.15	0.4	Not Significant
LGP	0.1	0.23	0.39	Not Significant
NRDs(ann)	-0.29	-0.54	0.01	Not Significant
NRDs (MS)	0.16	-0.18	0.14	Not Significant

Graph 4: Chance of dry spell at AdamituluJidokombolcha, Meiso, Werer and Melkassa

rh g i f f fb

➢ The climate extreme will be analyzed for the rest stations too.

Bd j j 3; Modelling the impacts of dry spells on major rain-fed crops grown by Smallholders in dry lands
Bd j j f j e: July 2017 – June 2020
P ckf d j f; To analyze impact of dry spell simulation modeling on major rain-fed crops grown by

Smallholders in dry lands
Sf jcrfi f : Girma Mamo
Sf fe c : Girma Mamo
Zfb g f : January - December 2019
T b g if h f

- Data for the modeling were collected from four stations and modeling work is on progress.

U fb f : 85 combinations
M db j : Melkassa, Miesso and Debre Zeit

Sf m
Data on the duration of each phonological stage of the identified sorghum/maize/chick pea cultivars maturity category (90, 120, 150 and 180 days, as required) have been collected from secondary sources for an iterated simulation modelling, by putting dry spell stress scenario in context. Such modelling, tests the response of identified sorghum: cultivars to wet spells (excess rainwater) in terms of water logging /wetness, soil moisture flux, soil heat flux, seasonality of relative humidity (RH), seasonality of minimum (night coldness) and maximum temperatures, joint influence of wet spell and high temperature in terms of optimum crop disease and insect pest management.

rb g if f fb
Data analysis will be done for all stations whose respective data were collected.
Bd j j 4; Filed experimentation of in field rainwater harvesting practices via soil water balance modeling: towards enhanced PUE
Bd j j f j e: July 2017 – June 2020
Objective: Evaluate innovative in-field rainwater harvesting practices and identify best bet water harvesting practices for managing the in-season dry spell risks reducing wider yield gaps
Sf jcrfi f : Girma Mamo
Sf fe c : Girma Mamo
Zfb g f : January - December 2019
T b g if h f
Field experiment was conducted on Miesso and required data were collected.
M db j : Meiso

Sf m
This activity adopts the in-situ (micro catchment) rainwater harvesting practices, while setting a focus on the smallholder maize farmers inhabiting dry lands for the improved precipitation use efficiency (PUE). Accordingly, two rainwater harvesting treatments have been considered (1) basin tillage (2) mulching with various materials (organic and stone). In this case, basin tillage minimizes runoff from the field; with the technique consisting of inducing/enhancing runoff on a 2m wide strip between alternate crop rows, storing the runoff water in the basin. The second treatment takes account of mulching materials; including crop residue and stone, both of which are alternatively placed in the tillage basin and in the 2m wide run off strip.

Figure 12: Runoff plot at Meiso
rb g if f fb ; Data analysis and documentation will be done.

Crop Research Process

Lowland Pulse Research Program

Berhanu Amsalu
E-mail: berhanufenta@gmail.com; Tel: +251911796237

S f fb di df ; Crop Research
h b ; Lowland Pulse Program
kfd J; Enhancing common bean production and productivity through generation, promotion and dissemination of integrated technologies for livelihood improvement, income generation and resilience to climate change in Ethiopia
kfd ckfd j f ;

- To increase production and productivity of common bean through generation of varieties that are well adapted, high yielding, tolerant/ resistant to major biotic and abiotic stresses and preferred by consumer and export market
- To generate, adopt, and promote management technologies, information and knowledge for major common bean pests (insects, diseases and weeds) that contribute for common bean production and productivity
- To generate, verify and demonstrate improved natural resource management technologies (ISFHM & irrigation) and best agronomic practices for sustainable common bean production and productivity in different soil type and agro ecologies

kfd f j e; July 2018 – June 2020
D rfi fe S f fb di Bd j j jf
Bd j j 2; Collection and characterization of bush bean germplasms
Bd j j f j e; July 2018 - June 2020
P ckfd j f; To collect and characterize Ethiopian bush bean germplasms
S f jc rfi f ; Berhanu A., Dagmawit T., Abel M., Tigist S., and Behailu T., Girum
S f fe c ; Abel M, & Berhanu A.
f j e gS f : January - December 2019
T b g i f h f
Ef jh ; Non-replicated
U fb f : 150 collected landraces
M db j : Melkassa

S f m
More than 150 locally collected landraces were evaluated for their agronomic performance at Melkassa and genotyping done in collaboration with CIAT and data under analysis. Collected landraces also categorized based on their seed color across product concepts for future study (Table1.1).

Table1. Classification of germplasms based on product concepts.

Product concept (PC)	Number
PC 1 and PC 3	10
PC 2 and PC 4	15
PC 5	42
PC 6	17
Others	66

rb g i f f fb ; Based on genotyping and phenotypic result these genotypes will be incorporate to nursery trial under different product concepts.

Bd j j 3; Large white bean national variety trial (NVT)
Bd j j f j e; July 2018 – June 2020
P ckfd j f; To evaluate and identify high yielding, stable and disease (common bacterial blight (CBB), Anthracnose (Anth) and Angular Leaf Spot (ALS)) resistance large white bean genotype/s
S f jc rfi f ; Berhanu A., Abel M., Dagmawit T., Tigist S., Behailu T., Girum K., Ibsa A., Genet K.,
S f fe c ; Abel M, & Berhanu A.
f j e gS f : January - December 2019
T b g i f h f
Ef jh ; Row Column
U fb f : 65 large white genotypes with check varieties
M db j : Melkassa, Negele Arsi, Haramaya University and Sirinka

S f m

Spatial analysis using linear mixed model was done for days to maturity, pod per plant and grain yield. Based on the result, studied traits showed large genotypic variability in most locations and then improves the heritability of those traits. The heritability value was sufficiently high for grain yield which ranges from 76 to 80, indicating the possibility of progress from selection. Date to maturity and pod per plant had moderate heritability estimates at all locations and indicate the influence of environment on the trait. Days to maturity, pod per plant and grain yield performance of genotypes at individual location and mean performances across locations are presented. The genotypes have high variation around the mean number of pods per plant (11.3) and grain yield (2.3) and very small variation observed for days to maturity (91.6) across location. The ranges of date to maturity, pod per plant and grain yield across locations were from 90 - 93, 9.2 - 12.8 and 1.1 – 3.0-ton ha^{-1}, respectively. For mean grain yield, thirty-seven genotypes produced higher grain yield than the grand mean. In general, CCSS6915-11-92-2, Campusla and CCSS6915-11-68-1gave the best mean yield performance while DRSS6915-89-150-2, RNSS6915-89-114-1 and CCSS6915-11-84-1 had the lowest mean performance across locations.
rb g i f f fb ; Best performing genotypes will be select and advance to next season national variety trial to select the stable, high yield and disease resistant genotypes to verify to be used by the end users.

Bd j j 4; Large red bean national variety trial
Bd j j f j e; July 2018 – June 2020
P ckfd j f; To develop large red bean varieties that are well adapted, high yielding, tolerant/ resistant to major disease (CBB and rust) and a biotic stress (drought) with preferable quality
S f jc rfi f ; Berhanu A, Dagmawit T, Tigist S., Behailu T., Abel M., Girum K., Yeyis R., Ermiyas
S f fe c ; Abel M, & Berhanu A.
f j e gS f : January - December 2019
T b g i f h f
Ef jh ; Row Column
U fb f : 45 large red genotypes with check varieties
M db j : Melkassa, Negele Arsi, Asossa and Hawassa

S f m

From the result 0.27 and 0.29 genotypic variance was explained for grain yield at Arsinegelle and Melkassa, respectively using spatial analysis (Table1.3). Heritability estimate value was also high for these two locations when compared with other two locations, especially with Asossa. These large genotypic variances and heritability indicate the two locations i.e. Arsi negelle and Melkassa are potential environments for production of large red bean. At Hawassa the genotypic variability and heritability was moderate, this may due to some environmental variability during the growing period. But low genetic variability at Asossa may indicate the environment may not be potential for the production of large red bean. The genotypes average grain yield across environments ranged from the lowest of 1.1-ton ha^{-1} for DRSS6915-89-123-1 to the highest of 2.5 ton ha^{-1} for Melkedima (Table 3). Check variety Melkedima ranked the first at Arsi negelle and Asossa. Similarly, DRSS6915-89-86-1 and DAB481 ranked the first at Hawassa and Melkassa, respectively. Large inter-location variation was observed in the trial due to the variation in altitude, rainfall and temperature across locations for large red bean genotypes. The average environmental grain yield across genotypes ranged from 0.88-ton ha^{-1} of Asossa to 2.67-ton ha^{-1} at Melkassa.

rb g i f f fb ;

Best performing genotypes will be select and advance to next season national variety trial to select the stable, high yield and disease resistant genotypes to verify to be used by the end users.

Bd j j 5/ Small white bean national variety trial

Bd j j f j e; July 2018 – June 2020

Pckfd j f; To evaluate and identify disease (CBB, HB and ALS) resistance and high yielding small white bean genotype/s with desirable seed class and stable performance across bean growing environments of Ethiopia

Sf jcrfi f ; Berhanu A., Dagmawit T., Abel M., Tigist S., Behailu T., Girum K., Ibsa A., and Genet K.,

Sf fe c ; Abel M, & Berhanu A.

f j e gSf : January - December 2019

T b g i f h f

Ef jh ; Row Column

U fb f ; 60 small white genotypes with check varieties

M db j ; Melkassa, Negele Arsi, Haramaya University and Sirinka

Sf m

Spatial analysis using linear mixed model was done for small white bean genotypes which tested at four bean growing areas of the country, namely Melkassa, Arsinegelle, Haramaya and Sirinka. From the experiment, genotypic variance ranged from 3.6 to 21.9 for date to maturity, from 0 to 38.4 for pod per plant and from 0.1 to 0.2 for grain yield. Moderate heritability was observed for those three traits in most test environments. But heritability for pod per plant at Sirinka was zero, indicating the predominance of environmental effect more than that of the genetic effect.

For mean grain yield, twenty-four genotypes produced higher grain yield than the grand mean (3.1-ton $ha^{-1)}$ (Table 1.4)· In general, SEC22, SCAM15-21-348 and GENO110 gave the best mean yield performance while GENO348, SCAM15-21-400 and RAZ11 had the lowest mean performance across locations. The mean days to maturity for genotypes across location ranges from 91-95 days with a mean of 92 days. Among locations Melkassa was the earliest (82 days) and Arsinegelle was the late maturing location (104 days). The difference among locations in date to maturity was due to the effect of altitude that affects the climate. Highest pod per plant during the growing season was obtained from small white beans which grow at Arsinegelle. The highest pod per plant of (27.3) was recorded by SCAM15-21-124 and lowest (21.9) was recorded by SCAM15-21-348.

rb g i f f fb ; Best performing genotypes will be select and advance to next season national variety trial to select the stable, high yield and disease resistant genotypes to verify to be used by the end users.

Bd j j 6/ Small red bean national variety trial

Bd j j f j e; July 2018 – June 2020

Pckfd j f; To evaluate and identify high yielding, stable and disease (CBB, HB and ALS) resistance small red bean genotype/s
Sf jcrfi f ; Berhanu A., Dagmawit T., Tigist S., Abel M., Behailu T., Girum K., Yasin G., Yeyis R., and Solomon B.,
Sf fe c ; Abel M, & Berhanu A.
f j e gSf : January - December 2019
T b g if h f
Ef jh ; Row Column
U fb f ; 40 small white genotypes with check varieties
M db j ; Melkassa, Negele Arsi, Goffa, Hawassa and Bako

Sf m
The result of spatial analysis using linear mixed model for grain yield of small red bean genotypes revealed it ranges from 0.06 at Bako to 0.23 at Hawassa. The heritability estimates values also range from 61.2 at Melkassa to 84.6 at Goffa. Among tested genotypes NUA648, SSIN1148 and SSIN939 were identified the best genotypes, as recorded mean grain yield of 2.9 ton ha^{-1} across environments, while NUA640 and SCR11 were the least performer with a mean grain yield of 2 ton ha^{-1}. The mea environmental grain yield ranges from 3.17 ton ha^{-1} at Melkassa to 1.61 ton ha^{-1} at Bako.
rb g if f fb ; Best performing genotypes will be select and advance to next season national variety trial to select the stable, high yield and disease resistant genotypes to verify to be used by the end users.

Bd j j 7/ Maintenance of common bean germplasm (breeding lines)
Bd j j f j e; July 2018 – June 2020
Pckfd j f; To maintain common bean germplasms for future activities/use
Sf jcrfi f ; Abel M., Berhanu A, Dagmawit T, Tigist S., Behailu T.,
Sf fe c ; Abel M, & Berhanu A.
f j e gSf : January - December 2019
T b g if h f
Ef jh ; Non-replicated
U fb f ; greater than 100 common bean varieties and germplasms
M db j ; Melkassa

Sf m
Maintenance of more than 100 common bean germplasms and varieties were done at Melkassa using a single plot.
rb g if f fb ; The maintained germplasms and varieties will be used in the coming years for different breeding activities. Moreover, the maintained germplasm will be reserved at cold-room for future use and the germplasm at the store will be also maintained in the future too.

Bd j j 8/ Maintain the genetic purity of released varieties and multiply breeder seed
Bd j j f j e; July 2018 – June 2020
Pckfd j f; To maintain the genetic purity of released varieties and to increase breeder seed
Sf jcrfi f ; Berhanu A, Dagmawit T, Tigist S., Abel M., Behailu T., Girum K.,
Sf fe c ; Abel M, & Berhanu A.
f j e gSf : January - December 2019
T b g if h f
Ef jh ; Non-designed
U fb f ; All released common bean varieties
M db j ; Melkassa

S f m

A total of 9.7 quintals of breeder seed for 10 popular and recently released common bean varieties were multiplied in the main cropping season (Table2). In addition, more than 50 nationally and regionally released common bean varieties maintenance and seed multiplication also done.

Table 2. Varieties and amount of breeder seed multiplied

No	Variety	Amount (Quintal)
1	Awash1	1.1
2	Awash2	1.5
3	Nasir	1.5
4	SER125	1.2
5	SER119	0.9
6	Ado/SAB736	0.7
7	Tafach/SAB632	1.3
8	KATB1	0.4
9	KATB9	0.4
10	Derash/BZ2	0.7
Total		9.7

rb g i f f fb ;

The multiplied seed will be availed to the seed growers. In the future, seed multiplication and maintenance will continue to maintain common bean seed multiplication.

Bd j j 9/ Advancing F6 Bruchid resistance small red bean populations to nursery

Bd j j f j e; July 2018 – June 2020

P ckfd j f; To develop high yielding, Bruchid and disease (CBB, HB and ALS) resistance small red bean genotype/s

S f jc rfi f ; Tigist S., Berhanu A., Dagmawit T., Abel M., Behailu T., Girum K.,

S f fe c ; Abel M, & Berhanu A.

f j e gS f : January - December 2019

T b g i f h f

Ef jh ; augmented

U fb f ; 77 germplasms

M db j ; Melkassa

S f m

Among tested 77 genotypes (73 which developed by crossing and 4 check varieties), 33 genotypes flowers early than the one check variety DAB 107(Table3). For days to maturity only four days differences were observed among all genotypes. The grain yield performance of tested genotypes showed 32 genotypes performed above the best performing check variety SER119.

rb g i f f fb ;

Best performing genotypes by merging with other fixed lines from the same PC or other PC will be promote into PNVT

Bd j j : / Advancing F4 common bean bacterial blight (CBB) resistance

Bd j j f j e; July 2018 – June 2020

P ckfd j f; To develop CBB resistance and high yielding genotypes for four PC (PC 1, PC2, PC3 and PC 6)

S f jc rfi f ; Dagmawit T., Berhanu A., Tigist S., Abel M., Behailu T., Girum K.,

S f fe c ; Abel M, & Berhanu A.

f j e gS f : January - December 2019

T b g i f h f

Ef jh ; Single plot observation

U fb f ; Advanced 1217 F4’s

M db j ; Melkassa and Negele Arsi

S f m

Important agronomic traits and common bacterial blight (1-9) were assessed across two locations. Based on the result 591 genotypes shows high level of resistance (1-3) for CBB, 609 genotypes shows moderate level of resistance (3.1–6) and the remains 18 genotypes shows high level of susceptibility(6.1– 9) (Fig 1).

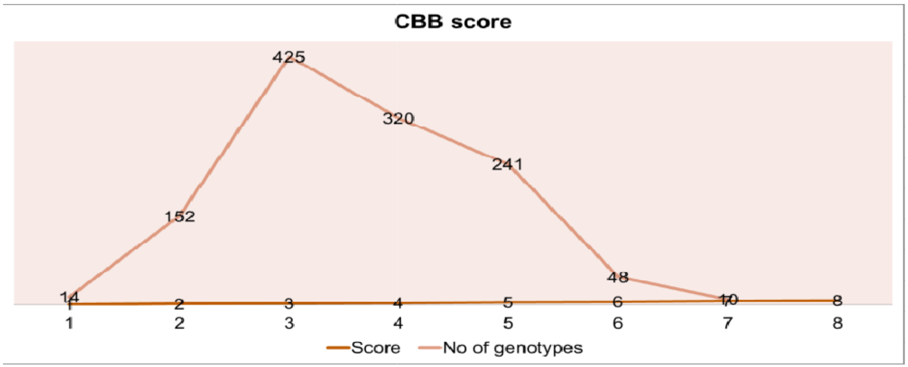


Figure 1. Common bacterial blight (CBB) score of F4 populations

rb g i f f fb ;

After Selection at F4 based ondisease resistance and agronomic performance, genotypes will be advance into F5

Bd j j 21/ Advancing F3 Halo blight (HB) resistance populations (Small white, large white, small red and speckled bean)

Bd j j f j e; July 2010 – June 2012

P ckfd j f; To develop HB resistance and high yielding genotypes for four PC (PC 1, PC2, PC3 and PC 6)

S f jc rfi f ; Dagmawit T., Berhanu A., Tigist S., Abel M., Behailu T., and Girum

S f fe c ; Abel M, & Berhanu A.

f j e gS f : January - December 2019

T b g i f h f

Ef jh ; Single plot observation

U fb f ; Advanced 1821 F3’s

M db j ; Melkassa and Negele Arsi

S f m

The trial was done at Melkassa and Negelle Arsi. Although, halo blight was not appear this season, data for the other agronomic traits like grain yield, days to maturity and other prevailed diseases like common bacterial blight (CBB) score. Totally 1442 genotypes selected out of 1821 genotypes.

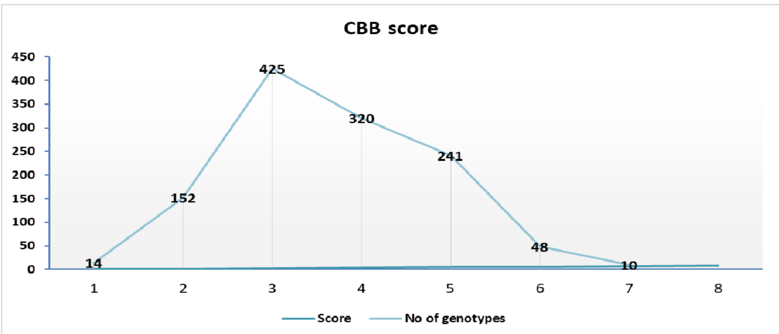


Figure 2. Common bacterial blight (CBB) score of F3 populations

rb g i f f fb ; The selected genotypes from these crosses have advanced to F4 in the offseason. Then after, after the selection made, the promising lines will be promoted to next breeding stage.

Bd j j 22/ Developing population for high iron and zinc content and study on gene action and inheritance
Bd j j f j e; July 2018 – June 2020
P ckfd j f; To develop high Fe and Zn genotypes and study their inheritance and gene action
S f jc rfi f ; Berhanu A., Yonas M., Dagmawit T., Tigist S., Abel M., Behailu and T., Girum K.,
S f fe c ; Abel M, & Berhanu A.
f j e gS f : January - December 2019
T b g i f h f
Ef jh ; North Carolina Design II
U fb f ; 14 genotypes
M db j ; Melkassa and Haramaya

S f m

49 crossing combinations were made using North Carolina Design II (Table3). F1 crosses were developed for many of the crosses and incompatibility were observed among the Mesoamerican and Andean gene pools and climbing ones for some of the crosses.

Table 3. Crossing design to develop F1 Populations

	Male						
Femele	NUA561	NUA560	NUS9	NUS33	MB	RWR	NUA229
Awash2	X	X	X	X	X	X	X
Tinike	X	X	X	X	X	X	X
SER119	X	X	X	X	X	X	X
Tatu	X	X	X	X	X	X	X
Dor	X	X	X	X	X	X	X
Hawassa Dume	X	X	X	X	X	X	X
Awash Melka	X	X	X	X	X	X	X

rb g i f f fb

Backcrossing, advancement of population and nutrient analysis will continue in the coming off and main season.

Bd j j 23; Common bean population development targeted to different constraints
Bd j j f j e; July 2018 – June 2020
P ckfd j f; To develop genotypes for different biotic (disease) & abiotic (drought) stress and quality (canning) traits
S f jc rfi f ; To develop genotypes for different biotic (disease) & abiotic (drought) stress and quality (canning) traits
S f fe c ; Abel M, & Berhanu A.
f j e gS f : January - December 2019
T b g i f h f
Ef jh ; non-replicated
U fb f ; 34 genotypes
M db j ; Melkassa

S f m

Crossing was designed to develop biotic and a biotic stress resistance/ tolerance genotypes with preferable traits like canning and high Fe and Zn for domestic and international markets. Released varieties, genotypes advanced from the breeding program and landrace collection were used as a parental material. A total of 67 cross combinations were done for

Table 6. Crossing design for s[redacted]

small [redacted]
(Tab[redacted]

Table [redacted]

Gf b[redacted]
Ado [redacted]
Adamitul [redacted]
Tafach [redacted]
De [redacted]
De [redacted]
Gofta [redacted]
Ayenew [redacted]
Total [redacted]

Gf brfi [redacted]
Awash [redacted]
Awash- [redacted]
Chore [redacted]
CB142 [redacted]
Argene [redacted]
Nasir [redacted]
SER 11 [redacted]
SCR 11 [redacted]
SCR 5 [redacted]
U bm [redacted]

[redacted]

Table 1. Yield advantage of released varieties compared with standard checks

No	Name and Yield (kg/ha) of candidate and check varieties		Percent (%) yield of candidates over the checks	
	Candidates and checks	Yield	Showarobit	MH-97-6
1	MB 6173-B-33	1155	12.7	4.3
4	Showarobit	1025		
5	MH97-6	1107		

rb g i f f fb ; The released variety breeder seed will be multiplied and provided for seed multipliers for further promotion.

Bd j j 3; Cowpea variety verification trial
Bd j j f j e; July 209 - June 2020
P ckfd j f; U develop stable, high yielding with acceptable quality cowpea varieties that meet different market and domestic needs and also tolerant/resistant to biotic and abiotic stresses prevailing in major growing regions/
S f jc rfi f ; Dagmawit T., Berhanu A., Behailu T., Tigist S., Abel M, Girum K., Yasin G., Dembele E. and Eyeberu
S f fe c ; Girum K. & Berhanu A.,
Zfb g f ; January - December 2019
T b g i f h f
Three cowpea genotypes were evaluated with the check variety Kenketi across 4 locations.The general performances, field observation and farmers' preferences on the candidate genotypes was good and we are waiting the approval of these varieties.
Ef jh Single plot with 10 m X 10 m size
U fb f ; Three candidates and one check varieties
M db j Melkassa, Miesso, Gofa and Kobo

S f m
From Table 2.2 the best performing genotype (NLLP-CPC-07-145-21) found to give average grain yield potential up to 1970 kg/ha followed by other superior performing genotypes, NLLP-CPC-07-54, with gave average grain yield of 1848kg/ha and NLLP_CPC-103B with 1684kg/ha yield potential. The trial was evaluated by national variety release committee across locations.

Table 2.Yield (kg/ha) of candidate and percentage (%) yield of candidates over the check

No	Name and Yield (kg/ha) of candidate and check varieties		Percent (%) yield of candidates over the check
	Candidates and checks	Yield	Kenketi
1.	NLLP_CPC-145-21	1970	35
2.	NLLP_CPC-103B	1684	22
3.	NLLP_CPC-07-54	1848	26
4.	Kenketi	1462	

rb g i f f fb ; The released variety breeder seed will be multiplied and provided for seed multipliers for further promotion.

Bd j j 4; Cluster bean (Guar) variety verification trial
Bd j j f j e; July 2019 - June 2020
P ckfd j f; U register introduced Cluster bean genotype with good grain yield and stability across location
S f jc rfi f ; Dagmawit T., Berhanu A., Behailu T., Tigist S., Abel M.,Girum K., Yasin G., Habtamu and Nigussie
S f fe c ; Girum K. & Berhanu A.,
f j e gS f : January - December 2019
T b g i f h f
One cluster bean genotype was introduced and evaluated/verified across 3 locations
Ef jh ; Non replicated 10*10 m
U fb f One candidates

M db j Melkassa, Miesso and Arba

S f m

The candidate genotype has a potent
has also a unique feature of adapti
evaluated by national variety release
field observation and farmers' prefer
the approval of the release of these va

Figure 1. Cluster bean plant

rb g i f f fb ; After re
disseminated for seed producers

Bd j j 5; Mung bean genotypes Na
Bd j j f j e; July 2019 – June 20
P ckf d j f; To develop stable, high y
meet different market and domestic
stresses
S f jc rfi f ; Dagmawit T., l
A., Yasin G.,Yirga K.,Habtamu and E
S f fe c ; Girum K. & Berhanu A
Zf b g f ; January - December
T b g i f h f
45 Mung bean genotypes were evalu
The tested genotypes were given]sssg5
presented in Table 3.
Ef jh ; 5x9 alpha lattices
U f b f ; 45 genotypes with the c
M db j # ddhf d 0 n

was 13.3kg/ha^{-1}. These results showed that the differences in grain yield performance among the tested genotypes were non-significant.

rb g i f f fb : The trial will be repeated across multi-location for the coming cropping season to select genotypes with higher yield and stable performance.

Bd j j 6; Cowpea early duration national variety trial

Bd j j f j e; July 2019 - June 2020

P ckfd j f; To develop stable, high yielding with acceptable quality cowpea varieties that meet different market and domestic needs and tolerant/resistant to biotic and abiotic stresses prevailing in major growing regions

S f jc rfi f ; Dagmawit T., Berhanu A., Behailu T., Tigist S., Abel M., Girum K., Yasin G., Genet

S f fe c ; Girum K. & Berhanu A.,

Zf b g f ; January - December 2019

T b g i f h f

In these trial 25 promising cowpea genotypes along with check variety Kenketi was assembled in lattice design with 3 reps and evaluated across 7 agro ecologies. Mean performances of the test genotypes for grain yield is presented in Table 5.

Ef jh ; 5 x 5 triple lattice

U fb f ; 25 entries including the check variety

M db j ; Melkassa, Miesso , Babile, Gofa, Sekota, Jinka and Kobo

S f m

The analysis of variance of data at individual locations and over location revealed highly significant difference at P< 0.01between the genotypes in grain yield at all locations. The mean performance across environments of 25 early duration cowpea genotypes showed a considerable amount of variation in grain yield (Table4).

The mean average grain yield of the genotypes across the environments ranged from the lowest to the highest grain yield (1220–2000 kg ha^{-1}). The highest means grain yield value was 2000 kg ha^{-1} on the Cp63 followed by Cp65 with mean 1980 kg ha-1, whereas the lowest mean grain yield value of 1220 kg ha^{-1} was obtained on CP25 genotype (Table 2.4). Similarly, the difference between the highest yielding Cp63 genotype and the check Kenketi variety was 1790 kg ha^{-1}. The variation in range of mean reflects the extent of phenotypic variability in respect of the characters, includes another variance component (GEI)

Table 3. Mean grain yield (ton/ha) performance across environments of 25 earrly duration cowpea genotype

Genotype	Babile	Jari	Kobo	Melkassa	Miesso	Overall
Cp63	1.97	2.63	2.05	1.78	2.03	2
Cp65	1.89	2.81	2.14	1.29	2.07	1.98
Cp59	1.65	2.87	1.93	1.22	2.08	1.96
Cp56	1.62	2.77	1.96	1.26	2.03	1.89
Cp18	1.04	2.5	2.03	1.64	2.39	1.88
Cp24	1.34	2.51	1.79	1.7	2.38	1.86
Cp44	1.45	2.44	2.02	1.25	2.15	1.84
Cp26	1.51	2.59	2.04	1.15	1.89	1.81
Kenketi	1.15	2.51	1.87	1.73	1.72	1.79
Cp54	1.2	2.71	2.1	0.81	2	1.78
Cp22	1.56	2.06	1.93	1.42	2.12	1.78
Cp55	1.45	2.53	1.97	1.25	1.68	1.77
Cp14	1.09	2.16	2.4	1.49	1.61	1.76
Cp42	1.59	2.18	1.79	1.1	1.71	1.72
Cp31	1.15	2.16	2.3	1.02	1.81	1.71
Cp73	0.95	2.45	2.15	0.83	1.74	1.68
Cp53	1.65	1.75	1.53	1.3	1.95	1.6
Cp52	1.01	1.9	1.26	1.65	1.87	1.57
Cp43	0.8	1.6	2.1	0.61	2.66	1.56
Cp35	1.03	2	0.98	1.52	2.05	1.52
Cp20	0.85	2.09	1.62	0.88	1.9	1.49
Cp7	1.07	1.7	1.71	0.93	1.55	1.43
Cp12	0.72	2.01	1.47	1.12	1.28	1.4
Cp70	0.56	1.96	1.51	1	1.63	1.38
Cp25	0.7	1.61	1.65	0.5	1.27	1.22

Genotype	Babile	Jari	Kobo	Melkassa	Miesso	Overall
Mean	1.24	2.26	1.85	1.22	1.9	1.7
LSD	0.28	0.59	0.48	0.34	0.28	0.29
CV	21	28.09	23.53	26.18	13.75	24.51
Genotype sig	**	**	**	**	**	**
Genx Env sign						**

rb g i f f fb : The trial will be repeated one more year to select stable variety

Bd j j 7; Dual purpose cowpea National Variety Trial
Bd j j f j e; July 2019 - June 2020
P ckfd j f; To select dual purpose cowpea genotype/s with superior performance in yield, disease resistance & stability across testing site
S f jc rfi f ; Dagmawit T., Berhanu A., Behailu T., Tigist S., Abel M., Girum K., Yasin G., Genet
S f fe c ; Girum K. & Berhanu A.,
Zf b g f ; January - December 2019
T b g i f h f
In this trial 25 promising dual-purpose cowpea genotypes along with checks Black eye bean and TVU were assembled in lattice design and tested bread wheat genotypes at 7 locations during main cropping seasons (2019). Mean performances of the test genotypes for the grain yield is presented in (Table 2.5).
Ef jh ; 5 x 5 triple lattice
U f b f ; 25 genotypes including the check variety
M db j ; Melkassa, Miesso , Babile, Gofa, Sekota, Jinka and Kobo

S f m
There were significant differences among entries at (p>0.01) in all locations except at Kobo. Genotypes Trt-26, Trt-1, Trt-33, Trt-59 and Trt-18 showed better yield performance over the checks (Black eye bean and TVU). A total of 12 genotypes showed a superior yield performance over the grand mean.
The mean average grain yield of the genotypes across the environments ranged from (1220 – 1550 kg ha^{-1}). The highest means grain yield value is obtained 1550 kg ha^{-1} from Trt-26 followed by Trt-1 with mean yield of 1540 kg ha^{-1}, whereas the lowest mean grain yield value of 470 kg ha^{-1} was obtained on Trt-17 genotype. Similarly, the difference between the highest yielder Trt-26 genotype and the check Black eye bean variety was 24 kg ha-1 in grain yield. These results showed that differences in grain yield performance among the tested genotypes were significant.

Table 4. Mean grain yield performance of dual-purpose cowpea genotypes at individual location and combined over locations

Hf f	**H gb**	**I b b b b**	**L c**	**N frhb b**	**N jf**	**P f bm**
Trt-26	1.13	1.60	1.80	1.61	1.76	**2/66**
Trt-1	1.08	1.49	1.80	1.46	1.98	**2/65**
Trt ---	1.14	1.20	1.80	1.69	1.83	**2/5:**
Trt-33	0.46	1.92	1.80	1.14	1.99	**2/47**
Trt-59	0.95	1.57	1.80	1.14	1.69	**2/47**
Trt-18	0.72	1.57	1.80	1.34	1.70	**2/44**
Black eye bean	1.00	0.97	1.80	1.14	1.93	**2/3:**
Trt-49	0.87	1.64	1.80	1.02	1.47	**2/36**
TVU	0.95	1.40	1.80	1.04	1.58	**2/36**
Trt-37	1.09	1.47	1.80	0.61	1.61	**2/32**
Trt-52	0.88	1.01	1.80	0.92	1.56	**2/1:**
Trt-54	0.70	1.02	1.80	0.93	1.70	**2/1:**
Trt-8	0.68	1.11	1.80	0.59	1.60	1.00
Trt-7	0.63	0.67	1.80	0.85	1.81	0.99
Trt-31	0.74	1.05	1.80	0.88	1.29	0.97
Trt-15	0.63	0.78	1.80	1.24	1.31	0.95
Trt-32	0.00	0.82	1.80	0.65	1.64	0.94
Trt-5	0.42	1.32	1.80	0.46	1.52	0.90
Trt-20	0.55	0.98	1.80	0.72	1.39	0.87

Trt-14	0.43	1.15	1.80	0.75	1.19	0.82
Trt-43	0.45	0.77	1.80	0.55	1.50	0.79
Trt-12	0.47	0.66	1.80	0.57	0.84	0.56
Trt-13	0.00	0.77	1.80	0.36	0.88	0.53
Trt-69	0.54	0.53	1.80	0.24	0.86	0.51
Trt-17	0.00	0.41	1.80	0.21	0.00	0.47
H b e Nfb	**1/86**	**2/23**	**2/91**	**1/99**	**2/64**	**2/15**
MIE	0.44	0.29	0.00	0.26	0.47	0.27
Hf f jh	**	**	Ns	**	**	**
Hf F jh						**

rb g i f f fb : The trial will be repeated one more year to select stable variety

Bd j j 8; Lima bean (*Phaseolus lunates*) variety verification trial
Bd j j f j e; July 2019 - June 2020
Pckfd j f; U register introduced Lima bean genotype with good grain yield and stability across locations.
Sf jcrfi f ; Dagmawit T., Berhanu A., Behailu T., Tigist S., Abel M, Girum K., Ibsa A.,Yasin G.Yirga.,Eyuel and Eyeberu
Sf fe c ; Girum K. & Berhanu A.,
Zfb g f ; January - December 2019
T b g i f h f
Seed multiplication for two lima bean genotypes were done
Ef jh Single plot with 10 m X 10 m size
U fb f ; Two candidate genotypes
M db j ; Melkassa, Negelle Arsi, Pawe, Jimma, Bako, Assosa and Harosebu
Sf m
The seeds of candidate genotypes were multiplied.
rb g i f f fb : the trial will be verified the coming cropping season across location.

Bd j j 9; Adzuki bean adaptation Trial
Bd j j f j e; July 2019 - June 2020
Pckfd j f; To register introduced Adzuki bean genotype with good grain yield and stability across locations.
Sf jcrfi f ; Dagmawit T., Berhanu A., Behailu T., Tigist S., Abel M, Girum K., Ibsa A.,
Sf fe c ; Girum K. & Berhanu A.,
Zfb g f ; January - December 2019
T b g i f h f
Two Adzuki bean genotypes evaluated as an adaptation trial with the check
Ef jh Single plot with 10 m x 10 m
U fb f ; two candidate genotypes
M db j Melkassa, Meiso, Babile

Sf m
Adaptable variety was identified and one candidate genotypes showed 25% yield advantage than check
rb g i f f fb : Best performing genotype will be promoted for variety verification trial in the coming cropping season.

Bd j j : ; Breeder seed multiplication of Lowland pulses
Bd j j f j e; July 2019 - June 2020
Pckfd j f; T o maintain the genetic purity and the availability of other lowland pulse varieties
Sf jcrfi f ; Dagmawit T., Berhanu A., Behailu T., Tigist S., Abel M. and responsible persons from respective centers
Sf fe c ; Girum K. & Berhanu A.,

Zfb g f ; January - December 2019

T b g i f h f

This activity done with purpose of to multiply and maintain Mung bean and cowpea varieties breeder seeds in order to supply quality seed stocks in Melkassa .

Ef jh ; Big plot size

U fb f Two Varieties

M db j ; Melkassa and Miesso

S f m

During the season, a total of 10 Qt Bole and Kenketi cowpea varieties breeder seeds was multiplied and maintained. Similarly, a total of 4Qt NVL and N-26 Mung bean varieties breeder seeds was multiplied and maintained (Table6).

Table 5. Amount of cowpea and Mung bean breeder seed produced in 2019 cropping season

Variety	Amount (Qt)
Cowpea (Bole and Kenketi variety)	10
Mung bean (NVL and N-26 variety)	4
Total	14

rb g i f f fb ; The multiplied seed will be availed for subsequent seed producers and for promotion.

Bd j j 21; Germplasm maintenance of lowland pulses

Bd j j f j e; July 2019 – June 2020

P ckfd j f; To rejuvenate the available breeding materials of lowland pulse crops.

S f jcrfi f ; Dagmawit T., Berhanu A., Behailu T., Tigist S., Abel M., Girum K.,

S f fe c ; Girum K. & Berhanu A.,

Zfb g f ; January - December 2019

T b g i f h f

200 cowpea genotypes were maintained

Ef jh ; non randomized single plot

U fb f ; 200 different cowpea genotypes

M db j ; Melkassa

S f m

A total of 200 cowpea genotypes were maintained and rejuvenated

rb g i f f fb ; The multiplied seed will be used for future nursery trial and reserved. In the future rejuvenate of germplasm will also continue to maintain the existing germplasm for future use.

Moisture and Heat Stress Maize Research

Alemshet Lema
E-mail: alegc98@gmai.com; Phone: +251911782027

S f fb di df ; Crop Research
kfd ; Improved maize technologies for drought stressed, heatprone and irrigated areas of Ethiopia (Government and small grantfunded activities)
kfd f j e; June 2017 - June 2020
Bd j j 2: Introduction and evaluation of early and intermediate maturing non-QPM hybrids for drought and heat prone areas
Bd j j jf f j e: June 2017 - June 2020
P ckfd j f; To identify well adapted maize hybrids to the local agroecology with ≥10% yield advantage and other biological merits over the check for possible release.
S f jc jnjn ; Dereje A., Lealem T., Alemeshet L., Talef W.
S f fe c ; Alemeshet L.
f j e gS f : January - December 2019
T b g i f h f
Six Sets of trials containing 255 genotypes were evaluated at Melkassa and Dhera (Table 1). Data were collected for traits Like GY (ton/ha), AD(d),SD (d), PH(cm), EH(cm), RL(%), SL(%), NP(n), NE(n), EA(Scale of 1-5), PA(Scale of 1-5), MOI(%), as well as TLB(Scale of 1-5) and CLR (Scale of 1-5). Data was analyzed using CIMMYT Field book and selection was made based on their performance over the local checks used based on the combined analysis results over the locations. Better materials were identified for request to introduce and evaluate them further in more location to generate better data for possible release. Since the project ended the selected materials were incorporated in different activities proposed in the new project so that the pass all the appropriate trials stages to be qualified for the requirements of variety release in Ethiopia.

Table 1. Summary of Different sets of Trials Evaluated under Activity 1.

Trial Name	Source	Design	# Geno	Loc	# Geno>Chk
EHYB19	CIM. ZIM	α-Lattice	40	BS	38
IHYB19	CIM. ZIM	α-Lattice	42	BS	40
STT19-FAW-	CIM.KEN	α-Lattice	55	BS,DR	30 (DK777)
EVALTWC-06	CIM.KEN	α-Lattice	55	DR	27
STT19A-MLN	CIM.KEN	α-Lattice	45	BS,DR	27(Duma43)
M19-05	IITA	α-Lattice	18	BS,DR	0

Ef jh ; RCBD and Alpha lattice
U fb f ; Maize varieties of different background including pro-vitamin A introduced from IITA, Conventional three way cross and MLN tolerant hybrids from IMMMYT.
M db j ; Melkassa and Dhera (Quarantine sites)

S f m
255 hybrids from CIMMYT regional trial as well as WEMA project and IITA were introduced and evaluated in five different trial sets at Melkassa and Dhera in 2011/12 main season. Data analysis showed that the genotypes performed differently and significantly at the two locations and combined analysis was not performed. Therefore, selection was made based on the data observed at Melkassa. The Genotypes in each sets of trials showed that sufficient variability in grain yield. The top ten Genotypes in EHYB19 showed a yield range from 7.3tonha^{-1}(Ent 40) to 9.6tonha^{-1} (Ent 27) with a yield advantage over the check (Ent 39 with yield of 6.6tonha^{-1}) ranging from 12% to 46% respectively (Table 2). From IHYB19 set the top ten hybrids depicted yield ranging from 7.4tonha^{-1}- 9.8tonha^{-1} and yield advantage over the check with the range of 8% to 43% over the check (Ent 41). From STT19A-FAW sets the yield range of the top ten hybrids were 6.88tonha-1 to 9.75tonha-1 and yield advantage of 22% to 73% over the check (Ent 49), whereas set STT19A-EVALTWC showed a yield performance varied from

8.41tonha-1 to 9.88tonha-1 and yield advantage of 16% to 37% as well as M19-05 set showed none of the genotypes were better than the check (Table 2). In General 162 genotypes showed better yield performance (≥10% Yield Advantage over the best check) from all the Six sets of trials evaluated were selected and advanced to be considered for evaluation in the upcoming project (Table 1).

rb g i f f fb : The selected materials will be requested along with their parental lines and will be promoted to the next stage of varietal evaluations

Table 2. Yield Performance of the top ten Genotypes evaluated across Melkassa and Dhera under Six Trial Sets

	EHYB19			IHYB19			STT19A-FAW			STT19A-MLNEVLTWC-			STT19A-EVALTWC			M19-05		
Entry	GW	Rank	ADV	Entry	ADV		Entry	GW	ADV	Entry	GW	ADV	Entry	GW	ADV	ADV	GW	Rank
27	9.6	1	1.46	30	10	1.4	15	9.75	1.7	5	9.9	1.37	20	12.48	1.31	MH140	9.45	1
23	9.4	2	1.43	12	10	1.4	33	9.7	1.7	17	9.8	1.36	24	11.86	1.24	14	9.1	2
8	9.2	3	1.41	20	10	1.4	55	8.84	1.6	13	9.3	1.28	29	11.74	1.23	1	9.08	3
13	9.1	4	1.39	29	10	1.4	13	7.86	1.4	10	9.2	1.28	7	11.48	1.2	7	9.06	4
11	9	5	1.38	11	10	1.4	36	7.25	1.3	8	9.1	1.25	23	11.47	1.2	16	8.82	5
26	8.9	6	1.36	8	10	1.4	28	7.17	1.3	2	9	1.24	6	11.42	1.2	13	8.76	6
20	8.9	7	1.36	9	10	1.4	10	7.11	1.3	1	8.9	1.23	36	11.3	1.18	17	8.55	7
36	8.8	8	1.35	3	9	1.4	37	6.92	1.2	11	8.7	1.2	35	11.29	1.18	2	7.94	8
6	8.7	9	1.32	13	9	1.4	27	6.9	1.2	43	8.5	1.18	5	11.21	1.18	15	7.75	9
29	8.5	10	1.3	10	9	1.4	46	6.88	1.2	26	8.4	1.16	10	11.19	1.17	8	7.75	10
40	7.3	33	1.12	42	7	1.1	49	5.65	1	39	7.2	1				6	7.63	11
39	6.6	39	1	41	7	1												
Mean	8	21			9			5.85			7.6			10.16			7.87	
MSe	0.5				1			1.83			0.7			2.51			1.88	
CV	9.2				9			23.2			11			15.6			17.42	
p	***				***			*			ns			*		p	**	

Note-

*ADV= Yield Advantage Over the Local Check (%), the two digits after the Decimal point shows the Yield Advantage in % over the appropriate local check in that specific trial.

** Abbreviated traits are explained under Table 6.

Bd j j 3/ Introduction and evaluation of non-QPM OPVs for drought prone areas

Bd j jjf f j e: June 2017 - June 2020

Pckfd j f; To identify well adapted maize OPVs to the local agroecology with ≥10% yield advantage and other biological merits over the check for possible release

S f jc jnjn : Lealem T., Alemeshet L., Dereje A., Talef W.

S f fe c : Alemeshet L.

f j e gS f : January - December 2019

T b g h f : Three Sites of Trials were Hosted which were requested from IITA in 2019 and were evaluated at Melkassa and Dhera sites (Table 3). All the three trials were conducted very well and data was collected for GY (ton/ha), AD(d),SD (d), PH(cm), EH(cm), RL(%), SL(%), NP(n), NE(n), EA(Scale of 1-5), PA(Scale of 1-5), MOI(%), as well as TLB(Scale of 1-5) and CLR (Scale of 1-5). Data was analyzed using CIMMYT Field book and selection was made based on their performance over the local checks used based on the combined analysis results over the locations. Entries with at least 10% Yield advantages were advanced to the next trial stages. Seed request was made for those selected genotypes from their parent institutions for evaluations.

Table 3. Summary of Different sets of Trials Evaluated under Activity 2

Trial	SOURCE	Design	#GENO	#GENO>CHC
M19-02	IITA	α-Lattice	20	1 (not 10%)
M19-17	IITA	RCBD	12	0
M19-18	IITA	RCBD	12	2 (not 10%)

Ef jh : RCBD and Alpha lattice

U fb f : Maize varieties of different background including pro-vitamin A introduced from IITA, Conventional three way cross and MLN tolerant hybrids from CIMMMYT.

M db j : Melkassa and Dhera (quarantine sites)

S f m

44 OPVs were introduced from IITA in three different sets each with ProA and Stress tolerant OPVs and were evaluated at Melkassa and Dhera. The result Showed that Only

Three OPVs showed better performance over the check but no variety showed 10% Yield Advantage over the check. In These Sets of IITA trials, The top ten individuals showed yield ranging from 2.3tonha^{-1} to 4.64tonha^{-1} in Set M19-17 with none of the materials showed superior performance to any of the checks whereas in M19-18 the yield range of the top ten varieties were in the range of 2.4tonha^{-1} to 4.01tonha^{-1} with only 2 varieties with better performance than the check though the yield advantage does not reach the minimum 10% , in set M19-02 the top ten varieties at Melkassa and Dhera showed yield in the range of 4.29tonha-1 to 6.01 tonha-1and only one variety was better than the check (Table 4). The result showed that all the genotypes performed very poorly which was due to late planting of all the trials which faced terminal stress and heavy FAW leaf damage which may contributed to the observed performance

rb g i f f fb : the selected materials will be requested along with their parental lines and will be promoted to the next stage of varietal evaluations

Table 4. Yield Performance of the top ten Genotypes evaluated across Melkassa and Dhera under three Trial Sets

M19-17				M19-18				M19-02		
ENTRY	NAME	GW	Rank	Entry	Name	GW	Rank	Entry	GW	Rank
12	MH140	4.64	1	9		4.01	1	3	6.01	1
11	MK2	4.42	2	7		3.89	2	MK2	5.62	2
7		4.18	3	12	MH140	3.79	3	5	4.63	3
8		3.67	4	11	MK2	3.76	4	9	4.57	4
5		3.51	5	6		3.6	5	7	4.44	5
2		3.33	6	10		3.53	6	10	4.31	6
6		2.92	7	5		3.3	7	15	4.29	7
9		2.87	8	3		2.5	8	11	3.99	8
3		2.73	9	8		2.4	9	4	3.94	9
1		2.54	10	4		2.22	10	6	3.9	10
4		2.5	11	1		1.87	11	8	3.86	11
10		2.3	12	2		1.76	12	16	3.85	12
Mean		3.3	7			3.05	7		4.02	11
LSD (0.05)		0.63	4			0.47	4		1.19	6
MSe		0.2				0.09			0.43	
CV		13.54				9.65			16.36	
p		***				***			***	

Bd j j 4: Per se performance evaluation of introduced and locally generated conventional and non-QPM inbred lines for drought and heat prone areas

Bd j j jf f j e; June 2017 - June 2020

Pckfd j f; To evaluate and identify inbredlines with acceptable yield performance by seed producers under random environmental conditions

Sf jcjmj : Dereje A., Lealem T., Alemeshet L., Talef W.

Sf fe c : Alemeshet L.

f j e gSf : January - December 2019

T b g h f : Four sets of trials were conducted again at Melkssa and Dhera. One of the trial was introduction from IITA and the rest three are for MSC student thesis works (Table 5). A total of 182 Inbred lines were evaluated across the two locations and data was collected for GY (ton/ha), AD(d),SD (d), PH(cm), EH(cm), RL(%), SL(%), NP(n), NE(n), EA(Scale of 1-5), PA(Scale of 1-5), MOI(%), as well as TLB(Scale of 1-5) and CLR (Scale of 1-5). Data was analyzed using CIMMYT Field book and selection was made based on their performance as well as their overall adaptation to the environments which were made by panel of breeders. In this case the number of genotypes selected for advancement were not made based on yield comparison but based on other merits like their disease reaction or over all adaptation to their local genotypes. The student Thesis work analysis and interpretation will be done by three students (Tefera, Bulo and Estifanos) and their thesis work is under progress but not completed yet t include results from their work in this report. The IITA trial result is presented as below.

Table 5. Summary of Different sets of Trials Evaluated under Activity 3

Trial	Design	Source	# Lines
M19-08	α-Lattice	IITA	40
TeferaMsc	α-Lattice	Local	65
Bulo MSc	α-Lattice	Local	42
EstifanosMsc	α-Lattice	Local	35
Total			182

Ef jh ; Alpha lattice
U fb f ; Maize Inbredlines from IITA and Locally Developed Lines
M db j ; Melkassa and Dhera (quarantine sites)

S f m

ANOVA for Introduced IITA Lines showed that sufficient variability was observed among the inbred lines for the traits measured. The top ten lines showed a yield performance ranging from 2.46tonha^{-1} (L8) to 3.6tonha^{-1}(L16) with mean of 1.88tonha^{-1} which was within the range of the minimum yield potential that is considered acceptable by seed producers. These lines showed late flowering time ranging from 75.6d (L5) to 83.9d (L13) with mean of 82.4d which might not be suitable for low moisture stress agro ecologies but since the trials were planted late the flowering time could have been affected due to the terminal stresses occurred during the trial period. The EH measured were within the range of 0.41 to 0.64 which 0.64 was not a good type of line which showed high ear placement which might result in lodging where as some lines showed good level of prolificacy like L13 with 2.09 EPP and L16 with 1.97 EPP and L29 with 1.64EPP which were good for high yield performance as well as drought adaptation. The Ear rot percentage ranged between 0 to 8% and mean of 3.3% which showed that these genotypes relatively showed better tolerance to ear rot. Among the top ten Lines like L5 (2.2), L15 (2.4), L8 (2) showed acceptable ear aspect which showed that these lines were good for breeding and hybrid formation (Table 6). When it Comes to selection since these is a per se trial usually the selection was done based on their merits in terms of disease reaction, plant architecture or some other attributes. The number of genotypes selected in this case was much higher than the usual yield trails.

rb g i f f fb : the selected lines will be requested and will be used as integral part of the local breeding program to generate hybrids and to develop other lines through recycling.

Table 6. Yield and Agronomic Trait Performance of the top ten Lines evaluated across Melkassa and Dhera

Entry	GW	Rank	AD	ASI	PH	EH	EPO	RL	SL	EPP	HC	ER	MOI	EA	PA
16	3.60	1	80.4	-1.1	183.2	80.5	0.45	1.0	0.3	1.97	15.7	4.1	16.5	2.8	2.5
5	3.54	2	75.6	-0.9	171.9	76.2	0.46	1.1	0.5	1.00	7.3	8.0	18.9	2.2	2.8
28	3.12	3	80.5	-0.7	173.7	103.4	0.59	0.9	0.9	1.64	6.8	-0.2	15.3	2.7	2.7
13	2.85	4	83.9	0.5	198.7	92.8	0.47	5.1	-0.2	2.09	-4.7	-0.8	19.7	3.1	3.1
25	2.76	5	77.4	-0.6	146.2	71.2	0.45	-6.2	1.3	1.27	7.6	1.6	24.0	2.9	2.9
9	2.65	6	78.8	2.3	150.2	79.4	0.52	1.0	-0.6	1.43	-3.3	1.8	16.0	3.4	2.5
14	2.63	7	82.6	-2.3	195.2	97.9	0.50	-1.1	0.7	1.04	4.5	4.5	16.5	2.8	2.6
15	2.62	8	82.9	0.6	184.4	121.5	0.64	0.2	-0.3	0.77	18.2	0.0	21.2	2.4	3.1
21	2.53	9	81.0	0.6	162.4	63.3	0.41	0.8	-0.8	0.86	-2.0	7.2	15.5	2.9	2.9
8	2.46	10	79.8	-1.6	186.9	92.4	0.49	-2.0	0.7	1.32	30.2	-3.7	17.9	2.0	2.6
Mean	1.88	21	82.4	0.5	155.3	79.7	0.51	3.1	0.7	1.02	6.9	3.3	18.9	3.0	3.0
LSD (0.05)	0.87	12		2.4	22.7			18.3	5.3	0.41	15.2	16.4	3.3	1.2	
MSe	0.25		17.3	2.1	166.3	121.3	0.00	82.9	6.3	0.07	77.9	74.6	2.5	0.3	0.2
p	***		ns	***	***	ns	ns	ns	ns	***	***	ns	***	**	ns

GW=Grain Weight (toonha-1); AD= Anthesis Day (d); ASI= Anthesis Silking Interval; PH= Plant Height(cm); EH=Ear Height(cm); EPO=Ear Position (EH/PH); RL=Root Lodging(%); SL= Stem Lodging (%); EPP=Ear Per plant (no.); HC= Bad Husk Cover (%); ER= Ear Rot (%); MOI= Moisture Content (%); EA=Ear Aspect (Scale 1-5, 1=Excellent, 5= Worst); PA= Plant Aspect (Scale 1-5, 1=Excellent, 5= Worst);

Bd j j 5: Formation of different bi-parental crosses for development of inbred lines
Bd j j jf f j e; June 2017 - June 2020
P ckfd j f; To begin Line development through recycles breeding locally
S f jc jmjn ; Dereje A., Lealem T., Alemeshet L., Talef W.
S f fe c ; Alemeshet L.
f j e gS f ; January - December 2019
T b g h f ;
This Activity was Part of MERCI Project Line development program at Melkassa. The nursery was done in 2017 and the advancement continued until this report compiled. 12 populations 6 of them male and 6 of them were made using 12 inbred lines and 12 populations were generated in 2017 and Advanced to F2, F3stages in 2018 and 2019 respectively. Currently this nursery is at F3 stage ready for Advancement to F4 and then to be used in Test Cross formation.
Ef jh : None
U fb f t: 12 Inbred lines
M db j : Melkassa

S f m
In this Activity each of the male Line was crosses with each of the female within the group in a bi parental mating design. The male and The Female lines in each group were from the same heterotic group. From these bi-parental crosses schemes 36 different populations were generated to start breeding program through line recycling. Out of the generated bi-parental crosses only 12 of them were advanced to Selfing stages.

rb g i f f fb ; The lines will be advanced to F4 and will be used to form Test Crosses.

Bd j j 6; Inbred line development of non-QPM materials for drought prone area
Bd j j jf f j e: July 2017 - June 2020
P ckfd j f; To develop high combiner non-QPM inbredlines through pedigree and SSD method breeding
S f jc jmjn ; Lealem T., Dereje A., Alemeshet L., Talef W.
S f fe c ; Alemeshet L.
f j e gS f ; January - December 2019
T b g h f
Two sets of inbredlines development nurseries were conducted. EEILD(Melkassa1) (31) and the second ILD19 extracted from (Melkassa2, CML444/CML547, CML440/CML445, Melkassa3 and China source) and containing 148 lines were planted at Melkassa A2 field and were Advanced to F3 Stages and then Planted at B1 field and Advanced to F4 Stage through selfing.
Ef jh ;None
U fb f : Maize Inbredlines
M db j ; Melkassa

S f m
ILD19 = 148 1 ILD lines test cross were made for early generation evaluation For MSc Student and at the same time the other set were used to advance the lines. In addition, 31 Extra early lines were selected out of 71 lines and Advanced to F5 (Table 7).
rb g i f f fb - The Advancement will Continue to the next Inbreeding Stage while test cross formation will take place at
Table 7. Lines Advancement at Melkassa of Activity 5

Nursery Name	# of Lines	Advaced
ILD19	148	148
EEILD (Melkassa1)	71	31

Bd j j 7: Molecular diversity analysis of non-QPM and QPM inbred lines
Bd j jf f j e; July 2017 - June 2020
P ckfd j f; To characterize the genetic pools of inbredlines developed at Melkassa as compared to the known maize genetic pools across the world
S f jc jmjn ; Lealem T., Dereje A., Alemeshet L., Talef W.
S f fe c ; Alemeshet L.
f j e gS f : January - December 2019
T b g h f
Twentyseeds from 648 inbred lines from different sources including locally developed lines, CIMMYT Advanced Lines, DH lines were prepared and submitted along with all the information to Holeta Plant Biotechnology Research Program. They will germinate them on trays and take leaf samples and send them to University of Queens Land. The Genotyping Result was not sent to us yet.
Ef jh : None
U fb f : 648 Maize Inbred lines
M db j : Melkassa /Holeta/UQ

S f m
648 Lines were submitted to Holeta biotechnology Laboratory for Genotyping and the Genotyping result was not reported back yet.
rib g i f f fb : The result will be used to classify the genotypes according to their Genetic relation ship

Bd j j 8: Formation of non-QPM and QPM test crosses
Bd j jf f j e: July 2017 - June 2020
P ckfd j f: To determine the heterotic pools and combining ability of maize inbredlines
S f jc jmjn : Alemeshet L., Dereje A., Lealem T., Talef W.
S f fe c ; Alemeshet L.
f j e gS f : January - December 2019
T b g h f
Four Different Test Cross formation nurseries were planted at B1 in Melkassa and test cross was made using different testers (MK19Mn15 containing 84 lines crossed with 2 testers, Mk19MN16 containing 161 lines and test crossed with two testers, Bulo Thesis containing 148 Lines test crossed with two testers and Estifanos Thesis work containing 29 lines test crossed with four testers) (Table 8).
Ef jh : None
U fb f : Maize Inbred lines and Testers
M db j : Melkassa

S f m
A total of 902 test crosses were formed (Table 8). The Generated test crosses were organized in to different trial sets f evaluated 2019/2020 main season.
rib g i f f fb - The results from the test cross evaluation will be used to select inbredlines and use them for different hybrid formation.

Table 8. Summary of nurseries conducted under activity 7

Nursery name	Number of Lines	Testers	Expected Cross
MK19MN15	84	CML144, CML159	168
MK19MN16	161	CML144, CML159	322
BULO THESIS	148	CML312, CML395	296
ESTIFANOS THESIS	29	CML312, CML395, CML444, CML442	116

Bd j j 9: Formation of non-QPM & QPM single cross hybrids
Bd j jf f j e: June 2017 - June 2020
P ckfd j f; To identify best single crosses with ≥10%yield advantage over the check for possible release or to use them for three ways cross hybrid formation.
S f jc jmjn : Lealem T., Dereje A., Alemeshet L., Talef W.

S f fe c : Alemeshet L.
f j e gS f : January - December 2019
T b g h f : 48 inbred lines were selected based on the phenotypic and molecular characterization in Design-II to generate about 240 single crosses in 2018/19. They were planted in B1 field at Melkassa and due to irrigation problems, most of the lines failed to synchronize and were maintained by selfing.
Ef jh : NA
U fb f : Maize Inbred Lines
M db j : Melkassa

S f m
Single Crosses of 31 of the lines out of the 48 were successful l made. The seed produced was not enough for some of the crosses due to flower synchronization due to irrigation problem.
rb g i f f fb ; The generated single crosses will be evaluated for their yield potentials in the coming years.

Bd j j : ; Preliminary variety trial of early and intermediate non-QPM and QPM hybrids and test crosses
Bd j j jf f j e: June 2017 - June 2020
P ckfd j f; To identify best hybrids with ≥10%yield advantage over the check for possible release and identify inbredlines with good breeding values
S f jc jnjn ; Alemeshet L., Dereje A., Lealem T., Talef W.
S f fe c ; Alemeshet L.
f j e gS f ; January - December 2019
T b g h f ;
Two sets of trials were organized as PVT 2019. Set-1(Early) containing 238 Genotypes organized as one trial set and to be planted at Melkassa, Dhera and Werer. Unfortunately, it was not planted at Dhera due to land shortage. Set-2 (Intermediate) Containing 476 Genotypes organized as one trial set and to be planted at Melkassa, Dhera and Werer (Table 9). Unfortunately, it was not planted at Dhera as well due to the same reason. Both trials planted at Melkassa, were harvested and are on the process of Data analysis but the trials at Werer was planted very recently due to the seasonal variation and are on flowering stages. Out of the generated test crosses, we organized sub sets of trials for two students to do their MSC thesis work Studies on them and the detail report of their finding will be used by the breeding program.
Ef jh ; PREP
T **fb f** : Maize Test Crosses
M db j : Melkassa and Werer

S f m
Data was collected for GY (ton/ha), AD(d),SD (d), PH(cm), EH(cm), RL(%), SL(%), NP(n), NE(n), EA (Scale of 1-5), PA (Scale of 1-5), MOI (%), as well as TLB (Scale of 1-5) and CLR (Scale of 1-5). The Data from Melkassa was ready but due to the seasonal variation between Melkassa and Werer combined analysis not conducted. The trial at Werer is currently under harvesting. Data analysis and reporting will be done by UQ and EIAR biometricians, data cleaning and curing is under way for Melkassa Set. Bulo and Estifanos are currently working on the remaining sets of trials to be reported by the students themselves.

rb g i f f fb - The analysis will be done by the team of EAIR and UQ team since it is a PREP trial and the result will be used for advancing selected genotypes.

Table 9. Summary of Trials Evaluated under PVT (Activity 9)

Trial Name	# of gen.	Location
DIHP19	402	MK,DR, WR
DEHP19	228	MK,DR, WR
BULO THESIS	84	MK, DR
ESTIFANOS THESIS	72	MK, DR
TOTAL	786	

Bd j j 21: National variety trial of non-QPM hybrids
Bd j j jf f j e: June2017 - June 2020
P ckfd j f: To identify best hybrids with ≥10%yield advantage over the check for possible release
S f jc jnjn : Alemeshet L., Dereje A., Lealem T., Talef W.
S f fe c : Alemeshet L.
f j e gS f : January - December 2019
T b g h f : Two Sets of NVT was conducted which includes WEMA Hybrid Selected from CIMMIYT Source (MK, DR) and WEMA hybrids Selected from Monsanto (MK, DR, MS) .Two Candidate hybrids (Monsanto) were selected for verification and this was conducted to strengthen the data for VVT. Data analysis was done and Submitted to the variety evaluation committee.
Ef jh : RCBD and Alpha lattice
U fb f - Maize varieties
M db j -Melkassa, Dhera and Miesso

S f m

ANOVA for Across Location evaluation showed that significant difference was observed among the genotypes for grain yield and related traits. Grain Yield for WEMA source NVT across showed ranging from 4.8tonha^{-1} (MH138Q) to 7.6tonha^{-1} (WE7212) whereas the yield advantage over MH140 ranged from 11.6% (WE1259) to 40.2% (WE5202) (Table 10). Genotype performance of NVT trials from CIMMYT for grain yield ranged from 5.06tonha^{-1} (MH140) to 7.29tonha^{-1} (Ent19) with a yield advantage ranging from 6% (Ent 13) to 44% (Ent 19) (Table 11). Currently we submitted WE7210 and WE8216 based on the data from 2017 and 2018 trials as candidate varieties for possible release but we found also genotypes like WE6205 which is doing well across locations and years (Table 10).
nb g if f fb - Selected Materials will be advanced to the next Trial Stages

Table 10. National variety Trial of Maize Hybrids from WEMA source

Entry	Name	Across	Across										
Entry	Name	Rank	GY	Yield Advantage(%)/MH140	ER	EPP	RL	SL	HC	EA	PH	EH	ASI
1	WE6205	2	7.3	29.1	3.6	1.07	0	1.6	18	2	184	99.9	0.3
2	WE7201	8	6.9	22	3.6	1.59	0	0.2	11.9	3	197	99.9	-0
3	WE5202	1	8	40.2	3.6	1.24	0	0.5	19.4	2	196	99.9	-1
4	WE7209	1	7	24	3.6	1.26	0	0.9	14.7	2	194	99.9	-0
5	WE8208	6	7.4	29.6	3.6	1.18	0	0.8	19.1	1	199	99.9	0
6	WE4208	2	6.8	19.3	3.6	1.25	0	1.4	5.6	2	198	99.9	0.7
7	WE7206	6	7.5	32.6	3.6	1	0	2.7	21.1	2	200	99.9	-0
8	WE7210	6	7	23.9	3.6	1.18	0	1.3	12.8	2	181	99.9	0.2
9	WE8206	10	6.9	22.1	3.6	1.11	0	1.3	6.7	2	201	99.9	1
10	WE7212	12	7.6	33.6	3.6	1.13	0	-0	12	2	193	99.9	-1
11	WE1259	2	6.3	11.6	3.6	1.08	0	1.8	4.2	3	186	99.9	0.1
12	WE8216	1	7.4	30.3	3.6	1.26	0	-0	5.5	2	201	99.9	-0
13	WE6204	1	7.1	25.1	3.6	1.12	0	-0	24.9	2	183	99.9	0.2
19	MH140	0	5.7	-	3.6	1.04	0	-0	17.6	2	212	99.9	0.6
20	MH138Q	0	4.8	-	3.6	1.23	0	1.5	9.3	2	204	99.9	0.6
Mean		3	6.8		3.6	1.2	0	0.9	14.4	2	194	99.9	0.3
LSD (0.05)		3	1.1		8.2	0.14	2	2.4	11	1	10.5	19.8	2.2
MSe			1		25	0.01	1	4.2	135	0	123	146	3.6
No. significant Sites		2	2		1	1	1	2	3	1	3	1	2

Note: Abbreviated traits are explained under Table 6.

Table 11. National variety Trial of Maize Hybrids from CIMMIYT source

Entry	GW	YLD.ADV	Rank	AD	ASI	PH	EH	EPO	RL	SL	EPP	ER	MOI	EA	PA
19	7.29	1.44	1	76.9	-0.3	254.6	100.4	0.41	-4.1	0.6	1.30	0.0	18.6	2.5	2.4
18	7.23	1.43	2	82.5	1.3	245.8	121.7	0.51	0.9	1.1	1.13	0.0	19.2	2.5	2.5
21	7.16	1.42	3	74.7	-2.0	250.1	116.8	0.48	0.0	-0.5	1.07	-0.1	17.0	2.7	2.7
12	7.00	1.38	4	81.4	1.1	285.5	127.9	0.45	-2.9	3.2	1.29	-0.1	18.2	2.8	1.9
1	6.84	1.35	5	78.9	0.5	252.1	115.5	0.48	0.1	4.2	1.05	0.0	19.2	2.0	2.0
11	6.79	1.34	6	81.9	0.6	255.7	128.4	0.52	-0.4	-0.3	1.08	0.0	21.3	2.3	2.0
14	6.38	1.26	7	83.5	-0.6	257.2	119.1	0.48	-0.4	-0.2	1.14	-0.2	16.5	2.8	2.5
22	6.38	1.26	8	74.5	-1.4	227.4	107.8	0.48	3.8	-0.8	1.19	0.0	17.8	2.2	3.0
10	6.14	1.21	9	80.1	0.2	253.5	127.8	0.50	-3.4	1.3	1.17	0.0	19.5	2.7	2.3
9	6.04	1.19	10	79.1	0.6	247.9	145.6	0.60	-1.3	-0.7	1.00	0.0	19.5	2.2	2.8
3	5.81	1.15	11	80.2	-0.8	230.9	115.5	0.48	1.2	-0.8	1.12	0.0	17.9	2.5	[illegible]
4	5.70	1.13	12	83.4	0.9	253.8	144.8	0.60	5.7	2.0	1.18	0.1	20.6	2.1	2.8

[[CML444/CML395//	10	0.5	Self
CML442	20	10	Self
CMl202	5	0.5	Self
KI SERIES	20	3	Self
Total		31	

Bd j j 23: Nucleus seed regeneration for released OPVs & hybrids' parents
Bd j j jf f j e; June 2017 - June 2020
P ckfd j f; To avail high quality foundation seed for seed producers
S f jc jmjn ; Talef W., Dereje A., Lealem T., Alemeshet L.,
S f fe c : Alemeshet L.
f j e gS f : January - December 2019
T b g h f
Seven Different important lines were planted at Melkassa and EthiovegFru for nucleus seed regeneration during the off season but not harvested yet.
Ef jh ; None
U fb f : Maize varieties
M db j :Melkassa

S f m
The nucleus seed regeneration takes Place during the off season and main seasons. During the main season the regeneration process was jumped due to over stretch plan and availability of isolation but during this main season the 45kg of seed will be expected to be harvested (Table 13).
rıb g i f f fb - Seed production will continue for the remaining varieties and Lines

Table 13. Nucleus Seed Regeneration of parental Lines of Released and candidate hybrids at Melkassa

Variety	# Rows	Expected	Status
CML444	20	10kg	Not harvested
CZL0814	60	0	(Stolen all in all)
CML547	-	0	New seed Source (Off season)
CZL0814	10	5kg	5k Harvested
CML539	10	10kg	5kg harvested
WMB0001	10	10kg	Not harvested
WMA2002	10	10kg	Not harvested
Total		45kg	

Bd j j 24: Breeder/pre-basic seeds increase for OPVs and parents of released hybrids
Bd j j jf f j e: June 2017 - June 2020
P ckfd j f; To avail high quality breeder seed for seed producers
S f jc jmjn : Talef W., Dereje A., Lealem T., Alemeshet L.,
S f fe c ; Alemeshet L.
f j e gS f : January - December 2019
T b g h f
Melkassa2 and Melkassa4 was both planted at Mehoni to produce breeder seed. According to their report, it was discovered that Due to Smut Contamination both varieties were rejected by the regional Quality Control Unit. Whereas Melkassa 6Q we harvested 3 quintals of breeder seed and stored it in seed store for distribution to the seed producers who have agreements with EIAR for this variety.
Ef jh : None
U fb f : Maize varieties
M db j ; Melkassa and Mehoni

S f m
Breeder Seed production is also an issue of a continuous process and it has been undergoing at Mehoni and Melkassa. Only in 2019, 950 Kg of these OPVS were produced and

distributed to different stake holders mainly for those organizations with pre contractual agreement (Table 14). In total 4300kg of breeder seed of ten different varieties from 2019 and from previous stock were available for distribution and managed to distribute 3200kg to different stakeholders.
rb g i f f fb : Breeder Seed production has been challenged by isolation therefore we will be focusing on producing high quality small quaintly of seed through controlled pollination

Table 14. Breeder Seed production of OPV at Melkassa

Wb jf	B fb)i b*	Zjfm)l h*0F fd fe	T b
Melk2	0.25	400	400kg harvested and distributed
Melk4	0.25	250	250 harvested and distributed
Melk6	0.125	300	300 kg harvested and distributed
Total	0.625	950	950 kg Distributed

Bd j j 25; Popularization of improved maize varieties in Western Hararge
Bd j j jf f j e: June 2017 - June 2020
P ckfd j f: To popularize already released varieties in West Hararge
S f jc jnjn : Abdulfeta
S f fe c ; Alemeshet L.
f j e gS f : January - December 2019
T b g h f
These Activity was handled by Chiro research Center and the report will be reported by them as well. We are mentioning it because the financial support was from the low land maize project and the varieties were also from the project. These varieties were planted on 8 Demo plots across Chiro, Hirna and Bedessa and a total of 130 visitors visited the plots formally and informally.
Ef jh ; None
U fb f ; Maize varieties
M db j ; Chiro, Hirna and Bedessa

S f m
Based on farmers' preference ranking MH138Q got the highest score followed by MH140 based on the yield performance and other aspects of the varieties (Table 15). The complete report will be compiled and reported by Chiro Center.
rb g i f f fb ;
The activity has to be done by the Center itself if they decide it is important for the community but we are not going to support them financially for such activities any more though we will continue availing breeder seed of the varieties if they are needed.

Table 15. Demonstration of two low land maize varieties in EastHararge Zone

Variety	Location	Variety	Planned Participant	Actual Participant	Farmers Preference Rank
MH140	Chiro, Hirna, Badesa	MH140	370	130	2
MH138Q	Chiro, Hirna, Badesa	MH138Q			1
Total			370	130	

Bd j j 26: Demonstration of highland and mid-altitude maize technologies in southern Tigray
Bd j j jf f j e: June 2017 - June 2020
P ckfd j f: To popularize and demonstrate already released varieties in Southern Tigray.
S f jc jnjn ;Alamir
S f fe c : Alemeshet L.
f j e gS f - January - December 2019

T b g h f
These Activity was handled by Mehoni research Center and the report will be reported by them as well. We are mentioning it because the financial support was from the low land maize project and the varieties were also from the project. According to the report the Demo for the highland variety planted at Ofla was successful while it was not for drought tolerant varieties planted at Mehoni and no Field day was conducted for the drought varieties.
Ef jh : None
U fb f :Maize varieties
M db j : Mehoni

Sf m
According to the report the Demo for the highland variety planted at Ofla was successful while it was not for drought tolerant varieties planted at Mehoni and no Field day was conducted for the drought varieties.
rb g if f fb :The activity has to be done by the Center itself if they decide it is important for the community but we are not going to support them financially for such activities any more though we will continue availing breeder seed of the varieties if they are needed.

Bd j j 27; Verification of drought tolerant hybrids in moisture prone areas of Ethiopia
Bd j j jf f j e; June 2019 - June 2019
Pckfd j f; To release high performing maize hybrid for drought stressed agro-ecology which can replace the existing old varieties
Sf jc jnjn ; Alemeshet L., Dereje A., Lealem T., Talef W.
Sf fe c ; Alemeshet L.
f j e gSf ; January - December 2019
T b g h f ; This Activity was conducted at Melksaa, Dhera, Miesso all on station and Dugda, AdamituluJidokombolcha and Adamitulu Judo Kombolcha on farm. All the sites were visited by variety evaluation committee and all the necessary data and documents were submitted for considerations to release at least one of the hybrids.
Ef jh : None
U fb f : Maize varieties
M db j : Melkassa and Dodotaand Miesso plus on farm

Sf m
ANOVA showed that the genotypes performed very differently across the three locations and the candidate varieties showed yield ranging from 5.9tonha^{-1} (WE8216) at Miesso to 8.3tonha^{-1} (WE7210) at Dhera at the same time the minimum yield on farm was recorded at Dugda 4.3tonha^{-1} of MH140 whereas the maximum was 8.84tonha^{-1} of WE7210 at AdamituluJidokombolcha. The Farmer at Adamitulu harvested the trial by himself without our knowledge and it was excluded from decision making though our visual observation showed that WE7210 was the best followed by WE8216 and MH140 at Adamitulu (Table 16). ANOVA for line per se performance showed that a yield potential ranging from 1.5tonha $^{-1}$(WMB20001) to 3.3tonha^{-1}(WMB4846) at Melkassa and Miesso which was also a good characteristic for seed producers (Table 17). At the same time the flower synchronization study showed that there is no need to do staggering in planting for seed production of both the single crosses as well as the hybrids themselves which was also another important advantage.
rb g if f fb : We will be doing seed increase of the released varieties and promote it to the pre extension and demonstration stages following the decision by Variety releasing Committee.

Table 16. Variety Verification Trial on Farm and On Station Yield Performance of Candidate varieties with the check

	On Station		On Farm	
Name	Location	Yield (ton/ha)	Location	Yield (ton/ha)
WE7210	Dhera	8.3	AdamituluJidokombolcha	8.84
WE8216	Dhera	8.1	AdamituluJidokombolcha	8.09
MH140	Dhera	7.9	AdamituluJidokombolcha	5.78
WE7210	Bishola	8.2	Dugda	6.18
WE8216	Bishola	7.9	Dugda	4.36
MH140	Bishola	7.2	Dugda	4.30
WE7210	Miesso	6.4	AdamiTulu	NA (Farmer Harvest)
WE8216	Miesso	5.9	AdamiTulu	NA(Farmer Harvest)
MH140	Miesso	6.2	AdamiTulu	NA(Farmer Harvest)

Table 17. Inbred Lines per se performance for the candidate varieties

	Line Per Se for VVT_MIESSO											
ENTRY		GY	RANK	PH	EH	EPO	RL	SL	EPP	MOI	EA	PA
1	CML539	1.9	4	116.1	41.7	0.39	-2.8	-1.3	1.17	18.7	3.5	2.7
2	WMB4846	3.3	1	114.2	62.3	0.53	-4.0	-3.5	1.44	20.1	2.0	2.1
3	WMB4842	2.5	3	141.1	52.4	0.45	9.8	13.5	0.96	18.7	2.1	3.2
4	WMB2001	1.5	5	86.2	57.4	0.43	-7.5	1.3	1.20	19.6	3.1	2.4
5	WMB0001	2.8	2	141.5	59.1	0.46	7.2	1.5	1.21	19.4	2.6	2.6
Mean		2.42		119.8	54.6	0.45	0.5	2.3	1.20	19.3	2.7	2.6
MSe		0.01		139.7	193.1	0.01	51.6	54.0	0.65	1.1	0.1	0.0
p		Ns		ns	ns	ns	ns	ns	ns	Ns	ns	Ns

	Line Per Se for VVT_MELKASSA													
ENTRY	Name	GW	Rank	AD	ASI	PH	EH	EPO	RL	SL	EPP	MOI	EA	PA
1	CML539	2.0	4	67.7	0.4	142.6	52.7	0.35	21.5	8.2	0.70	14.3	2.0	2.4
2	WMB4846	2.9	1	69.5	-0.2	143.9	76.4	0.54	13.7	4.1	1.53	16.4	1.8	2.4
3	WMB4842	2.0	5	69.7	-0.3	147.6	69.1	0.45	12.0	3.1	1.48	13.5	2.3	3.1
4	WMB2001	2.6	2	70.0	-0.9	126.0	55.1	0.43	13.0	6.6	1.39	15.5	1.5	2.9
5	WMB0001	2.3	3	71.6	1.2	176.1	86.2	0.50	8.6	0.1	1.11	17.2	1.2	2.0
Mean		2.35	3	69.7	0.1	147.3	67.9	0.45	13.8	4.4	1.24	15.4	1.8	2.6
LSD (0.05)		1.42	2			58.8	47.5				0.31			
MSe		0.22		0.6	0.4	414.9	245.0	0.18	4081.4	1001.2	0.03	412.8	0.5	13.9
p		+		ns	ns	**	Ns	ns	ns	Ns	**	Ns	ns	ns

Note: Refer Abbreviated character under Table 6

Sorghum Improvement Program

Alemu Tirfessa
E-mail: tirfessa@hotmail.com; Phone: +251911887517

kfd J: Development and Promotion of Improved Sorghum Varieties and Management Options for dry lowland, Highland, Humid Lowland and Intermediate Agro-ecologies of Ethiopia

kfd D ej bj hDf f ; Melkassa Agricultural Research Center

kfd D ej b ; Alemu Tirfesa

e d U f;

1. Local landraces with Striga resistance and stay green for dry lowlands
2. Early maturing varieties with acceptable yield, quality and biomass production for dry lowlands
3. High yielding hybrids with acceptable quality and biomass production for dry lowlands
4. Long duration OPVs with acceptable grain yield and striga and anthracnose resistance for humid lowlands
5. Long duration OPVs with acceptable grain yield and anthracnose resistance for highlands
6. Intermediate maturing OPVs with acceptable grain yield, grain mold and anthracnose resistance for intermediate agro-ecologies with high rainfall

Hf f bmP ckfd j f:

To develop and promote improved sorghum technologies that enhances productivity, utilization and food security in humid lowland and intermediate agro-ecologies of Ethiopia

kfd JJ: Enhancing sorghum productivity, food and feed quality through genetic improvement and production management options in the dry lowlands of Ethiopia

kfd f j e ; July 2020 to June 2022

Bd j j 2; Evaluation of F2 for stay green and striga resistant gene intercrossed population

Bd j j f j e; July 2017 to June 2020

P ckfd j f; To evaluate and select intercrossed populations for gene stacking of stay green and striga resistant traits

S f jc rfi f ; Alemu T, Amare S, Taye T, Amare N, Adane G,

S f fe c ; Hailemariam Solomon

Zf b g f ; January - December 2019

T b gS f fb di h f ;

Ef jh ; Row Column

U fb f ; 51 generetions

M db j ; Mieso

S f m

A total of 51 F2 generations which captured stay-green and striga resistant traits were planted at Miesso in 2018 main season. From the previous population a total of 603 heads were selected from 51 F2 generations. These 603 selected heads will be planted next season as F3 for future selection.

rb g i f f fb ; Produced F3 generations will be evaluated over the target locations

Bd j j 3; Evaluation of Near Isogenic sorghum lines for Striga Resistance (Long Maturing)

Bd j j f j e; July 2017 to June 2020

P ckfd j f; To develop striga resistant version of the popular landraces and varieties through introgression striga resistant traits

S f jc rfi f ; Alemu T, Teklay A, Amare S, Sewmehon S and Daniel N

S f fe c ; Hailemariam Solomon

Zf b g f ; January - December 2019

T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 108 genotypes
M db j ; Sheraro and Fedis (HU)

S f m
A total of 108 sorghum genotypes were planted for field evaluation in row column arrangement. Genotypes were evaluated for the desired traits. Promising sorghum genotypes could be identified at both sites. Some of the derived NILs are better than their recurrent parent in terms of striga count and biomass.

Table1: List of some NIL of sorghum tested at Fedis and Sheraro

Fedis		Sheraro	
Genotype	GY kg/ha	Genotype	GY kg/ha
BC2F3_ETSC_17022	3000	BC2F3_ETSC_17014	1547
BC2F3_ETSC_17025	3007	BC2F3_ETSC_17096	1553
BC2F3_ETSC_17067	3023	BC2F3_ETSC_17063	1560
America-1	2040	BC2F3_ETSC_17013	1723
Jigurti	2210	Jamiyu	843
Jamiyu	2353	Framida	920
SRN39	1163	Jigurti	1073
Framida	1707	SRN39	1273
Birhan	840	Gobiye	1377
Gobiye	900	Birhan	2017
Local	703	Local	1233

rb g i f f fb ; Best performing genotypes in terms of striga resistance characteristics will be evaluated under NVT for further validation.

Bd j j 4; Evaluation of Near Isogenic sorghum lines for Striga Resistance (Early type)
Bd j j f j e; July 2017 to June 2020
P ckfd j f; To develop striga resistant version of the popular landraces and varieties through introgression striga resistant traits
S f jc rfi f ; Taye T, Teklay A, Amare S, Sewmehon S and Ligaba
S f fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 30 genotypes
M db j ; Humera, Sheraro, and Fedis

S f m
A total of 30 early matured sorghum genotypes were evaluated at three locations with three replications at each testing site. The combined mean values of early matured sorghum genotypes evaluated at two location revealed that except genotype BC2F3_ETSC_17107(1083 kg ha^{-1}) the remained genotypes showed poor performances.
rb g i f f fb ; Best performing genotypes in terms of stay green characteristics will be evaluated under NVT for further validation.

Bd j j 5; Evaluation of Near Isogenic sorghum lines for Drought Tolerant (Long Maturing)
Bd j j f j e; July 2017 to June 2020
P ckfd j f; To develop drought tolerant version of the popular landraces and varieties through introgression stay-green traits
S f jc rfi f ; Taye T, Teklay A, Amare S, Sewmehon S and Ligaba
S f fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019

T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 85 genotypes
M db j ; Miesso and Kobo

Sf m
A total of 85 long matured sorghum genotypes were evaluated at two locations within three replications. As indicated in table below some of the NILs are superior compared to their recurrent parent terms of grain yield because of the introgressed stay-green trait.

Table 2: list of some sorghum genotypes evaluated at Miesso

Genotype	DTF	DTM	PH	Yd (tone /ha)
America-1	78	155	249	2.61
B35	79	120	105	0.24
ETSC16120	77	155	254	3.02
ETSC16121	79	160	227	3.06
ETSC16123	83	154	236	4.08
ETSC16124	73	148	263	3.60
ETSC16130	77	152	241	3.54
ETSC16161	78	153	269	3.04
ETSC16162	77	152	260	2.48
ETSC16206	82	154	296	3.27
ETSC16207	72	151	280	0.82
Gorade-2	79	161	293	0.23
Hodem-1-3	82	141	231	3.91
Jamiyu	84	157	217	2.71
Jigurti	80	157	305	4.86
H b e U bm	**89**	**266**	**364**	**3/28**

rb g if f fb ; Best performing genotypes will be evaluated under NVT for further validation.

Bd j j 6; Evaluation of Near Isogenic sorghum lines for Drought Tolerant (Early Maturing)
Bd j j f j e; July 2017 to June 2020
Pckfd j f; To develop drought tolerant version of the popular landraces and varieties through introgression stay-green traits
Sf jcrfi f ; Taye T, Teklay A, Amare S, Sewmehon S and Daniel
Sf fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 70 genotype
M db j ; Miesso, Kobo and Sheraro

Sf m
A total of 70 genotypes were evaluated at different locations with three replications. Some of the performances of sorghum genotypes listed in the table below. Hence promising genotypes will advance to the next breeding step.
rb g if f fb ; Drought tolerant and promising sorghum genotypes will be advanced and evaluated

Bd j j 7; Crossing of advanced breeding lines and farmers' preferred landraces with lines conferring stay-green, Striga resistance and grain quality traits
Bd j j f j e; July 2017 to June 2020

Pckfd j f ;

- To incorporate stay-green, Striga resistance and grain quality traits into the genetic background of improved varieties, advanced breeding lines and existing landraces
- To develop early and medium maturing segregating populations conferring striga resistance, drought tolerant and grain quality traits

Sf jcrfi f ; Amare S, Taye T, Ligaba A, Daniel N., Hailemariam S., Kidanemariam W.

Sf fe c ; Hailemariam Solomon

Zfb g f ; January - December 2019

T b gSf fb di h f ;

Ef jh ; Row Column

U fb f ; 53 genotypes

M db j ; Melkassa

Sf m

A total of 53 parental lines which were selected based on their agronomic performance; pedigree history and gene of interest were used for crossing. Crossing has been conducted among 53 defined parental groups. About 220 F1 effective crosses have been made and among these effective crosses a total of about 2013 F1 crosses were advanced to F2. In order to enhance the genetic gain of sorghum genotypes the crossing scheme developed by considering the rule of thumb 80% crosses would be elite by elite.

rb g if f fb ; Effective cross F1 generation will be selfed and seed increased

Bdj j 8; Selfing F1 crosses to generate F2 populations

Bdj j f j e; July 2017 to June 2020

Pckfd j f; To maintain F1 seeds to be used for F2 grow out evaluation in main season

Sf jcrfi f ; Amare S, Taye T, Daniel N, Kidanemariam W. & Hailemariam S.

Sf fe c ; Hailemariam Solomon

Zfb g f ; January - December 2019

T b gSf fb di h f ;

Ef jh ; Row Column

U fb f ; 220 genotypes

M db j ; Melkassa & Werer

Sf m

To keep the genetic purity of the genotypes before anthesis the head was covered by paper bag and then by cloth bag to prevent from bird attack. Most of the time F1 seed increase is designed to speed up the pipeline development and to reduce the cycle of generation advancement. In product concept two (PC2) 220 effective crosses were made in the main season at Melkassa and F1 generation planted at Werer to advance the population to F2 generation.

rb g if f fb ; All lines will be tested and evaluated at their target location for the trait of interest

Bdj j 9; Evaluation of mutant populations for striga resistance

Bdj j f j e; July 2017 to June 2020

Pckfd j f; To generate genetic variability for the development of striga resistant/tolerant varieties

Sf jcrfi f ; Ligaba A, Hailemariam S & Daniel N.

Sf fe c ; Hailemariam Solomon

Zfb g f ; January - December 2019

T b gSf fb di h f ;

Ef jh ; Row Column
U fb f ; 36 genotypes
M db j ; Melkassa

Sf m
Two genotypes (Melkam and Degalit Yellow) were irradiated with 4 different radiation frequencies to create Striga resistance mutant lines. These 8 mutant populations were planted at Melkassa and evaluated for their seed germination and performance. Among 4 radiation frequencies 2 of them were found good and showed better performance and the rest were poor in stand establishment. Based on their performance on the field and their stand establishment genotypes irradiated with 300 level was found good. These will be evaluated in striga infested areas next season.
rb g if f fb ; Drought and promising sorghum genotypes will be advanced and evaluated

Bd j j : : Development of NAM populations for the dry lowland environment
Bd j j f j e ; July 2017 to June 2020
Pckfd j f ;
- To develop populations for mapping and dissecting complex traits
- To broaden and diversify the genetic bases of the breeding program

Sf jc rfi f ; Taye T, Amare N, Amare S, Chalachew E, Ligaba A & Daniel N
Sf fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gSf fb di h f ;
Ef jh ; Row Column
U fb f ; 3600 RILS within the NAM population
M db j ; Miesso and Melkassa

Sf m
Nested association mapping (NAM) is a technique used for identifying and dissecting the genetic architecture of complex traits as indicated in the objective of the trail. Hence, 18 diverse sorghum lines were selected as the parental line for NAM population in order to encompass the remarkable diversity of sorghum and preserve linkage disequilibrium. Each selected sorghum parental lines were crossed with sorghum genotype of Gambella 1107 which has been used as a reference line. The F1 plants were self-fertilized and advanced to F2 population. From F2 population about 2500 heads were selected to advance to F3 population.
In the main season of 2019 F3 sorghum population were planted at Miesso and from each crosses selection of heads completed. The selected heads from each family will be advanced to F4 generation. Then the Plan for the next year in the development of NAM population, it is expected that at the end of F6 generation to create a total of 200 homozygous recombinant inbred lines (RILs) per each family or crosses and finally a total of 3,600 RILs within the NAM population will be developed. At the end the developed population will be mapped and will have a significant contribution to broaden the genetic bases of sorghum breeding program.

Table 3: NAM population of sorghum genotypes

Plot#	Genotypes	Pedigree	# of head selected
1	ETSC17480	Gambella1107/Girana-1	232
2	ETSC17481	Gambella1107/Emahoy	128
3	ETSC17482	Gambella1107/ETSL 100026(K013)	132
4	ETSC17483	Gambella1107/IS9302	219
5	ETSC17484	Gambella1107/Melkam	141
6	ETSC17485	Gambella1107/NTJ-2	52
7	ETSC17486	Gambella1107/Degalit yellow (ETSL_101848)	163
8	ETSC17487	Gambella1107/Jamiyu (Red)	117
9	ETSC17488	Gambella1107/Jamuye(White)	151

10	ETSC17489	Gambella1107/Wetetbegunche	42
11	ETSC17490	Gambella1107/Muyra-1	221
12	ETSC17491	Gambella1107/Dabir	218
13	ETSC17492	Gambella1107/Jigurti	184
14	ETSC17493	Gambella1107/ETSL_100033 (Mt070)	59
15	ETSC17494	Gambella1107/IS 3830	44
16	ETSC17495	Gambella1107/ICSV 700	180
17	ETSC17496	Gambella1107/ETSC 30005 (2000 DSBM progeny#25)	79
18	ETSC17497	Gambella1107/PGRC/E Acc#69228	209
Total			2571

rb g i f f fb ; The developed sorghum population will be evaluated and genotyped

Bd j j 21: National sorghum hybrid trial
Bd j j f j e; July 2017 to June 2020
Pckfd j f; Identify stable and high yielding sorghum hybrids for drought prone areas of Ethiopia with at least 10% yield advantage over the improved check
S f jc rfi f ; Kidanemariam W., Tamirat B., Chalachew E., Amare S., Amare N. & Hailemariam S
S f fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 62 genotypes
M db j ; Kobo, Sheraro&Miesso

S f m

In total 62 advanced sorghum genotypes including checks were evaluated at different in row-column arrangement with two replications. The plot assize was 5m length with 0.75m between rows and 0.20m spacing between plants have been used. The whole agronomic practices have been applied as per the specific environmental recommendations. The total number of hybrid sorghum genotypes was evaluated along with the standard checks of ESH-4, ESH-5 and Argity at three different targeted sites. When we compare the tested sites, the maximum mean grain yield was obtained at Miesso (3764.45kg ha^{-1}) followed by Sheraro and Kobo with mean grain yield of 2969.14 kg ha^{-1} and 2440.45 kg ha^{-1}respectively. This elucidated that the tested hybrid sorghum genotypes showed better genetic performance at Miesso.

The predicted mean values of sorghum genotypes tested at Kobo revealed that two hybrid sorghum genotypes (ETSH19227 and ETSH19241) showed 10% yield advantage as compared to ESH-5 sorghum variety. However, 29 sorghum genotypes showed 10% yield advantage as compared to ESH-4 sorghum variety. Similarly, the predicted mean values of sorghum genotypes tested at Miesso revealed that none of the genotypes showed 10% yield advantages as compared to ESH-4 and ESH-5 sorghum hybrid varieties.

Sorghum genotypes tested at Sheraro; the predicted mean values revealed that eight sorghum genotypes showed 10% yield advantage as compared to ESH-4 sorghum variety. However, there were no any sorghum genotypes showed 10% yield advantage as compared to ESH-5 variety.

Based on the result obtained at three different locations the number of sorghum genotypes showed 10% yield advantage varies for each location and hence it will be advisable to compute combined analysis for three locations. Depending on the result obtained from combined analysis and the previous data for the locations stability and performance genotypes will be identified for the final identification of sorghum genotypes to precede to the next breeding step.

Table 4: List of superior hybrid sorghum genotypes based on predicted mean values in 2019

		Kobo		Miesso		Sheraro	
No	Genotype	Predicted. Value	Standard. Error	Predicted. Value	Standard. Error	Predicted. Value	Standard. Error
1	ETSH19240	3054.91	327.58	3925.01	144.67	3151.54	155.97
2	ETSH19261	3063.21	323.53	3927.06	143.84	3154.67	154.1
3	ETSH19250	3119.41	324.22	3940.98	143.95	3175.83	154.39
4	ETSH19269	3209.55	323.17	3963.3	143.81	3209.78	154.12
5	ETSH19226	3247.37	324.49	3972.66	144.02	3224.02	154.57
6	ETSH19227	3374.68	325.35	4004.19	144.11	3271.96	154.75
7	ETSH19241	3695.76	323.73	4083.69	143.89	3392.86	154.11
8	Argity	1556.41	323.47	3553.97	143.8	2587.26	154.1
9	ESH-4	2207.51	325.1	3715.19	143.99	2832.45	154.51
10	ESH-5	3046.25	323.39	3922.86	143.85	3148.28	154.08

rb g i f f fb ; Replicated one more year

Bd j j 22; Early Maturing Sorghum National Variety Trial
Bd j j f j e; July 2017 to June 2020
P ckfd j f: To develop sorghum varieties for high & stable grain yield and biomass performance with at least 10% yield advantage over the improved check
S f jc rfi f ; Amare S, TamiratB, Kidanemaryam W, Tadese A, Hailegebriel, Shumet.
S f fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 100 early maturing genotypes
M db j ; Mieso, Kobo, Sheraro, Erer, Shewarobit, Jinka and Arbaminch

S f m
Early maturing sorghum genotypes advanced form PYT were evaluated at different locations which represents the dry lowlands of the regions. In total,100 sorghum genotypes were evaluated at six locations using row-column arrangement with two replications. Combined predicted mean values of sorghum genotypes revealed that seven genotypes (ETSC14697-1-2, ETSC14252-3-2, ETSC14789-3-2, ETSC15312-3-1, ETSC14020-1-1, ETSC15438-4-1 and ETSC14793-5-1) showed more than 10 % yield advantage as compared to Melkam variety. Similarly, four genotypes (ETSC15312-3-1, ETSC14020-1-1, ETSC15438-4-1 and ETSC14793-5-1) showed more than 10% yield advantage as compared to Argity variety.
rb g i f f fb ; Replicated one more year

Bd j j 23; Early maturing preliminary yield trial _PYT
Bd j j f j e; July 2017 to June 2020
P ckfd j f; To evaluate, identify and advance early maturing sorghum genotypes which are better than the checks in terms of yield, drought tolerance and striga resistance.
S f jc rfi f ; Amare N., Amare S., Kidanemaryam W., Taye T., Chalachew E, Tadesse A, Hailegebriel
S f fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 500 eraly maturing genotypes
M db j ; Miesso, Sheraro& Kobo

S f m
A total of 500 sorghum genotypes advanced from pedigree lines (F5s) were used to constitute this trial. 33% were partially replicated in each location constituting 680 plots

including three checks which made nearly full replicated across the three locations. The genotypes were planted in the row-column arrangements.
The predicted mean values of sorghum genotypes tested at Sheraro revealed that the maximum grain yield was 2194.52 kg ha-1 (ETSC16011-2-1) and the minimum was 151.13kg ha-1 for sorghum genotype ETSC16072-20-1. From the total tested sorghum genotypes 205 genotypes had below 10 Qu per hectare and the remained sorghum genotypes had below 21 Qu per hectare. The main reason, for poor performances of genotypes was mismanagement of the trial.

Based on the predicated mean values of sorghum genotypes tested at Kobo the minimum and maximum grain yield were 938.61 kg ha-1 and 2396.19 kg ha-1 respectively. The performance of sorghum genotypes in terms of grain yield were poor because of unpredictable weather condition of the season that caused limitation of rain fall at the time of the trial conducted at Kobo.
Similarly, preliminary yield trial of sorghum genotypes was evaluated at Miesso and hence the predicated mean values revealed that the maximum grain yield (35.85 kg ha-1) was recorded for sorghum genotype ETSC16011-2-1. However, when we compare this genotype with the checks of Melkam, Argiti and Tilahun the yield variation was 186 kg ha-1, 236 kg ha-1 and 292 kg ha-1 respectively.
In general, from the total sorghum genotypes evaluated at three different locations about 76 sorghum genotypes showed better grain yield as compared to the check of Melkam variety. So that based on the predicted mean values of the grain yield, overall plant aspect, earliness and biomass, these genotypes will be advance to the next breeding steps (NVT).
From each plot a single head were selected to advance to the next breeding program. Samples from each sorghum genotypes were also collected for the purpose of characterization of quantitative and qualitative physical grain properties like kernel color, size, shape, grain hardness, endosperm, texture etc. At the same time profiling of the chemical composition of the grain using NIR which is basically include protein content, amylose, amylo-pectin, iron, zinc, ash, tannin content etc.
rb g i f f fb ; advanced to NVT for further evaluation over year and location

Bd j j 25; Segregation Generations Selection (F2-F4)
Bd j j f j e; July 2017 to June 2020
Pckfd j f ;

- To evaluate, select and advance early types of sorghum segregating generations for drought tolerance and striga resistance traits
- To evaluate, select and advance high yielding and high biomass producing segregating generations with landrace backgrounds

S f jcmfi f ; Amare S., Amare N, Daniel N, Tadese A, Muluberhan, Hailegebriel
S f fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 3502 generetions
M db j ; Miesso, Kobo, Humera and Sheraro

S f m
Evaluation and selection of F sorghum populations at different locations were conducted and advanced to the next segregation population. Basically, there were four different stages of F2 to F4 segregating generations and hence the developed population were evaluated and selected based on the stated objective indicated above. Brief description of the generation advancement indicated in table xxx and hence promising lines or heads were selected and advanced to the next breeding step.

Table 5: Sorghum generation advancement and number of heads selected

No	Activity Name	# of genotype planted	# of heads selected	Advanced to
1	Early maturing F2 population selection (two sets)	273	3000	F3
2	F4 generation advance for early and medium types (offseason)	1200	800	F5
3	F3 families for drought and grain (2 Sets)	1283	800	F4
4	Evaluation and selection of early maturing F3 sorghum families for striga resistance	746	600	F4
Total		3502	5600	

rıb g i f f fb ; advanced to the next filial generation and selected based on trait of interest

Bd j j 26; Pheno typing of early type sorghum genotypes selected based on root angle under moisture stressed and non-stressed conditions
Bd j j f j e; July 2017 to June 2020
P ckfd j f ;

- To characterize early maturing sorghum genotypes under moisture stress and non-stress condition
- To evaluate the effect of root angle for drought tolerance
- To quantify the correlation of sorghum root angle with yield and yield components

S f jc rıfi f ; Chalachew, Frezer, Daniel N.
S f fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gS f fb di h f
Ef jh ; Row Column
U fb f ; 23genotypes
M db j ;Mieso, Kobo and Sheraro

S f m

In total 23 early maturing sorghum genotypes which were selected based on root angle data planted at respected sites using RCBD design with row-column arrangement in 2 replications. These genotypes showed 13.0-26.75-degree root angle variation. Root angle revealed positive correlation with grain yield, grain filling rate and thousand grain weights. The results also showed that the importance selecting moderate to wider root angle for drought tolerance of sorghum as it enhances lateral water absorption of roots.

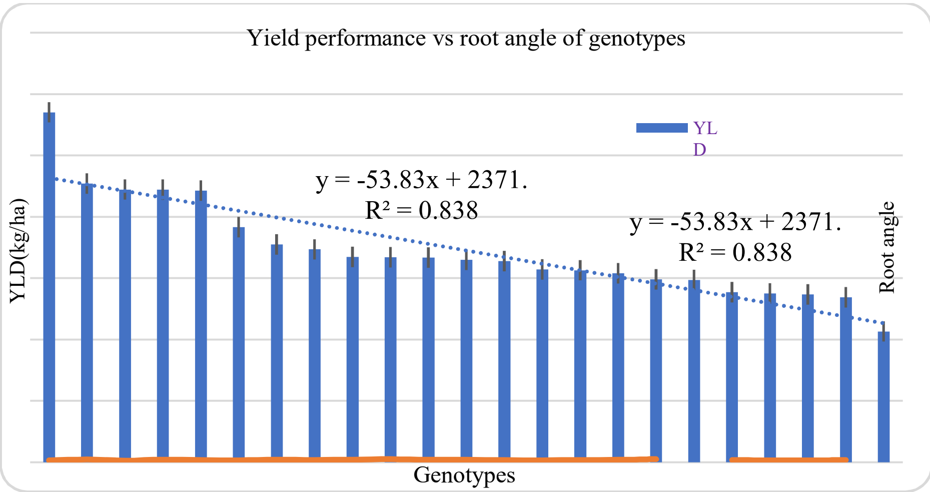


Fig. Yield performance of sorghum genotypes versus to root angle of sorghum genotypes
rıb g i f f fb ; Replicated one more year

Bd j j 27; Medium maturing sorghum preliminary variety trial
Bd j j f j e; July 2017 to June 2020
P ckfd j f; To develop medium maturing group high yielding sorghum varieties for the dry lowland environments
S f jc rfi f ; Hailemariam S, Taye T, Chalachew E, Hailegebriel, Solomon M
S f fe c ; Hailemariam Solomon
Zf b g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 135 genotypes
M db j ; Sirinka and Sheraro

S f m

A total of 135 genotypes advanced from long maturing by early maturing crosses were evaluated in the target sites. The trial was arranged in row-column arrangement with two reps. The data from Sheraro showed that there are promising varieties better in plant biomass & early flowering time. From the total tested genotypes about 16 genotypes were found better than the recent released check (Argity).

Table 6: Grain yield and other trait of medium maturing sorghum genotypes

Genotypes	Pedigree	YLD(Qt/ha)	DTF	PHT	PAS
ETSC14673-2-1	America-1/13sudanint#14	34.1	78.3	296.1	3.5
ETSC14298-2	Baduqane/2372	30.4	75.5	248	3
ETSC14688-7	AbaAre-1/13sudanint#27	29.4	73	266	2
ETSC14295-1	Berjokecoll#1/2372	27.2	75	229	2
ETSC14425-8-1	Baduqane/Meko	27.1	76.5	267	3
ETSC14674-2	Baduqane/13sudanint#14	26.8	74.8	267.6	2
ETSC14418-8	Jamiyu/Meko	26.5	73.8	269.8	1.5
ETSC14425-7-1	Baduqane/Meko	26.2	75.5	229.3	2.5
ETSC14655-1-1	Berjokecoll#1/13sudanint#13-2	26.1	73.5	276.3	2
ETSC14290-3-2	Gorade-2/2372	26	76.5	306.8	3
ETSC14616-6-1	Jigurti/13sudanint#10-1	25.8	72.5	244.3	3.5
ETSC14671-2	Berjokecoll#1/13sudanint#14	25.7	77.5	309.5	2.5
ETSC14256-4	Jigurti/S35	25.4	75.5	283.5	3.5
ETSC14418-6-2	Jamiyu/Meko	25.2	75.5	259.8	3
ETSC14290-3-1	Gorade-2/2372	24.9	77.3	273.8	2.8
ETSC14616-9-2	Jigurti/13sudanint#10-1	24.5	73.5	293.8	2.5
Argity	WSV387/P9403	22	72.5	223.5	2

rb g i f f fb ; These genotypes will be evaluated along with the early maturing NVT in next season.

Bd j j 28: Early maturing sorghum variety verification trial
Bd j j f j e; July 2017 to June 2020
P ckfd j f; To verify high yielding and drought tolerant sorghum varieties for production with at least 10% yield advantage over the improved check.
S f jc rfi f ; Amare S, and Chalachew E., Solomon,Fuad A, HailegebrielAmare N
S f fe c ; Hailemariam Solomon
Zf b g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; No
U fb f ; 4 genotypes
M db j ; Miesso, Kobo, Erer, Sheraro, Shewarobit.

S f m

The trial includes 4 genotypes (3 candidates and 1 Check). This trial was planted on 10mx10m plot in each of proposed sites one on station and two on-farms. The trial was not evaluated by the NVRC due to the pattern and distribution of rain fall of the season was good and hence it was not the right season to evaluate these candidate varieties.

rb g if f fb ; These genotypes will be evaluated along with the early maturing NVT in next season.

Bd j j 29: Striga resistant sorghum variety verification trial
Bd j j f j e; July 2017 to June 2020
P ckfd j f; To verify high yielding and striga resistant sorghum varieties for production with at least 10% yield advantage over the improved check
S f jc rfi f ; Amare S, Muluberhan, Hailegebriel, Fuad A, Tadesse A
S f fe c ; Hailemariam Solomon
Zf b g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f : 4 varieties
M db j ; Humera, Erer, Kobo, Sheraro and Fedis

Sf m

This trial was planted on 10mx10m plot in each of proposed sites one on station and two on-farm sites. The ccandidate sorghum variety of 05MW6073 was found better in YLD followed by ETSC300003. In general, all the candidates were found better than the check in their YLD. However, the trail was not evaluated by TNVRC and hence it will be conducted in 2020 crop season.

rb g if f fb ; will be conducted in 2020 crop season.

Bd j j 2: : Stay green introgressed sorghum national variety trial
Bd j j f j e; July 2018 to June 2019
P ckfd j f; to develop high yielding stay-green introgressed sorghum variety for drought prone areas.
S f jc rfi f ; Chalachew E, Taye T, Amare N & Amare S, Tadesse A, Fuad A, Hailegebriel
S f fe c ; Hailemariam Solomon
Zf b g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 55 genotypes
M db j ;Meiso, Kobo, Erer&Sheraro

Sf m

In total, 55 sorghum genotypes were laid in row-column arrangement with two replications. Based on the predicted mean value from more than 6 locations top three genotypes have been identified and proposed for VVT.

Table 7: Predicted mean values of sty green introgressed sorghum genotypes

Hf f	fejd fe bmf	T b eb e f	S b l	Db ejeb f
3512	4.725	0.383	1	1st
3462	4.617	0.389	2	2nd
36: 8	4.556	0.382	3	3rd
3394	4.541	0.383	4	
35: 5	4.332	0.383	5	
3749	4.31	0.381	6	
3616	4.27	0.382	7	
3731	4.24	0.382	8	
3611	4.234	0.382	9	
T46	4.093	0.385	11	
N frhb	3.462	0.382	27	Check
C46	1.322	0.387	55	Check

Bd j j 31; Breeder and pre-basic seed multiplication

Bd j j f j e; July 2017 to June 2020
P ckfd j f: To multiply quality seed of the improved dry lowland sorghum varieties.
S f jc rfi f ; Hailemariam S and Chalachew W.
S f fe c ; Hailemariam Solomon
Zf b g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 11 varities
M db j ; Melkassa, Mehoni and Werer
S f m
Breeder and pre-basic seeds of 11 sorghum varieties were produced. A total of 3.73 qt and 212 qt of sorghum breeder and pre basic seed produced respectively.
Of Zfb rb ;

Bd j j 32; Maintenance and seed increase of selected genotypes for PYT & NVT
Bd j j f j e; July 2018 to June 2020
P ckfd j f; To maintain and increase seeds of advanced breeding lines to be used for next season field evaluation for the respective trials
S f jc rfi f ; Chalachew E, Kidanemaryam W., Daniel N.
S f fe c ; Hailemariam Solomon
Zf b g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 120 genotypes
M db j ; Melkassa and Werer

S f m
Advanced entries for NVT (~120) and F5 lines for PYT (~800) seeds will be multiplied. The seeds of these genotypes have already planted at Werer in this offseason. More than 600 genotypes seeds willbe increased and maintained using off-season for next season NVT and PYT trial.
Of Zfb rb ;

Bd j j 33; Test cross development for hybrid evaluation of preliminary sorghum hybrid trial (PSH)
Bd j j f j e; July 2017 to June 2019
P ckfd j f; To develop test cross hybrids for PSH multi environment evaluation
S f jc rfi f ; Amare S, Taye T, Amare N, Adane G,
S f fe c ; Hailemariam Solomon
Zf b g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 236 F1 test cross hybrid
M db j ; Melkassa and Werer

S f m
It was designed to develop F1 hybrids to be evaluated as preliminary hybrid trial and hence a total of 90 male parents derived from advanced breeding used as pollen parents were crossed with three female parents (ATX623, ICSA21 and MARC2A). In this trial 236 F1 test cross hybrids were developed in 2010 main season and fertile hybrids evaluated at dry lowland areas in 2011 main season.
rb g i f f fb ; Promising lines will be advanced and evaluated.

Bd j j 34;Test cross development for hybrid evaluation of national sorghum hybrid trial (NSHT)
Bd j j f j e; July 2018 to June 2020
P ckfd j f; To develop test cross hybrids of NSHT for multi environment evaluation
S f jcrfi f ; Tamirat B., Amare S, Alemu T., Daniel N.
S f fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 68 F1 hybrids
M db j ; Melkassa and Werer

S f m
A total of 68 lines used as pollen parents (Rlines) from advanced breeding lines were crossed with10 female parents (ATX623, ICSA10, ICSA21, ICSA34, ICSA88006, MARC1A, MARC2A, MARC4A, MARC5A and MAR62A). In 2010 main season 68 F1 hybrids were developed at Melkassa. The test crosses will be used for performance evaluation of sorghum hybrids across locations.
rb g i f f fb ; Promising lines will be advanced and evaluated.

Bd j j 35; Preliminary Sorghum Hybrid Trial (PHT)
Bd j j f j e; July 2017 to June 2020
P ckfd j f; to evaluate the performance and identify high yielding and stable sorghum hybrids in dry lowland areas
S f jcrfi f ; Tamirat B., Amare S, Amare Nega., Taye T, Ligaba A.
S f fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 68 hybrids
M db j ; Miesso and Kobo
S f m; A total of 68 hybrids along with standard check were evaluated. The mean grain yield performances of 41 genotypes were higher than standard check. So, based on sterility reaction and grain yield performance 41 hybrid entries have been selected and will be advanced to HNVT.
rb g i f f fb ; Promising lines will be advanced and evaluated.

Bd j j 36; National Sorghum Hybrid Trial (NHT)
Objective: Identify stable and high yielding sorghum hybrids for drought prone areas of Ethiopia with at least 10% yield advantage over the improved check
Bd j j f j e; July 2017 to June 2020
S f jcrfi f ; Tamirat B., Amare S, Amare Nega., Taye T, Ligaba A.
S f fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 83 hybrids
M db j ; Kobo, Sheraro, Shewarobit, Erer, Arbaminch

S f m
A total of 83 hybrid entries were evaluated along with the standard check ESH-4 at the target sites. The predicted mean value showed that hybrid sorghum genotypes of TX623A/ETSL 100134 and TX623A/PRL984182 had better grain yield performance as compared to others.

The location genetic correlation showed that Arbamminch and showarobit had positive correlation and the same was true for Kobo and Sheraro locations.

rb g i f f fb ; Promising lines will be evaluated for one more year.

Bd j j 37; Combining ability study of sorghum hybrid seed parent
Bd j j f j e; July 2018 to June 2020
P ckfd j f: to investigate the magnitude of heterosis and combining ability of sorghum inbred lines
S f jc rfi f ; Temesgen B. Taye T., Amare S,
S f fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 41 hybrids
M db j ; Miesso and Kobo

S f m

A total of 41 hybrids with standard check ESH-4 were planted using 2 rows and 2 replications. Detailed combining analysis will be conducted to identify best combiner for future breeding work. These genotypes will be advanced to HNVT.

Table: 8. Combining ability study of sorghum hybrid seed parent

	DTF		PHT		GLD	
Hf f	**L c**	**N jf**	**L c**	**N jf**	**L c**	**N jf**
TX-623A X ICSR-14	72.50	67.50	176.17	189.80	8071.43	3689.33
ESH-4	69.50	66.50	123.33	126.00	5928.57	3610.00
P-9534A X Melkam	71.50	66.50	194.33	176.20	9428.57	3204.67
MARC6A X ICSR-14	74.00	68.00	281.83	221.00	5928.57	3196.67
A6 X ICSR-14	73.00	69.50	185.00	176.20	8928.57	2911.33
MARC1A X ICSR-14	71.50	68.50	293.50	236.60	8000.00	2741.33
MARC1A X Melkam	72.00	68.00	289.33	233.20	8285.71	2740.00
MARC2A X Melkam	76.50	70.00	302.33	248.20	5857.14	2646.00
A5 X Melkam	73.00	67.50	216.33	197.60	7928.57	2562.67
TX-623A X Melkam	75.00	68.50	209.83	183.80	8142.86	2514.00
P-850341A X ICSR-14	71.50	68.00	225.00	195.00	8642.86	2504.67
P-850341A X Melkam	73.00	69.00	198.00	194.80	7642.86	2484.67
MARC6A X Melkam	74.50	68.50	268.00	236.60	7285.71	2480.00
MARC3A X Melkam	74.50	66.50	285.50	229.40	8000.00	2288.00
P-851015A X ICSR-14	72.50	69.50	224.00	201.80	7642.86	2241.33
MARC2A X ICSR-14	74.00	69.00	307.33	230.80	6714.29	2223.33
A6 X Melkam	72.50	66.50	201.67	173.80	7142.86	2216.00
N fb	**84/34**	**79/26**	**312/::**	**291/25**	**7656/: 3**	**3135/94**

rb g i f f fb ; will be evaluated one more year

Bd j j 38; Conversion of locally adapted B line for hybrid development
Bd j j f j e; July 2018 to June 2020
P ckfd j f; To develop land race-based seed parent for the hybrid breeding from the identified B lines of landrace collections
S f jc rfi f ; Ligaba A., Daniel N. and Tamirat B., Alemu T.
S f fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U fb f ; 41 lines
M db j ;Melkassa and Werer

S f m

The 4 locally adapted genotypes which were identified as B lines were crossed with TX623A and the F1 produced in 2008 off-season nursery. The F1 were crossed with the 4 recurrent parents to generate BC1F1 in 2009 main season. Previously 16 BC2F1 effective crosses were obtained. In next season 13 BC3F1 generations will be used to generate BC4F1 lines. The process will continue until BC4F1 stage.

rb g i f f fb ; Promising lines will be advanced and evaluated

kf d JJJ; Development and Promotion of Improved Sorghum Varieties and Management Options for the Humid Lowland, and Intermediate Agro-ecologies of Ethiopia

Hf f bmP ckf d j f; To develop and promote improved sorghum technologies that enhance productivity, utilization and food security in humid lowland and intermediate agro-ecologies of Ethiopia

Bd j j 2. Crossing improved sorghum varieties and advanced breeding lines with best performing landraces

Bd j j f j e; July 2018 to June 2020

P ckf d j f; To develop segregating generation for striga and anthracnose resistance with acceptable grain yield

S f jc rfi f ; Amare S, Adane GY, Tokuma L & Daniel N

S f fe c ; Hailemariam Solomon

Zf b g f ; January - December 2019

T b gS f fb di h f ;

Ef jh ; Row Column

U fb f ; 41 **d f**

M db j ; Melkassa

S f m

A total of 74 effective cross has been done and F-1 seed increase will be cared out in this off season.

rb g i f f fb ; F1 effective crosses will be maintained.

Bd j j 3; Introgression of striga (LGS) resistance gene in to farmers preferred sorghum varieties adapted to humid lowland and intermediate agro-ecologies (21-13-02)

Bd j j f j e; July 2018 to June 2020

P ckf d j f ; To introgressLGS resistant genes into farmers preferred sorghum genotypes using marker assisted selection

S f jc rfi f ; Amare S, Adane GY, Tokuma L & Daniel N

S f fe c ; Hailemariam Solomon

Zf b g f ; Jan January - December 2019

T b gS f fb di h f ;

Ef jh ; Row Column

U fb f ; 9

M db j ; Melkassa

S f m

The F1 seed increase has been done and F2 population will be planted along with the recurrent parent. The introgression will be conducted in this off season. MAS and bioassay will be used.

rb g i f f fb ; Promising lines will be advanced and evaluated.

Bd j j 4: Introgression of anthracnose resistance gene in to farmers preferred sorghum varieties adapted to humid lowland and intermediate agro-ecologies (21-13-03)

Bd j j f j e; July 2018 to June 2020

Pckfd j f ; To introgress Anthracnose resistant genes into farmers preferred sorghum genotypes using marker assisted selection
Sf jcrfi f ; Amare S, Adane G., Tokuma L & Daniel N
Sf fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gSf fb di h f ;
Ef jh ; Row Column
U fb f ; 9 varities
M db j ;Melkassa

Sf m
The F1 seed increase has been done and F2 population will be planted along with the recurrent parent. The introgression will be conducted in this off season and hence MAS will be used conducted.

Table 9: List of sorghum donor and recurrent parental lines

	Donor Parent		
Female Parent	PML 981475	ETSL 100346	PML981342
Adukara	XX	XX	XX
Assosa-1	XX	XX	XX
07MW6085	XX	XX	XX
BF082	XX	XX	XX
SI081	XX	XX	XX
Bobe red -2	XX	XX	XX
Bobe white	XX	XX	XX

rb g if f fb ; Promising lines will be advanced and evaluated.

Bdj j jrfi 5.9; Evaluation and selection of segregating generation
Bdj j f j e; July 2018 to June 2020
Pckfd j f; To advance segregating lines conferring genes for important agronomic traits
Sf jcrfi f ; Amare S, Adane GY, Tokuma L & Daniel N
Sf fe c ; Hailemariam Solomon
Zfb g f ; January - December 2019
T b gSf fb di h f ;
Ef jh ; Row Column
U fb f ; 9 lines
M db j ; Melkassa

Sf m
T b g f fb di h f
For BC1F1 screening for anthracnose 10 heads per plot were selected to advance to BC1F2 Population. For Humid lowland F1 seed increase will be conducted to generate F2 population. For evaluation and selection of humid lowland F2 sorghum population 809 heads selected to advance to F3 families. At the same time evaluation & selection of humid lowland F3 sorghum families for grain and leaf disease resistance 130 heads selected to advance to F4 population. For the activity of evaluation & selection of humid lowland F4 sorghum Lines for grain and leaf disease resistance 96 heads were selected to advance o PYT.

Table10: List of activities and advanced generation of sorghum genotypes

No	Activity title	Project Code	Location	Duration	#of Popns tested	# of Heads selected	Advanced to
1	BC1F1 screening for anthracnose	(21-13-04)	Bako	1 year	24	10h/plot	BC1F2 Pop.
2	Humid lowland F1 seed increase	(21-13-05)	MARC	1 year	63	63	F2 Population
3	Evaluation and selection of humid lowland F2 sorghum population	(21-13-07)	Assosa & Jima	1 year			

U fb f ; 72 sorghum landraces
M db j ; Jimma and Asosa

S f m

Analysis of variance revealed highly significant (P≤ 0.01) variation for most of the traits tested except disease reaction which showed significant (P≤ 0.05) variation among sorghum landraces at Assosa condition (Table 3). The variation observed for yield and other agronomic traits signifies the presence of sufficient opportunity to improve sorghum landraces through selection. Thirty promising genotypes were advanced to national variety trial primarily based on their performance of grain yield and plant agronomic aspect. At Pawe highly significant (P≤ 0.01) variation were observed among genotypes for all the tested traits. From 72 tested sorghum landraces 22 high yielder landraces were advanced and from these selections ten of the landraces were performed under both locations whereas 12 landraces best perform under Pawe condition only which shows specific adaptation.

Zfb g f ; January - December 2019
T b gSf fb di h f ;
Ef jh ; Row Column
U fb f ; 9 lines
M db j ; Bako, Jimma & Pawe

Sf m
Analysis of variance revealed highly significant (P≤ 0.01) variation for all of the traits tested including grain yield among sorghum lines at Bako condition (Table 9). The variation observed for yield and other agronomic traits signifies the presence of sufficient opportunity to improve sorghum lines through selection. The minimum and maximum yield performance of sorghum lines recorded 604.6 kg/ha and 4449.5 kg/ha for genotypes ETSC_120032 and ETSC_120053-1, respectively with the average value of 2632.7 kg/ha. Moreover, genotypes ETSL 100644, ETSC_120033-1 and ETSC_10022-34-2 revealed superior agronomic and yield performances.
rb g i f f fb ; Promising lines will be advanced and evaluated.

Bd j j 23; Phenotyping of Ethiopian sorghum germplasms for anthracnose resistance
Bd j j f j e; July, 2010-June, 2012 E.C
P ckfd j f; To identify sorghum genotypes resistant to sorghum anthracnose
Sf jc rfi f ; Abebe G, Amare S, Firezer G, Tokuma L & Nesriya
Sf fe c ; Abebe Gezahegn
Zfb g f ; January - December 2019
T b g i f h f ;
Ef jh ; Single Plot in two replications
U fb f ; Field screening of 270 sorghum genotypes
M db j ; Assosa and Jimma

Sf m
In 2018, Ten (10) genotypes from Jimma and 103 genotypes from Assosa showed moderately resistant reaction (<5 mean severity) to Anthracnose. In 2019, 81 genotypes from Jimma and 41 genotypes from Assosa showed moderately resistant reaction. Out of which six genotypes (ETSL100092, ETSL100261, ETSL101433, ETSL102001, ETSL102005 and ETSL102016) were also found in 2018 list.
rb g i f f fb ; . Promising lines will be advanced and evaluated

Bd j j 24; Evaluation of genotypes (leaf detach) against sorghum anthracnose
Bd j j f j e; July 2018-May 2020
P ckfd j f; To exercise DLA and rapidly screen sorghum genotypes resistant to sorghum anthracnose
Sf jc rfi f ; Abebe G., Getachew A., Yitayih G., Endrias G/K, and MARCSorghum team
Sf fe c ; Abebe Gezahegn
Zfb g f ; January 1, 2018 – December 31, 2019
T b g i f h f ;
Ef jh ; Single plot
U fb f ; screening of 270 sorghum genotypes using DLA
M db j ; MARC pathology laboratory

S f m

We try to exercise the Detached Leaf Assay as indicate in figure 1.

Figure 1: Exercised leaf inoculation

After optimization of DLA for sorghum anthracnose we screened the 270 sorghum genotypes which were screened at field condition. Regarding the reproducibility of the method; the data showed the reproducibility of the DLA.

rh g i f f fb ;will be evaluated next year

Bd j j 25; Crossing of sorghum for development of high yielding varieties & lines resistant to major leaf & grain diseases

Bd j j f j e; July 2018 to June 2020

Objective:

S f jc rfi f ; Meron B, Hailemraiam S, Zigale S, Tokuma L, KidanemariamW, AmareS & Daniel N

S f fe c ; Zigale Semahegn

Zfb g f ; January - December 2019

T b gS f fb di h f ;

Ef jh ; Row Column

U fb f ; 31 crosses

M db j ; Melkassa

S f m

Crossing was designed targeting the product development of disease resistance, grain quality and yielding varieties for the highland environments of Ethiopia. In the cropping season 17 genotypes advanced from the breeding program, released varieties (to add additional traits lacking from the improved varieties) were used as parental line to make F1 crosses (Table 1). A total of 31 effective crosses of anthracnose resistance and grain quality into advance breeding lines were done in 2019 main season.

Table 11. Group of parental lines used for crossing in 2019 season

Group	Desirable trait	Number of genotypes	Parent type
G-I	Anthracnose and grain mold resistance	2	Male
G-II	Grain yield and overall plant aspect	4	Male
G-III	Grain quality & seed weight	2	Male
G-IV	Advanced breeding lines	9	Female
Total number of genotypes used		17	

rh g i f f fb ; For the next main season produced F1 generations will be selfed and increased for future breeding stage.

Bd j j 26; Seed increase, evaluation and selection segregating generations for highland environment (F1-F3)
Bd j j f j e; 2017-2019
P ckfd j f;
f f jc rfi; Zigale S, Alemu T, Temesgen T, Kidanemariam W, Daniel N, Ligaba A, Meron B &Teshome
S f fe c ; Zigale Semahegn
Zf b g f ; January - December 2019
Ef jh ; Row Column
U f b f ; 473 high land sorghum
M db j ; Negele Arsi and Melkassa

S f m

In the 2019 crop season, 473 populations from F1 to F3 stages were planted in the target environment and 421 heads were selected based on visual evaluation for the targeted traits (Table 2). The number of populations tested and selected heads for subsequent evaluation is indicated in Table 2.

Table 12: Number of populations grown and selected heads at different testing sites

Testing site	Generation	Number of populations	
		tested	Selected heads
Melkassa	F1	52	52
Arsi-Negele	F2	38	60
Arsi-Negele and Haramaya university	F3	383	117
Total		473	229

rb g i f f f b ; For the next main season each selected generation will be evaluated at the target environment.

Bd j j 27; Highland Sorghum National Variety Trial
Bd j j f j e; July 2017 to June 2020
S f jc rfi f ; Temesgen T., Zigale S., Firezer G., KidanemaryamW., Alemenesh B., Diriba T.,
S f fe c ; Zigale Semahegn
Zf b g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; Row Column
U f b f ; 52 varities
M db j ; Haramaya University, Kulumsa, Arsi-Negele and Hirna

S f m

A sorghum national variety trial containing 52 varieties along with the standard checks was evaluated at Haramaya University, Kulumsa, Arsi-Negele and Hirna during 2018 and 2019 main season. Specific and combined analysis was conducted to separate the genotypes using spatial analysis in R software. The overall mean performance of the fifty-two genotypes along with the three standard checks for days to flowering, plant height and grain yield evaluated at Arsi-Negele, Hirna, Haramaya University and Kulumsa is presented in Table 3. The mean days to flowering, plant height and grain yield performance of tested genotypes across testing locations ranged from 126.2 to 145.9 days, 283.9 to 376.7 cm and2252.6 to 5355.1 kg/ha, respectively. Genotype had ETSC11013-1 superior grain yield at Hirna during 2018 main season, while lower at Hirna during 2019 main season. This shows that the performance of evaluated genotypes changed from single location to another. In terms of grain yield, any genotype was not yielder than the standard check jiru (Table 3). Therefore, there is no any candidate genotype to be advanced as VVT due to poor performance as compared to the checks.

rb g i f f fb ;Best performed hybrids will be evaluated in 2020 main season

F f bm G efe S f fb di kfd

kfd j rfi; Harnessing Opportunities for Productivity Enhancement (HOPE) of Sorghum and Millets in sub-Saharan Africa-Phase 2

kfd f j e; July 2016 - June 2020

Bd j j 2/ Stay green introgressed sorghum national variety trial

Bd j j f j e; June 2017 to June 2020

P ckfd j f; To develop high yielding stay green variety for drought prone areas.

f f jc rfi; Chalachew Endalamaw, Taye Tadesse, Amare Nega and Amare Seyoum

S f fe c ; Chalachew Endalamaw

Zfb g f ; January - December 2019

T b g i f h f

Ef jh ; Randomized Complete Block Design with row column arrangement

U fb f ; 57 early maturing advanced sorghum genotypes and one sorghum released variety (Melkam) as a standard check were used

M db j ; Kobo, Sheraro and Miesso

S f m

The trial was conducted using Randomized Complete Block Design with row column arrangement and three replications. The candidate variety were evaluated along improved sorghum variety Melkam as a standard check and exhibited better yield advantage and earlier in days to flowering as it has been reflected by the superiority in drought prone areas. Hence, Candidate 1 variety 2401 had 24.8%, the candidate 2 variety 2351 had 23.7%, and Candidate 3 had 17.2% earlier in days to flowering in addition to the grain yield advantage in comparison to the recently nationally released standard check variety Melkam. In the 2017 to 2020 crop season, this national variety trial containing 57 genotypes including two improved sorghum varieties Melkam and stay green line B35 as a standard check were evaluated in three locations (Kobo, Sheraro&Miesso). Based on the grain yield and stability of performances across environments, earliness of days to flowering and total biomass production, three candidate varieties were selected for further verification, on station as well as on farm for developing high yielding stay green variety for drought prone areas. The yield advantage of the candidate varieties exceeded by 10 to 17 % the improved check variety, Melkam.

rb g i f f fb ; Based on the predicted mean value from 6 locations top three genotypes have been identified and proposed for VVT. Activity has been initiated to verify.

Bd j j 3; Variety verification trial of stay-green introgressed sorghum genotypes

Bd j j f j e; June 2019 to June 2020

P ckfd j f; To develop high yielding stays green variety for drought prone areas.

S f jc rfi f ; ChalachewEndalamaw, Amare Seyoum, and Alemu Tirfessa

S f fe c ; Chalachew Endalamaw

Zfb g f ; January - December 2019

T b g i f h f

Ef jh ; Each variety was planted in 10m x 10 m in on station and on farm fields

U fb f ; Three selected candidate varities and two standard checks were planed across targeted environments

M db j ; Meiso, Kobo & Sheraro

S f m
The selected 55 genotypes were laid in row-column arrangement in two reps for last three consecutive years in the target environments. The three candidate varieties were proposed and planted for VVT in 2019 crop season. But the selected candidate varieties had inconsistence performance in tested locations. The national sorghum program decided that the VVT should be extended and replanted in 2020 crop season in the targeted environments.
rb g i f f fb ;.

Bd j j 4: Develop NAM population using 18 sorghum genotypes selected from the population panel crossed with a reference genotype (Gambella 1107).
Bd j j f j e; June2017 to June 2020
P ckfd j f; To develop NAM population using diverse sorghum genotypes to broadening the genetic bases of sorghum and use for dissecting complex traits
S f jcrfi f ; ChalachewEndalamaw, Amare Seyoum, and Alemu Tirfessa
S f fe c ; ChalachewEndalamaw
Zfb g f ; January - December 2019
T b g i f h f
Ef jh ; No design
U fb f ; 18 diverse sorghum genotypes were selected based on their genetic distance and agronomic merits and crossed with Gambella1107 to develop NAM population.
M db j ; Mieso

S f m
F3 NAM populations were advanced and total of 2068 recombinant inbreed line heads were selected based on visual evaluation for the targeted traits for F4 population in 2020 main season. In coming season both the single seed descent and pedigree breeding progenies will be advanced to subsequent generations and planted in head to row to advance to next stage of evaluation.
rb g i f f fb ; The best recombinant inbred line will be generated.

Bd j j 5; Development of test cross hybrids for sorghum hybrid variety development
Bd j j f j e; June 2017 to June 2020
P ckfd j f; To develop F1 hybrids for estimating the heterotic performance of early and stay green type locally adapted sorghum genotypes
S f jcrfi f ; Chalachew Endalamaw, Tamirat Bejiga and Alemu Tirfessa
S f fe c ; Chalachew Endalamaw
Zfb g f ; January - December 2019
T b g i f h f
Ef jh ; No design
U fb f ; 40 genotypes were selected and planted with three female parents (ATx623A, MARC2A and ICSA21)
M db j ; Wrer

S f m
A total of 80-100 testcross F1 hybrids will be developed throughestimating the heterotic performance of early and stay green type locally adapted sorghum genotypes in 2019/2020 off-season at Werer.
rb g i f f fb ; These F1 hybrids will be advanced to evaluate their performance across environments.

Bd j j 6; Populations development for blast resistance finger millet varieties
Bd j j f j e; June 2018 to June 2020
P ckfd j f; To develop NAM population of finger millet for blast resistance
S f jcrfi f ; Rebuma Merera, Chalachew Endalamaw, Amare Seyoum

S f fe c ; Chalachew Endalamaw
Zfb g f ; January - December 2019
T b g i f h f
Ef jh ; No design
U fb f ; Two blast resistance female parents (Tessema and Necho) crossed with selected 15 male finger millet genotypes.
M db j ; Melkassa

S f m
Crossing was designed targeting the product development of blast resistant varieties for the potential of finger millet growing areas of Ethiopia. These 15 genotypes advanced from the breeding program, released varieties (to add additional traits lacking from the improved varieties), and landrace collections were used as parental line to make F1 crosses. The total of 30 F2 seed increase were conducted to produce F3 seed of the crosses to screen to the target environment in subsequent generations.
rb g i f f fb ; Evaluation of the success full introgressed population will be start at F_2

Bd j j 7; Finger millet preliminary yield trial
Bd j j f j e; May 2019 to June 2020
P ckfd j f; To identify superior finger millet varieties for release.
S f jcrfi f ; Rebuma Merera, Chalachew Endalamaw, Amare Seyoum
S f fe c ; Chalachew Endalamaw
Zfb g f ; January - December 2019
T b g i f h f
Ef jh ; The trial was organized in RCBD design using 3 replications in a row-column arrangement and plot size of 3 rows x 0.4m x 5m was used.
U fb f ; 100 genotypes were introduced from ICRISAT to evaluate and select the best varieties
M db j ; Pawe and Assosa
S f m*; 100 genotypes were introduced from ICRISAT and evaluated at Pawe and Asosa in 2019 crop season. Genotypes were affected and damaged by disease (blast) at Pawe. The grain yield performance of top 23 genotypes had higher grain yield than the two checks at Asosa.
rb g i f f fb ; Best genotypes will be advanced for the next breeding stage.

Bd j j 8; Breeder & pre-basic seed increase of released finger millet varieties
Bd j j f j e; June 2017 to June 2020
P ckfd j f; To multiply and provide quality seed for growers and other users.
S f jcrfi f ; Chalachew Endalamaw, Rebuma Merera, Alemu Tirfessa
S f fe c ; Chalachew Endalamaw
Zfb g f ; January - December 2019
T b g i f h f
Ef jh ; No design**-** 0.4m between rows were used for seed multiplication.
U fb f ; A total of 8 finger millet varities for the highland and intermediate agro-ecology
M db j ; Negelle Arsi, Bako, Axum

S f m
Eight finger millet varities of 13.2 quintals breeder seed, 80 quintals pre-basic seed and 300 quintals basic seed were produced.
rb g i f f fb ; The selected varities will be multiplied for future breeding activities.

Bd j j 9: Evaluation of nutrition quality of released finger millet varieties in Ethiopia
Bd j j f j e; June 2017 to June 2020

P ckfd j f; To assess the nutritional quality of released varieties
S f jc rfi f ; Mulate Zerihun, Chalachew Endalamaw and Amare Seyoum
S f fe c ; Chalachew Endalamaw
Zfb g f ; January - December 2019
T b g i f h f
Ef jh ; No design
U fb f ; A total of 22 released finger millet genotypes evaluated for grain quality traits
M db j ; Melkassa

S f m
A total of 22 released finger millet genotypes evaluated for grain quality traits. Best varieties with high starch, amylopectin, iron, zin, protein, ash and moisture contents were identified. Degu, Meba, Mecha, and Tekeze varieties had higher in Fe content. Necho variety had highest in starch and amylopectin content.
rb g i f f fb ; Utilization of finger millet for different end use products (injera and porridge) making quality will be determined.

Bd j j : / Establishment of demonastration plots at least three zones of districts in each region
Bd j j f j e ; January 2017 - June 2020
P ckfd j f; To demonstrate improved sorghum and finger millet new varieties in comparison to the varieties underproduction
S f jc rfi f ; Hailemariam Solomon, Chalachew Endalamaw, Bediru Beshir, Amare Seyoum, Mesfine Bahata, Ibsa Ali, Hailgebriel Kinfe
S f fe c ; Chalachew Endalamaw
Zfb g i f f ; January - December 2019
T b g i f h f
M db j ; Oromia, Amhara and Tigray regions
Ef jh ; 20m x20m for each plot

S f m
Improved sorghum and finger millet varieties have been demonstrated in Oromia, Amhara and Tigray regions where they are major sorghum growing areas in the country. In 2019/ 2020 crop season 192 demonstration plots have been established for improved sorghum varieties and this result showed that 107.7% achievement as compared to the annual plan. From the total established demonstration plots of improved sorghum varieties 60, 72 and 180 demonstration plots could be established in Tigray, Amhara and Oromia regions respectively. At the same time a total of 69 demonstration plots of improved finger millet technologies could be established in major finger millet growing regions.
During the establishment of demonstration plots improved sorghum varieties of Melkam, Dekeba, Argity, ESH-1 and ESH-4 have been demonstrated in the targeted regions. Similarly, improved finger millet varieties of Meba, Mereb-1, Axum and Tessema have been demonstrated in major finger millet growing regions.
Generally, the overall progress of demonstration plots establishment for improved sorghum and finger millet varieties in 2016, 2017, 2018 and revealed that an achievement of 108.4%, 49.4%, 130 % and 170% respectively. Four years (2016 to 2019) cumulative achievements for both crops have been reached to 115 % and this indicated the effort can accomplished the targeted goal of the project. The detail of the three years progress of the demonstration plots briefly described in Table (1). Currently based on the plan of the project, demonstration of improved sorghum and finger millet varieties are being established in major sorghum and finger millet growing regions of the country.

Ubc rfi 2/ Demonstration plots established for sorghum and F. millet technologies, 2016-2019

Crop	2016		2017		2018		2019		Cumulative		2020	Total
	plan	Achiv	plan	Achiv	plan	Achiv	plan	Achiv	plan	Achiv	Plan	
Sorghum	170	130	180	83	180	194	200	292	730	684	250	980
F.millet		54		6		40		69		169		
Total		184		89		234		341		853		
% achiv		108.2		49.4		130		171		117		

rb g i f f fb ; will continue in coming year

Activity title 10: Increase farmers awareness for improved sorghum and F. millet technologies

Bd j j f j e; January 2017 - June 2020

P ckfd j f; To increase access of preferred varieties to farmers by enhancing adoption andproductivity of sorghum and millets technologies in Ethiopia

S f jc rfi f : Hailemariam S., Chalachew E., Bedru B., Amare S., Taye T. &Adane GY

S f fe c : Chalachew Endalamaw

Zfb g i f f : January - December 2019

T b g i f h f

M db j ; Oromia, Amhara and Tigray regions

Ef jh ; No design

S f m

To increase farmers awareness for improved sorghum and finger millet technologies HOPE II project designed to promote technologies through small seed pack (SSPs) in major sorghum and finger millet growing regions. The main objective of destitution of small seed pack is to allow farmers to test varieties on a small piece of land, and thereby stimulate demand for improved varieties. Hence, in 2018/19 cropping season 14492 and 1539 small seed packs of improved sorghum and finger millet technologies could be dispatched to farmers respectively. This result showed that an achievement of 105.6% and 35 %` for improved sorghum and finger millet technologies respectively. Still it needs strong effort to achieve the goal of SSPs for finger millet technologies. The overall regional achievements in distribution of SSPs for sorghum and finger millet technologies are presented in table 2 and 3 including the type of varieties that has been used to dispatch for farmers.

In general, HOPE II project has been planned to distribute 62,000 and 24,500 small seed pack of sorghum and finger millet technologies in the second phase of the project period. Hence, the last four years (2016 to 2019) result indicated that an achievement of 91.2 % and 14.5% for improved sorghum and finger millet technologies respectively. As it has been already explained that the cumulative achievement of finger millet technologies requires strong effort to meet the stated objective of the project, The detail of small seed pack distribution presented in Tables two and three as follows. Base on the plan of the project in 2019/20 cropping season small seed pack of improved sorghum and finger millet technologies have been distributed to farmers in major sorghum and finger millet growing regions.

rb g i f f fb ; will continue in coming year

Bd j j 22/ Organize field days at district, regional and federal levels to demonstrate the performance of improved technologies and to create awareness to stakeholders

Bd j j f j e; January 2017 - June 2020

P ckfd j f; To create awareness about improved sorghum and finger millet varieties and/hybrids through demonstration

S f jc rfi f ; Hailemariam S., Chalachew E., Amare S., Taye T. & Adane GY.

S f fe c ; Chalachew E.

Zfb g i f f ; January - December 2019

T b g i f h f
M db j ; Oromia, Amhara and Tigray regions

S f m
National field days have been organized to demonstrate improved sorghum technologies in Oromiya (Gololcha). During the event of field days about 600 farmers have been participated and regional agricultural experts as well as districts actively involved and shared their experiences. Open discussion was held by the farmers and they have explained that the importance of using improved sorghum technologies in their farming practices. At the end higher management staff of the EIAR transferred professional message and future direction on how to expand the best fitted practices to the entire farmers
During the occasion of filed days different sorghum varieties and food recipes were demonstrated and promoted at Kobo district for agricultural experts, researchers, farmers and administrators. Additionally, Amharic and English version of sorghum production leaflets have been distributed. In these events higher federal and regional officials were forwarded future direction on the advancement of the improved sorghum technologies that would have been considered to ascertain food security and food self-sufficiency at national level.

Bd j j j rfi 23/ Establishplatform in SNNPs and strengthen the established plat forms in Amhara, Oromia, Tigray regions
Bd j j f j e; January 2017 - June 2020
P ckfd j f; To stablish platform for technology development, delivery and marketing to enhance adoption andimpactof sorghum technologies
S f jc rfi f ; Hailemariam S., Chalachew E., Bedru B., Amare S., Taye T. and Adane GY.
S f fe c ; Chalachew E.
Zfb g i f f ; January - December 2019
T b g i f h f
M db j ; Amhara, Oromia, Tigray and South regions
Ef jh ; No design

S f m
The experience of platform was shared to partners from different perspective views to make sorghum a gig industry for the country. previously platformshave been established in Amhara, Oromia and Tigray region with active participation of the relevant stakeholders. During the innovation of platform meeting key stakeholders and actors have been identified and participated on major key components of the platform structure. During the platform meeting federal gouvernement institutions, seed campaniens, unions, coopératives, NGOs and private sectors have been involved. At the time of platform meeting about 100, 91 and 104 stakeholders have been participated in Oromia, Amhara and Tigray regionsrespectively. Regarding to SNNP region the center will take the leading role and identified relevant stakeholders to be involved in the platform establishment.
rb g i f f fb ; Will be done in following year

Bd j j 24. Linking sorghum grain with consumer through packing of semi processed grain
Bd j j f j e; January 2017 - June 2020
P ckfd j f; To popularize the sorghum grain food recipe as functional and staple food and to increase the utilization of sorghum grain in different sorghum productive areas
S f jc rfi f ; Hailemariam S., Chalachew E., Amare S., Taye T. and Adane GY.
S f fe c ; Chalachew E
Zfb g i f f ; January - December 2019
T b g i f h f
M db j ; Amhara, Oromia, Tigray regions

Ef jh ; No design

S f m

Different food recopies from sorghum varieties have been prepared and demonstrated at different events such as field days and meetings. The event would have been a major role to promote the utilization of sorghum by different consumers. At the same time sensory evaluation have been done to identify the consumers preferences. To maximize the utilization of sorghum in the next crop season it is planned to conduct promotion of sorghum grain and semi processed food recipe as functional and staple food in Miesso and Shiraro districts.

rb g i f f fb : Continue in coming year

Bd j j 25/ Identification foundation seed producing cooperatives, unions, communities, private & public seed companies and seed production of sorghum

Bd j j f j e; January 2017 - June 2020

P ckfd j f; To popularize the sorghum grain food recipe as functional and staple food and to increasetheutilization of sorghum grain in different sorghum productive areas

S f jc rfi f ; Chalachew E., Kedir O, Hailemariam S., Amare S

S f fe c ; Chalachew E.

Zfb g i f f ; January - December 2019

T b g i f h f

M db j ; Amhara, Oromia, Tigray regions

Ef jh ; No design

S f m

T hi c ffef ffe e d j

In 2018, 378kg breeder seed of 7 sorghum varieties were produced in Ethiopia which is 627% increase over the 2017 production. In 2019, 1830kg of 10 sorghum breeder seed varieties were multiplied in Ethiopia which is 484 % increase over the 2018 production. Since 2016 a total of 3760 kg breeder seed for 7-10 selected sorghum OP (6-9) and hybrid (1) varieties were produced and used as sources for foundation seed multiplication. The breeder seed was produced by Melkassa (MARC) and Sirinka (SARC) research centers who developed the OP and hybrid varieties.

T hi G eb j) f.cb jd* ffe e d j

In 2019, 203.31 tons foundation seed of 12 sorghum varieties were produced in Ethiopia which represents 200 % increase over the 2018 production. Since 2016 a total of 351.25 tons foundation seed was produced for preferred varieties. Decentralized seed multiplication is being used for foundation seed multiplication where regional research center produced the seed for the demanded varieties for their mandate areas. Hence, Melkassa agricultural research center from the federal and Sirinka, Fedis, Shire Mystebri research centers from the three regions and Oromia seed enterprise were involved in the seed production.

Table 2. Foundation (pre-basic) seed produced and distribution per variety

Sorghum Variety	Year of release	Quantity of seed produced (Kg)			
		2016	2017	2018	2019
Argity	2016			1510	7250
Birhan	2002			640	20000
Chare	2011			700	1125
Dekeba	2013	3500	12434	18350	59800
Dibaba	2015	2200		159	700
ESH-1	2009		10	0	0
Girana1	2007	3000	7250	12375	14150
Gobiye	2000			180	0
ICSR-14				70	0
Meko	2002	1700		440	2000
Melkam	2009	8180	8191	64970	92550

Misikir	2007			2000	0
Teshale	2002			60	0
Hormat	2005				4000
Adelle	2016				750
Jiru	2016				362.5
Kalu					625
Total		18600	27885	101454	203312.5

T hi df jgjfe)cb jd* b e brjn efdrb fe ffe e dj

In 2019, a total of 133.60 tons of certified seed of 2 sorghum varieties were produced which represents 10.32% increase over 2018 production. Since 2016 a total of 1,464.64 tons certified and quality declared (QDS) seed through community/ cluster-based multiplication scheme was produced. The certified seed producers are regional agricultural research centers, e.g. Sirinka Agricultural Research Center (SARC), Mehoni Agricultural Research Center, Shire-Mytsebri Agricultural Research Center (SMARC), Fedis Agricultural Research Center (FARC), seed companies Oromia seed enterprise (OSE), and seed producer groups e.g. Sheraro seed producing group, Segen union, Kobo and Gololcha seed producing group.

Table 3. Certified seed produced and distribution per variety

Sorghum Variety	Year of release	Quantity of seed produced (Kg)			
		2016	2017	2018	2019
Birhan	2002			200	0
Dekeba	2013			240544	48000
Girana1	2007	7000		648000	0
Melkam	2009	5000	23900	406400	85600
Total		12000	23900	1295144	133600

rb g i f f fb ; will be done in following year

kf d JJ; Climate Smart interventions for small holder farmers in Africa (CultiAF-2)

kf d f j e ; April 2019 - Dec 2022

Bd j j 2;Whole genome marker screening (Genotyping) of advanced sorghum breeding lines

Bd j j f j e; July 2019 - June 2021

P ckf d j f;

S f jc rfi f (s): Kidanemaryam W., Dejene G., Amare S., Taye T.,

S f fe c ; Kidanemaryam W.

Zf b g f ; January - December 2019

T b g i f h f

Ef jh ; Entry order

U f b f ; 673 advanced sorghum genotypes

M db j ; Melkassa, Holeta and DArT (Australia)

S f m

A total of 673 advanced lines were planted at HABRC for tissue sampling process. The seeds were planted on 6 x 72 trays. The leaf tissue samples are ready for shipping to DArT in the end of March 2020.

Figure 13: Sorghum seedlings planted for tissue sampling

rb g i f f fb

The Plan for the next year is to do genomic analysis for the generated data. whole genome marker data for advanced PYT genotypes will be generated using DArT seq platform. Genetic variability for RA and TE will be assessed. GWAS for RA and TE will be conducted to identify genomic regions. Genotypes suitable for adaptation to drought stress will be identified & integrated in the variety development. Marker will be identified and validated to be used for MAS. The prediction capacity for TE will be validated. Genomic based breeding tools will be developed by UQ and EIAR, on Dec 2021.

Bd j j 3; Pheno typing of advanced sorghum lines for root architecture
Bd j j f j e ; 2019 - 2021
S f jc rfi f (s): Tewodros M., Kidanemaryam W., Temesgen M., Daniel N., Taye T., Amare S.,
S f fe c ; Kidanemaryam W.
Zfb g f ; January - December 2019
T b g i f h f
A total of 673 advanced genotypes are identified and designed for the experiment to be done in row column design at Jimma University.
Ef jh ; Row and column
U fb f ; 673 advanced sorghum genotypes
M db j ; Melkassa, Jimma

S f m
Currently the experiment is under implementation.
rb g i f f fb ;
The data recorded for this experiment will be co-analyzed with genomics and filed data to validate the association of root angle with yield and other agronomic data. Root angle trait data for the PVT genotypes will be correlated with the yield performance to determine the effect of the trait for adaptation to drought stress.

Bd j j 4;Phenotyping for transpiration efficiency of advanced sorghum breeding lines
Bd j j f j e ; 2019 - 2021
S f jc rfi f (s): Tewodros M., KidanemaryamW., Taye T., Amare S., Alemu T. and Mohammed S.
S f fe c ; Kidanemaryam W.
Zfb g f ; January - December 2019
T b g i f h f

A total of 673 advanced genotypes are identified and designed for the experiment to be done in row column design at MARC. After the construction of lysimetry platform the experiment will be commenced. The platform to be used for the experiment is developed (Z. Xin *et al.,*2008).

- Whole plant level TE will be determined gravimetrically in 20 L plastic pots
- All lysimeters will be filled to a constant weight with air dried and homogenized soil
- The topsoil from the MARC farm that has been characterized for DUL & LL will be used.
- Depending on the size of range (plant available water), we need to rewater the lysimeters to probably slightly below DUL to prevent waterlogging.
- Any water used will be replenished by carefully adding the required amount of water under the plastic cover near the base of the stem.
- 3-4 seeds will be planted per pot and later thinned to one plant at 7 days after emergence.
- The pots will be barcoded, and the initial weight will be taken automatically with **L fd** program
- Water use throughout the experiment will be monitored by weighing each lysimeter 3-4 times per week until harvesting done.
- During the entire experimental cycle, control pots without plants will be included
- Once plants had reached flag leaf, plants will be harvested and fresh and dry biomass will be recorded.

Ef jh ; Row and column
U fb f ; 673 advanced sorghum genotypes
M db j ; Melkassa

S f m
Currently the experiment is not yet start because of the lysimetry facility construction delays.
rb g if f fb ;
The selected genotypes will be screened for their TE reaction to the environment.

Bd j j 5; Establishment of manual load lysimetric platform
Bd j j f j e ; Dec 2020 – May 2020
S f jc rfi f (s): Tewodros M., Kidanemaryam W., Mekonnen S., Taye T., Amare S., Mohammed S.
S f fe c ; Kidanemaryam W.
Zfb g f ; January - December 2019
T b g if h f
Ef jh ; No design
U fb f ; No treatment
M db j ; Melkassa

S f m
Based on the stated requirements, site identification, clearing and leveling is done. Now the site is ready for construction. Design work also completed and the identification of appropriate contractor is underway.
rb g if f fb ;
The selected genotypes identified for TE experiment will be screened for their TE reaction to the environment when the construction is completed.

Bd j j 6; Increasing sufficient seed stocks of improved varieties for smallholder farmers
Bd j j f j e ; Dec 2020 – May 2020
S f jc rfi f (s): National Sorghum program team, Mehoni Sorghum team and Public seed enterprises (OSE & ASE)

S f fe c ; Kidanemaryam W.
Zfb g f ; January - December 2019
T b g i f h f
The planned seed multiplication was to produce 100 kg of breeder seed and 250 kg of pre-basic seed in 2019 for Argiti variety. So, 110 kg of breeder seed and 3000 kg of pre-basic seed was harvested and saved to be used for pre-extension, demonstration and scaling out activities.

Figure 14: Pre-basic seed multiplication at Mehoni in 2019

Ef jh ; No design
U fb f ; No treatment
M db j ; Melkassa, Mehoni

S f m
The produced 3,000 kg pre-basic seed will be distributed for seed growers to produce 75 tons of certified seed.

Table 14: Seed multiplication plan and achievements

Seed Class	Multiplication Center	2019 Plan	2019 Achievement	2020	2021	2022	Total
Breeder	Melkassa	100	110	100	100	100	400
Pre-basic seed	Melkassa, Mehoni & Worer	2500	3000	2500	2500	2500	10000
Certified	OSE			40	40	40	120
Certified	ASE			35	35	35	105

rb g i f f fb ;

Bd j j 7; Provide technical support for production on quality seed production system and quality control
Bd j j f j e ; Dec 2020 – May 2020
S f jcrfi f (s): Kidanemaryam W., Mekonnen S., Taye T., Amare S., Tewodros M.
S f fe c ; KidanemaryamW.
Zfb g f ; January - December 2019
T b g i f h f
The trainees are identified from the project targeted regions and the training will be given in April 2020.

- Annually, 30 technicians and seed growers will be trained on;
- Quality breeder, pre-basic and QDS seed production quality standards,
- Packing and handling
- Agronomy, benefits, and end-user attributes of available seeds,

- The linkages with QDS producers strengthened and supported to market
- M & E of the seed production sites and seed certification by the regulatory body will be conducted

rb g i f f fb ; Similar training will be organized for those selected trainees.

kfd JJJ; Genetic Improvement of Sorghum for Resistance to Fungal Pathogens (SMIL-II project 1)
Project Fund Source: USAID, Feed the Future Food Security Innovation Lab for Collaborative Research on Sorghum and Millet, Kansas State University
kfd D ej b j h Df f ; Melkassa Agricultural Research Center
Hf f bm kfd N b bhf ; Professor Tesfaye Mengiste
D J: Getachew Ayana (PhD)
kfd J rfi f j h Df f ; Melkassa, Jimma and Bako Agricultural Research Center
kfd f j e; April 2019 - July 2023
P ckfd j f g i f kfd

1. Develop new sorghum varieties with resistance to major diseases, improved yield and broad adaptation by advancing materials from Phase I.
2. Identify sorghum multi-pathogen resistant genes defined by the series of anthracnose resistance loci.
3. Identify and characterize genes for grain mold resistance defined by mold resistance lines identified in Phase I and integrate into breeding pipeline.
4. Genomic and trait analyses of a select subset of Ethiopian sorghum landraces for disease resistance and other traits to establish a genome enabled breeding platform

N bk g i f kfd

1. Germplasm that integrate disease resistance genes and other adaptive traits that will be accessible to researchers in Ethiopia.
2. Knowledge on genetic control of disease, technologies such as molecular markers that breeders could use for crop improvement.
3. Sorghum varieties that have better yielding, broad adaptation and disease resistant introduced to farmers.
4. Training of young scientists in plant pathology, application of molecular tools, breeding and genetics.
5. Increased support to sorghum research and capacity development
6. New knowledge on genetics of sorghum disease resistance, pathogen dynamics and sorghum genes and allelic variants involved in disease resistance and their genetic inheritance.
7. Detailed phenotype and genotype data, and genome sequences and a foundation for genomics enabled breeding

Bd j j 2/ SMIL Core collection subset seed increase
P ckfd j f; To increase seed of selected accessions from SMIL Core collection
E b j ; 2019 - 2020
f f jc rfi; Tamirat B., Getachew A., Alemu T., Amare S., Rebuma M., Meron
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b gS f fb di h f ;
Ef jh ; no design
U fb f ; 652 accessions
M db j ; Melkassa

S f m

A total of 652 accessions were selected and planted in one replication in 1 row x 3m x 0.75m plots. Five heads per plot were covered by cloth bag for protecting from bird damage. Selected heads were harvested, threshed and stored.

rb g i f f fb ; Stored seed will be used as a source for SMIL-II project activities.

Bd j j 3/ Sorghum National variety Trial
P ckfd j f; To evaluate and select sorghum best performed and disease resistance sorghum
E b j ; 2019-2021
S f jc rfi f ; Getachew A., Tamirat B., Alemu T., Tokuma L., Meron B., Nesriya,
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f ;
Ef jh ; S DCE
U fb f ; 26 varieties
M db j ; Jimma, Bako, Melkassa

S f m

A total of 26 sorghum including check were evaluated within two replications in 2 rows x 5m x 0.75m plots. Assessment of anthracnose severity was done two times based on 1-5 disease rating scale suggested by (Thakur et al., 2007), where,
1=No visible symptoms, presence of chlorotic flecks,
2=1-10% leaf areas covered with hypersensitive lesions without acervuli,
3=11-25% leaf areas covered with hypersensitive and restricted lesions without acervuli,
4=26-50% leaf area covered with coalescing necrotic lesions with acervuli and
5=>50% leaf area covered with coalescing necrotic lesions with acervuli.

rb g i f f fb ; This activity will be repeated for further evaluation

Bd j j 4/ Sorghum Disease nursery with white and yellow seeded germplasm
P ckfd j f; To evaluate and select sorghum for grain mold resistance
E b j ; 2019 - 2021
S f jc rfi f ; Getachew A., Tamirat B., Alemu T., Amare S., Tokuma L., Nesriya
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f ;
Ef jh ; row column
U fb f ; 185 germplasim
M db j ; Jimma and Melkassa

S f m

A total of 185 sorghum germplasms were evaluated in one replication in 2 rows x 5m x 0.75m in row column arrangement at Jima and seed of these genotypes were increased at Melkassa.

rb g i f f fb ; Best performed landraces will be used for the coming season

Bd j j 5/ Anthracnose resistance variants of sorghum
P ckfd j f; To increase seed of introduced anthracnose resistance sorghum
E b j ; 2019 - 2020
S f jc rfi f ; Alemu T., Amare S., Tamirat B., Rebuma M., Mesfin B., Temesgen T.
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f
Ef jh ; row column
U fb f ; 34 genotypes

M db j : Melkassa
S f m;
A total of 34 anthracnose resistance sorghum introduced from Purdue university were planted in 2 rows x 5m x 075m.
rb g i f f fb : Increased seed will be used for future breeding program.

Bd j j 6.White seeded sorghum lines resistance to grain mold
P ckfd j f; To increase seed of grain mold resistance sorghum lines
E b j ; 2019-2020
S f jc rfi f ; Alemu T., Amare S., Tamirat B., Mesfin B., Temesgen T.
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f
Ef jh ; row column
U fb f ; 11 lines
M db j : Melkassa

S f m
A total of 11 introduced sorghum lines were planted in 2 rows x 5m x 0.75m.
rb g i f f fb : Increased seed of these lines will be used in the future breeding program.

kfd JW; Advancing improved functionality & protein quality sorghum hybrids for food applications in Ethiopia (SMIL-II project 2)
kfd G e T df; USAID, Feed the Future Food Security Innovation Lab for Collaborative Research on Sorghum and Millet, Kansas State University
kfd D ej bj h Df f : Melkassa Agricultural Research Center and Hawassa University
Hf f bm kfd N b bhf ; Professor Joseph Awika
D J; Tamirat Bejiga
kfd J rfi f j h Df f ;Texas A & M university, Hawassa University, Melkassa
kfd f j e; April 2019 - July 2023
P ckfd j f g i f kfd
1. Develop commercially viable technologies to successfully incorporate the improved sorghums in various food processes and products in Ethiopia.
2. Establish the improved HPD sorghum hybrid seed and grain production in Ethiopia.
3. Establish heritability of the HPD trait in sorghum.

Bd j j 2/ Testing of 34 experimental hybrids for performance in Ethiopia
P ckfd j f; To evaluate and select sorghum hybrid for agronomic traits performance
E b j ; July 2019 - June 2023
f f jc rfi; Alemu T., Tamirat B., Amare S., Tokuma L., Temesgen T., Tadese A.
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g i f h f
Ef jh : row column
U fb f ; 34 hybrids
M db j ; Miesso& Kobo

S f m
A total of 30 new hybrids from Texas A & M university, 3 Ethiopian hybrids and one OPV (total 34 materials) were evaluated in 2 row plots in 2 replications. After harvest the seed was shipped to Hawasa University for food quality analysis. Ten best performed hybrids will be selected for testing in subsequentyears.
rb g i f f fb : Best performed hybrids will be evaluated in 2020 main season

Bd j j 3/ Evaluation of selected parental lines for hybrid seed production in Ethiopia
P ckfd j f; To select and seed maintenance of the selected sorghum hybrid parents
E b j ; July 2019 - June 2020
S f jc rfi f ; Alemu T., Amare S., Tamirat B., Tokuma L., Rebuma M.
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f ;
Ef jh ; no design
U fb f ; 3 parental lines
M db j ; Melkassa

S f m
Three sorghum hybrid parents selected based on their performance during phase one SMIL project. Each selected parents were planted in four rows A line and 2 rows R lines for crossing. Three hybrids were developed from selected parent of A-lines and R-lines.
rb g i f f fb : Performance of three developed hybrids will be evaluated in 2020 cropping season.

Bd j j 4/ Observation nursery of selected Ethiopian sorghum landraces for flowering time, agronomic performance under short cycle growing areas
P ckfd j f; To evaluate selected sorghum landraces for agronomic traits performance
E b j ; July 2019 – June 2012
S f jc rfi f ; Alemu T., Amare S., Tokuma L., Temesgen T., Zigale S.
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f ;
Ef jh ; row column
U fb f ; 102 landraces
M db j ; Melkassa and Meisso
S f m;
A set of 102 Ethiopian sorghum germplasms were selected based on grain size and color. Selected germplasms were planted in one rep in two rows in column row arrangement. A total of 39 sorghum lines were selected.
rb g i f f fb : Best performed germplasms will be evaluated for grain quality

kfd W; Genetic Enhancement of sorghum to promote commercial seed supply and grain market development (SMIL-II Project 3)
kfd f j e; April 2019 - July 2023
Bd j j 2/ Advanced drought tolerant Hybrid Yield Test
P ckfd j f; To select best performing sorghum hybrids for drought tolerance and grain yield.
E b j ; 2019 - 2023
f f jc rfi; Alemu T., Tamirat B., Temesgen T., Zigale S., Solomon M, HailegebrelK
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g i f h f
Ef jh ; RCBD
U fb f ; 21hybrids
M db j ; Miesso, Kobo and Sheraro

S f m
The study was used nineteen introduced genotypes with two standard checks (ESH-1 &Melkam) evaluated for yield performance and drought tolerance. The trial was laid out in

randomized complete block design (RCBD) with three replications at study location. The experimental plots consisted of 2 rows, each 5 m in length with 75 cm between and 15 cm in plant-to-plant spacing. The total row number of each plot was two, all these rows were harvested. Therefore, both the total area of each plot and the two harvestable rows had a size of 7.5 m^2. Sowing was done by hand drilling. The seed rate for each plot was calculated as per the recommendation for row planting (12 kg ha-1). Then, thinning was done two weeks after emergence to adjust plant to plant space. Nitrogen and phosphorus fertilizers were applied in the form of Urea (46 % N) and DAP (18 % N and 46 % P2O5) as the national sorghum improvement program have done. During planting, 100 kg ha-1 of DAP (NPS) was applied in the seed furrow. Urea was applied as top dressing at the rate of 50 kg ha-1 at knee height stage. The field was kept free of weeds during the period of the experiment. All the other recommended agronomic management practices such as land preparation and insect pest control were applied as required following research recommendation. Six crosses had higher scores than the average performance in overall agronomic aspect at Meisso, but, they all had average performance rank at Kobo. In general, 12 crosses having above average and average performance consistently over the two locations in all agronomic aspect were selected.

rb g i f f fb ;Selected hybrids based on general agronomic aspects and yield data will be advance to elite yield trails.

Bd j j 3/ Drought Observation Nursery of sorghum Hybrids
P ckfd j f; To evaluate fertility reaction and test cross performance in drought stress condition
E b j ; 2019 -2023
S f jc rfi f ; Alemu T., Tamirat B., Rebuma M., Temesgen T., Solomon M., Hailegebrel K.
S f fe c ;Tamirat B.
Zf b g f ; January - December 2019
T b g h f ;
Ef jh ; row column
U f b f ; 163 hybrids
M db j ; Melkassa, Kobo, Sheraro and Miesso

S f m

A total of One hundred sixty-three drought tolerant sorghum hybrids including ESH1, ESH4 and Melkam as a check were evaluated in non-replicated in 2 rows x 5m x 0.75m plot row column arrangement. The drought tolerant and early maturing sorghum hybrids were evaluated for various agronomic and morphological characteristics. All plots were fertilized uniformly with 100 kg/ha Urea and 100 kg/ha Diammonium Phosphate (DAP). Full dose of P and half of N was applied at the time of planting and the remaining half dose also applied side dressed at knee height stage of the crop. All other cultural practices were applied uniformly to all plots as per standard recommendations for the crop. Hybrids that are better over the three checks and good performance in overall agronomic aspect (PAS) were selected. Three crosses (K11307, K11315 and K11521) showed good agronomic performance consistently at four locations Hybrids having good agronomic performance with promising yield potential will be advanced to preliminary variety trial.

rb g i f f fb : promising hybrids will be advanced to preliminary variety trial.

Bd j j 4/ Dual Purpose Sorghum Hybrid
P ckfd j f; To select the best performing dual purpose sorghum hybrids
E b j ; 2019 – 2023
S f jc rfi f ; Alemu T., Tamirat B., Amare S., Zigale S., Solomon M., Hailegebrel
S f fe c ; Tamirat B.

Zfb g f ; January - December 2019
T b g h f ;
Ef jh ; RCBD
U fb f ; 22 hybrids
M db j ; Miesso, Kobo and Sheraro

S f m
A set of 22 elite dual-purpose hybrids and checks (ESH-1 and Melkam) were conducted at three testing sites. The treatments were arranged in an RCBD design arrangement with three replications. Each experimental plot has an area of 7.5 m2 with 5m length separated by a distance of 1.5 m between blocks and 75cm between plots within a block. A spacing of 75 cm between rows and 25 cm between plants was maintained. A seeding rate of 10 kg/ha will be used for all plots within each block. All plots were fertilized uniformly at the rate of 100 kg/ha Urea and 100 kg/ha DAP. All DAP and half of Urea was applied at planting. The remaining half also divided in to two and applied at knee height stage of the crop. All other cultural practices were applied uniformly to all plots as per standard recommendations for the crop. During the experimental period, all agronomic data were collected.
Two genotypes at Meisso and three genotypes at Kobo had higher scores than the average performance (3). 15 crosses having average PAS over the two locations were selected.
rb g i f f fb ;Promising genotypes in grain yield and biomass yield will be advanced to yield trail

Bd j j 5/ Sorghum – Sudan Forage Hybrids
P ckfd j f; To evaluate and develop sorghum hybrids for feed source
E b j ; 2019-2020
S f jc rfi f ; Alemu T., Amare S., Rebuma M., Mesfin B., Solomon M
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f ;
Ef jh ; RCBD
U fb f ; 4 hybrids
M db j ; Melkassa, Miesso and Kobo

S f m
Four sorghum hybrids were introduced from Purdue University for their Forage characters. The experiment was planted in RCBD design with two replications in 4 rows x 5m x0.75m plots. Biomass data (total fresh weight), Juice content and Plant height data was taken from the two middle rows. Hybrid 2 and 4 were high yielder in total fresh weight, while hybrid 1 and 2 were high yielder in juice content in their mean performance. Hybrid 3 and 2 had high yielder in total fresh weight, while hybrid 3 and 4 had high plant height.
rb g i f f fb ; will continue in coming year

Bd j j 6. A-line Test Cross Evaluation
P ckfd j f; To evaluate the performance of crosses and combining ability of selected female parents
E b j ; 2019-2020
S f jc rfi f ; Alemu T., Rebuma M., Mesfin B., Temesgen T., Zigale S.
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f
Ef jh ; resolvable alpha lattice
U fb f ; 200 A- lines
M db j ; Melkassa and Miesso

S f m

A set of 200 A-lines were crossed with 2 well-known high combining ability R-line (PU-304R and R633). Developed 198 hybrids including checks (ESH1 and Melkam) were evaluated using resolvable alpha lattice design with 2 replications in 1 row x 0.75m x 5m plots.

The analysis of variance for days to 50% flowering, insect pest and disease score, seed set percentage, grain yield per hectare and over all agronomic desirability score (PAS) indicated significant differences($p<0.05$) among the hybrids (Table 6) however, non-significant difference observed for plant height, heads per plot, insect pest score, days to maturity. All agronomic desirability score (panicle exertion, head shape, kernel size and color, uniformity, yield potential, thresh ability, etc.) was measured using 1-5 score where 5=excellent and 1=poor. In the study, out of 198 genotypes, five of them showed better performance over the two checks (ESH 1 &Melkam) in terms of grain yield per hectare even though they are not appealing in agronomic desirability except the 2 hybrids (Table 6). On the other hand, 53 hybrids showed better performance over the ESH 1(check) in terms of grain yield per hectare (t). Heritability values were also estimated for the indicated traits (Table 9) and among them, disease score, and plant height showed highest values (81%, 77%) at Melkassa and Mieso respectively. Considering average performance of lines and testers in hybrid-cross combination through general combining ability (GCA) is very important in order to select best hybrid parents. Thirteen females (red colors) gave positive and maximum general combining ability (GCA) effects for the days to flowering, plant height and grain yield per hectare. Whereas between the two R-lines, R 633 revealed positive and maximum GCA effects for the indicated traits demonstrating that both the parents (males and females) keep more additive genes, thus may be utilized in hybrid crossing program for the improvement of commercial hybrid development (Table 7). Because of dominant and epistatic gene effects, the specific combining ability (SCA) estimates from line x tester interaction for different traits in F1 hybrids. Among 198 F1 hybrids, 29 of them were found as the best specific combiners for days to flowering, plant height, and grain yield per hectare (Table 8). Summary: In the above, those 13 females and 1 R-line showed positive and significant GCA effects for yield contributing traits can be used as better hybrid parents in the hybrid crossing program. In addition to these, the hybrids that had showed positive and better SCA effects and better mean performance in terms of grain yield, and agronomic appreciation over the standard checks should be superimposed across locations on their target areas to identify the best promising hybrids. Now we are being included in hybrid crossing of 2020 off season nurseries at Werer to evaluate for yield in the coming main cropping season.

Table 9. Estimation of heritability of traits by Location for female lines evaluation

Traits	Location	Genotype Variance	Residual Variance	Heritability
Days to flowering	Mieso	0.48	8.2	0.10
	Melkassa	0.96	2.55	0.43
Insect Score(1-5)	Mieso	0	0.01	0.01
	Melkassa	0.03	0.17	0.25
Disease Score(1-5)	Mieso	0.00	0.08	0.10
	Melkassa	0.31	0.15	**1/92**
Plant height	Mieso	441.99	259.12	**1/88**
	Melkassa	29.59	671.4	0.08
Days to maturity	Mieso	0.8	5.23	0.23
	Melkassa	0	26.69	0.00
Head/Plot	Mieso	1.97	13.98	0.22
	Melkassa	1.28	5.67	0.31
Grain yield per hectare	Mieso	87.24	88.06	**1/77**
	Melkassa	64.53	161.57	0.44
Plant aspect	Mieso	0.04	0.3	0.23
	Melkassa	0.08	0.42	0.28

rb g i f f fb ; promising hybrids will be advance to Preliminary yield trial

Bd j j 7; R-line Test Cross Evaluation
P ckfd j f; To evaluate the performance of crosses and combining ability of selected male parents
E b j ; 2018 - 2021
S f jc rfi f ; Alemu T., Tamirat B., Rebuma M., Mesfin B., Temesgen T., Zigale S.
S f fe c ; Tamirat B.
Zf b g f ; January - December 2019
T b g h f ;
Ef jh ; resolvable alpha lattice
U f b f ; 192 R- Lines
M db j ; Melkassa and Miesso

S f m

A set of 100 R-lines previously introduced and including elite open-pollinated varieties that have been officially released in Ethiopia were set up as a crossing block to be crossed to 2 high combining A-lines, PU209A and TX623A and were generated 190 test crosses for evaluation. Developed test crosses were planted with 2 replications in a plot size 1row x 0.75m x 5m. 104 and 81 hybrids had average scores in PAS at Melkassa and Meisso respectively.The individual analyses of variance revealed highly significant differences ($p \leq 0.01$) among hybrids for all recorded traits in both locations except days to maturity, insect pest score, lodging score, and number heads harvested (Table 10). The combined analysis of variance also showed highly significant differences ($p \leq 0.01$) for genotypes (G) and the G × E interaction except disease score (Table 11). The significant effect of the G × E interaction revealed that the hybrids had variable performance in the tested environments. Among 190 F1 crosses, 80 of them showed best performance over the 2 checks in terms of grain yield per hectare and over all agronomic aspects and 102 of them indicated better performance than Melkam (check) in grain yield per hectare (qt) (Table 13).

High heritability values were also estimated for plant height, grain yield per hectare and days to 50% flowering at Melkassa. The highest heritability value was recorded by plant height (92%) followed by grain yield per hectare (76%) at this testing site (Table 12) whereas the lowest heritability value was recorded by lodging score (null) followed by insect pest score (2%) (Table 12). In general, heritability value was inferior estimated for all recorded traits except plant height, grain yield per hectare and days to flowering at both locations (Table 12). Considering the GCA effects is very important in order to identify the best general combiners in hybrid production and significant and positive GCA effects are required for the recorded traits. The analysis of variances (Anova) for combining ability indicated that highly significant variation due to days to 50% flowering, plant height, stand count, and grain yield per hectare. As regards in all source of variations, highly significant differences were observed for recorded characters except plant height, which is not significant in all interactions (LINE: TESTER; SITE: GENOTYPES; SITE: LINE; SITE: TESTER and SITE: LINE: TESTER). The estimates of GCA effects revealed that 12 testers exhibited significant GCA effects in desirable direction for days to flowering, plant height, stand count and grain yield per hectare. Out of 95 testers, IESX 037 showed highly significant and positive GCA effects in grain yield per hectare with highest GCA value (15.53). Similarly, between the two female lines, ATX 623 recorded positive and significant GCA effects for all recorded traits however female PU 209A exhibited negative GCA effects for all recorded traits (Table 14). Among 190 F1 hybrids, 19 of them showed significant and positive SCA effects for days to 50% flowering, plant height stand count, grain yield per plot and grain yield per hectare (Table 15). As regard grain yield per plot and/or grain yield per hectare, out of 190 F1 hybrids, 95 of them showed significant and positive SCA effects however, the remaining exhibited significant and negative SCA effects, which is not good for the specified characters (Table 15). Summary: In the above, 12 testers had showed the best GCA effects and these R-lines can be used as hybrid parents for the future hybrid-crossing program. In addition to this, 19 F1 hybrids showed significant and positive SCA effects for all recorded traits with reasonable grain yield per hectare. Therefore, superimposing these superior F1 hybrids across locations over the years on their target areas could be relevant to identify the best promising hybrids.

Table 10. Predicted statistic of traits for individual location

Location	Statistic	DTF	PHT	DTM	PSC	DSC	LDGscore	NHH	GY/Plot	PAS	GY/ha(qt)	SV	SS%	GY/head
Mieso	Heritability	0.72	0.18	0.68	0.02	0.12	0	0.46	0.7	0.63	0.7			
	Genotype Variance	4.18	750.87	3.78	0	0.01	0	3.47	35117.02	0.21	69.38			
	Residual Variance	3.17	6923.13	3.54	0.04	0.14	0.06	8.09	30581.16	0.24	60.4			
	Grand Mean	69.63	168.92	109.63	2.01	1.79	1.05	15.49	1023.34	3.18	45.48			
	LSD(0.05)	3.07	69.32	3.14	0.05	0.26	0	3.84	288	0.78	12.8			
	CV%	2.56	49.26	1.72	9.36	20.95	23.12	18.36	17.09	15.56	17.09			
	n Replicates	2	2	2	2	2	2	2	2	2	2			
	Genotype significance	**1.70E-16**	**1.80E-01**	**1.40E-13**	**8.90E-01**	**3.90E-01**	**1.00E+00**	**3.70E-05**	**1.10E-15**	**1.90E-11**	**1.10E-15**			
Melkassa	Heritability	0.7	0.92	0.06	0.16	0.33	0	0.22	0.75	0.51	0.76	0.37	0.85	0.76
	Genotype Variance	4.69	800	1.33	0.02	0.07	0	0.98	78527.8	0.11	155.1	0.13	539.2	168.9
	Residual Variance	3.93	145.6	41.4	0.25	0.31	0.06	6.78	49054.2	0.21	96.88	0.45	182.3	105.1
	Grand Mean	71.58	171	123.91	2.43	1.93	1.05	18.99	1586.2	3.14	70.5	4.04	91.32	84.02
	LSD(0.05)	3.33	23.3	3.12	0.4	0.62	0	2.45	386.8	0.65	17.19	0.8	24.93	17.68
	CV%	2.8	7.1	5.2	20.7	28.6	23.1	13.7	14	14.5	14	16.6	14.8	12.2
	n Replicates	2	2	2	2	2	2	2	2	2	2	2	2	2
	Genotype significance	**0.00**	**0.00**	**0.67**	**0.25**	**0.01**	**1.00**	**0.09**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

DTF=Days to Flowering; PHT=Plant height (cm); DTM=Days to maturity); DSC=Diseases Score; PSC=Pest Score; LDGscore=Lodging Score; NHH= No. of Head Harvested; GY/plot= Grain yield per plot in gram; GY/ha (qt) =Grain yield per hectare in quintal; PAS= Overall plant Aspect score (1-5) ; PV=Plant Vigor (1-5; SS%=Seed set percentage; GY/head= Grain yield per head

Table 11. Predicted statistic of traits for combined across locations

Location	Statistic	DTF	PHT	DTM	DSC	Pstand	NHH	GY/Plot	PAS	GY/ha(qt)
OVERALL	Heritability	0.69	0.46	0.10	0.00	0.24	0.21	0.55	0.63	0.55
	Genotype Variance	3.28	766.55	0.73	0.00	0.43	0.70	29136.12	0.12	57.55
	G X E Variance	1.17	17.74	1.86	0.05	0.48	1.51	27666.87	0.03	54.62
	Residual Variance	3.55	3517.79	22.43	0.22	4.55	7.44	40335.11	0.23	79.66
	Grand Mean	70.61	169.96	116.77	1.86	16.27	17.24	1304.79	3.16	57.99
	LSD(0.05)	2.84	56.70	2.26	0.00	1.59	2.08	320.88	0.61	14.26
	CV%	2.67	34.90	4.06	25.35	13.11	15.82	15.39	15.05	15.39
	n Replicates	2	2	2	2	2	2	2	2	2
	n Locations	2	2	2	2	2	2	2	2	2
	Genotype significance	**9.4E-15**	**2.1E-05**	**4.7E-01**	**1.0E+00**	**6.7E-02**	**1.1E-01**	**6.1E-08**	**4.9E-11**	**6.0E-08**
	G X E significance	**6.7E-05**	**9.4E-01**	**2.3E-01**	**4.7E-03**	**1.3E-01**	**7.3E-03**	**1.9E-12**	**4.3E-02**	**1.9E-12**

DTF= Days to Flowering; PHT= Plant height (cm); DTM=Days to maturity; DSC=Diseases score; Pstand=Plant stand; NHH= No. of Head Harvested; GY/plot= Grain yield per plot; GY/ha (qt) =Grain yield per hectare in quintal; PAS= Overall plant Aspect score (1-5); SS%=Seed set percentage

rb g i f f fb ; promising hybrids will be advance to Preliminary yield trial

kf d WJ; Integrated Striga Control (ISC II)-Striga and Drought Tolerant Sorghum Hybrid Seeds for Ethiopia

kf d G e T df; BMGF

kf d f j e; April 2017 - September 2021

Bd j j 2/ Elite Striga Resistant Hybrid Sorghum National Variety Trial

P ckf d j f; To select promising striga resistant and drought tolerant hybrids.

E b j ; 2018 - 2021

f f jc rfi; Alemu T., Tamirat B., Temesgen T., Zeleke, Abiy, Solomon M, Hailegebrel K.

S f fe c ; Tamirat B.

Zf b g f ; January - December 2019

T b g i f h f

Ef jh : row column

U f b f ; 43 hybrids

M db j ; Miesso, Fedis, Shewarobit, Kobo on farm, Kobo on station, Sheraro

Sf m

A total of 43 hybrids including 5 checks: ESH1, ESH4, Gobiye, Birhan and Melkam were evaluated in three replications in two row plots. Three of the 6 locations were on Striga sick plots and planted on 3m long rows, with blank rows on each side, and planted on hills spaced at 20cm apart. All entries in this set have been confirmed to have lgs in both their male and female parents. 12 hybrids were best performed in all locations compared to checks.

rb g if f fb ; Selected hybrids will be further evaluated and advanced to next stage

Bdjj 3/ Striga Resistant Hybrid Sorghum Observation Nursery

Pckfdj f; To identify promising striga resistant and drought tolerant hybrids.

E bj ; 2018 - 2021

Sf jcrfi f ; Alemu T., Rebuma M., Mesfin B., Zigale S., Solomon M., Hailegebrel K.

Sf fe c ; Tamirat B.

Zfb g f ; January - December 2019

T b g h f ;

Ef jh ; row column

U fb f ; 42 hybrids

M db j ; Miesso, Kobo, Sheraro and Melkassa

Sf m

A set of 42 striga resistant sorghum hybrids with both parents possessing lgs alleles were set for observation. A trial was evaluated in one rep in two rows in four sites including checks ESH4 and Melkam. K-11243 and K-5792 hybrid sorghum were showed good agronomic performance consistently at three locations.14 sorghum hybrids genotypes hybrids had average scores in (PAS).

rb g if f fb ; Best performed hybrids will be selected and advanced to preliminary variety trial

Bdjj 4/ Evaluation of MAGIC sorghum lines for Striga resistance

Pckfdj f; To evaluate and select developed lines for striga resistance

E bj ; 2018 - 2021

Sf jcrfi f ; Alemu T., Tamirat B., Temesgen T., Solomon M., Tadesse A., Hailegebrel K.

Sf fe c ; Tamirat B.

Zfb g f ; January - December 2019

T b g h f ;

Ef jh ; row column

U fb f ; 200 lines

M db j ; Kobo, Sheraro

Sf m

Random samples of 200 MAGIC lines plus 7 checks were evaluated for Striga resistance. The experiment was arranged by row column in a randomized complete black design with two replications, plot size of 3m x 0.75 m (2.25 m2) used (1 row plot (15-16 plants/row), with blank rows on each side, in 2 replications). The blocks also separated by 1.5m, whereas plots within a block are 0.75m apart from each other. Each plot consists of 1 row of 3m length. The magic population sorghum genotypes were evaluated for various agronomic and morphological characteristics. All plots were fertilized uniformly with 100 kg/ha Urea and 100 kg/ha Diammonium Phosphate (DAP). Full dose of P and half of N was applied at the time of planting and the remaining half dose also applied side dressed at knee height stage of the crop. All other cultural practices were applied uniformly to all plots as per standard recommendations for the crop.

Figure 1. Trial evaluation Sheraro, 2019

rb g i f f fb ; best performed hybrids identified and advanced to next stage

Bd j j 5/ Determination of heterotic pools among Ethiopian landraces
P ckfd j f; To develop test cross for study sterility reaction and determination of heterotic.
E b j ; 2019 - 2021
S f jc rfi f ; Alemu T., Amare S., Tamirat B., Tokuma L., Rebuma M., Mesfin B.,
S f fe c ; Tamirat B.
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f ;
Ef jh ; no design
U fb f ; 104 Landraces
M db j ; Melkassa

A set of 104 Ethiopian sorghum landraces with known R-line and B-line to intercross with two females (TX623A and TX2783MS3). A total of 82 landraces were crossed with TX623A while 70 landraces crossed with TX2783MS3.

rb g i f f fb ; developed test crosses will be evaluated in the 2020 cropping season

Bd j j 6/ Demonstrations of recently released hybrid sorghum
P ckfd j f; To introduce sorghum technologies options for the farmers
E b j ; 2018 - 2021
S f jc rfi f ; Alemu T., Temesgen T., Zigale S., Solomon M., Zeleke., Hailegebrel K
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f ;
Ef jh ; no design
U fb f ; 3 Varities
M db j ; Amhara, Oromia and Tigray National Regional states

S f m

Released sorghum varieties Melkam, ESH-5 and ESH-4 hybrids were demonstrated in Amhara (North and South Wollo), Oromia (East & West Hararge) and Tigray (Sheraro and Humera) targeted sites. Double cropping of hybrid ESH-4 and Melkam variety with Mung

bean, it performed very well in Oda Roba Kebele and farmers were showed their interest plan to plant in coming cropping season.
rb g i f f fb ; demonstrate in sorghum growing potential areas in Ethiopia

Bd j j 7/ Basic seed production of parental lines
P ckfd j f; To produce seed of selected parental lines and ESH-1 hybrid parental lines
E b j ; 2018 - 2021
S f jc rfi f ; Alemu T., Amare S., Tamirat B., Tokuma L., Rebuma M., Mesfin B.,
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f
Ef jh ; no design
U fb f ; 4 hybrids
M db j ; Melkassa

S f m
Parental lines of 527 A and B lines, 531 A and B lines and 633R line were planted for seed produced in 0.019 ha in Melkassa, 2019. Parental lines of ESH1 (A and B lines) were planted in 0.1296 ha in 2019 cropping season. Produced seed of parental lines will be used for hybrid seed production and breeding program

Figure 8. Parental seed production of ESH-1 (A and B), Melkassa, 2019
rb g i f f fb ; increased seed will be used for demonstration and hybrid breeding program

Bd j j 8/ Hybrid seed multiplication of ESH1
P ckfd j f; To avail enough hybrid seed of ESH1 for use demonstrations
E b j ; 2018-2021
S f jc rfi f ; Alemu T., Chalachew E., Hailemariam S., Kidanemariam W.
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f ;
Ef jh ; no design
U fb f ; 1
M db j ; Melkassa

S f m
ESH1 hybrid seed will be multiplied in a total of 0.25 ha in Melkassa in 2020 offseason.
rb g i f f fb ; produced seed will be used for demonstration purpose
Bd j j 9/ Hybrid seed multiplication of ESH4 (PU209 x PU304)
P ckfd j f; To avail enough hybrid seed of ESH4 for use demonstrations
S f jc rfi f ; Alemu T., Tamirat B., Rebuma M., Meron B., Mesfin B., Temesgen T.
E b j ; 2018-2021
S f fe c ; Tamirat B.
Zfb g f ; January - December 2019
T b g h f ;
Ef jh ; no design

U fb f ; 1
M db j ; Melkassa
S f m;
ESH4 hybrid seed will be multiplied in a total of 1 ha in Melkassa in 2020 offseason. Multiplied seed will be used for demonstration of ESH4 hybrid for upcoming cropping season
rb g i f f fb ; Will be done in the coming year

Feyera Merga
E-mail: feyeraliben@gmail.com, Phone: +251911673534

M rb e mf Bh S f fb di h b

kfd j rfi; Enhancing common bean production and productivity through generation, promotion and dissemination of integrated technologies for livelihood improvement, income generation and resilience to climate change in Ethiopia

kfd f j e ; July 2017 – June 2019

Bd j j 2; Evaluation of Common bean Varieties Compatibility to Intercropping with Maize in different agro ecologies.

Bd j j f j e ; July 2017 – June 2019

Pckfd j f; To select the best performing bean varieties in intercropping with maize at different agro-ecologies for higher productivity and profitability.

S f jc rfi f ; Fitsum M., Berhanu A., Dagmawit T., Abel M. and Behailu T.

S f fe c ; Fitsum Merkeb

Zfb g f ; January - December 2019

T b g i f h f

The activity was conducted for two years and the result has been discussed below

Ef jh ; RCBD

U fb f ; 3 bean varieties and 2 maize varieties (11 treatments)

M db j ; Melkassa, Meisso and Negelle Arsi

S f m

The two years research result indicated that there was a significant (P<0.05) yield difference among the treatments. Intercropping of maize variety Melkassa-4 with Awash-2 and Deme has given relatively higher bean yield at Melkassa and Negelle Arsi during the two experimental seasons. At Miesso maize variety Melkassa-4 with KAT-B1 gave higher yield in the first season. But in 2019 due to the extended rain fall at this area the early maturing KAT-B1 performance was low. System productivity analysis indicated difference in the land equivalent ratio (LER) among the systems in all site-season combination. Those treatments with LER values > 1 indicated that intercropping of bean varieties with maize has an advantage than practicing bean sole cropping. Therefore, from the result obtained it will be concluded that bean variety Awash-2 and Deme with Melkassa-4 maize variety at Melkassa and NegelleArsi, and at Miesso the early maturing bean variety with Melkassa^{-1} gave a relatively higher yield and can be used for intercropping at these locations.

Table 1. Response of beans and maize grain yield and Land Equivalent Ratio (LER) for sole and intercrop of maize with bean at Melkassa in 2018 and 2019 main cropping season

Treatments	2018	2019				
	MaizeGY (kg/ha)	Bean GY (kg/ha)	LER	MaizeGY (kg/ha)	BeanGY (kg/ha)	LER
Melkassa-2+ KAT-B1	3761^{cb}	726.3^{c}	0.88	1594.2^{b}	1268.7b	2.08
Melkassa-2+ Awash-2	3059^{c}	749.3^{c}	0.87	1734.6^{ba}	1385.3ab	1.98
Melkassa-2+ Deme	3993^{cb}	689.0^{c}	1.14	2070.1^{ba}	1389.3ab	2.27
Melkassa-4+ KAT-B1	2681^{c}	702.3^{c}	0.75	1904.1^{ba}	1429.9ab	1.81
Melkassa-4+ Awash-2	3790^{cb}	860.0^{cb}	1.09	1754.4^{ba}	1245.9b	1.82
Melkassa-4+ Deme	2394^{c}	701.0^{c}	0.94	1757.9^{ba}	1551.1ab	1.86
Melkassa-2(sole)	6702^{a}	---		2132.7^{a}	---	
Melkassa-4 (sole)	6145^{ba}	---		2001.4^{ba}	---	
KAT B^{-1} (sole)	---	2269.7^{a}		---	1683.4a	
Awash-2 (sole)	---	1831.0^{a}		---	1252.7b	
Deme (sole)	---	1263.7^{b}		---	1746a	
LSD5%	2525	509.7		518.6	337.5	
CV%	35.8	27.3		16.0	13.7	
Sig.	*	*		*	*	

Table 2. Response ofbeans and maize grain yield and Land Equivalent Ratio (LER) in sole and intercrop maize with bean at Meisso in 2018 and 2019 main cropping season

Treatment	2018			2019		
	MaizeGY (kg/ha)	BeanGY (kg/ha)	LER	MaizeGY (kg/ha)	BeanGY (kg/ha)	LER
Melkassa^{-1}+ KAT-B1	1594.2^{b}	798.2^{b}	1.55	1618.4b	1526.5bc	1.39
Melkassa^{-1}+ Awash-2	1734.6^{ba}	330.4^{d}	1.21	2248.7	1639.2ab	1.39
Melkassa^{-1}+ Deme	2070.1^{ba}	141.6^{e}	1.16	2476.9ab	1497.5bc	1.74
Melkassa-7+ KAT-B1	1904.1^{ba}	543.1^{c}	1.50	2696ab	951c	1.33
Melkassa-7+ Awash-2	1754.4^{ba}	303.6^{d}	1.24	2135.5ab	1721.8ab	1.37
Melkassa-7+ Deme	1757.9^{ba}	175.3^{e}	1.11	2071.5ab	1654.6ab	1.70
Melkassa^{-1}(sole)	2132.7^{a}	---		3358.1a	---	
Melkassa-7 (sole)	2001.4^{ba}	---		3504.3a	---	
KAT B^{-1} (sole)	---	995.3^{a}		---	1689.6ab	
Awash-2 (sole)	---	827.7^{b}		---	2266.2a	
Deme (sole)	---	749.4^{b}		---	1496.1bc	
LSD5%	518.6	120.4		1673.2	680.9	
CV%	16.0	12.9		38.4	24.7	
Sig.	*	*		*	*	

Table 3. Response of beans and maize grain yield and Land Equivalent Ratio (LER) in sole and intercrop maize with bean at Negelle-Arsi, 2019 main cropping season

Treatment	2019		
	Maize yield (kg/ha)	Bean yield (kg/ha)	LER
Melkassa-2+ KAT-B1	1841.8bc	1308.2de	1.47
Melkassa-2+ Awash-2	2033.6abc	1772.0b-e	1.28
Melkassa-2+ Deme	1521.7c	2781.9a-d	1.29
Melkassa-4+ KAT-B1	2058.0abc	1162.2e	1.52
Melkassa-4+ Awash-2	1804.3bc	3250.9ab	1.68
Melkassa-4+ Deme	1440.6c	3090.4abc	1.37
Melkassa-2(sole)	2689.8a	---	
Melkassa-4 (sole)	2523.8ab	---	
KAT B^{-1} (sole)	---	1658.5cde	
Awash-2 (sole)	---	3370.4a	
Deme (sole)	---	3850.2a	
LSD5%	737.4	1528.8	
CV%	21.4	36.1	
Sig.	*	*	

rb g i f f fb ;The trial is completed

Bd j j 3; Selection of different common bean varieties for irrigation production
Bd j j f j e ; July 2017 – June 2019
P ckfd j f; To select the best performing bean varieties for irrigated system at different agro-ecologies for higher productivity and profitability.
S f jc rfi f ; Fitsum M., Berhanu A. (Dr.), Shimels Alemayehu
S f fe c ; Fitsum Merkeb
Zfb g f ; January - December 2019
T b g i f h f

The trial is conducted at Melkassa and Werer using twelve large seeded bean varieties and nine small seeded bean varieties as a separate experiment to clearly identify which variety will suit for irrigation production.

Ef jh ; RCBD
U fb f ; 12 large seeded and 9 small seeded bean varieties
M db j ; Melkassa and Werer

S f m

From the small seeded genotypes used Awashe-2 resulted significantly higher grain yield (3426.8kg ha^{-1}) followed by Awash Miten (3182.7 kg ha^{-1}) variety under irrigation production. From the large seeded bean varieties, Cranscop and Goberasha, were gave relatively higher yield. Pod clearance (PC) from the ground is one of the parameters for selecting the varieties as the best fit for irrigation production, and it showed significant differences between the varieties. KAT-B-9, KAT-B^{-1}, Awash melka and Awash-2 were recorded the lowest distance from the ground to the tip of the pod, but Deme and Melkadima recorded higher PC

Table 4. Response of small seed common bean varieties yield and yield components for irrigation

Genotypes	PH	PC	PPP	SPP	SW	GY
KAT B^{-1}	26.0c	8.2dc	13.8c	3.1ab	30.3ab	2384.8c
$SER^{-1}19$	44.3a	11.3ba	18.5c	3.7ab	24.0bcd	2510.3bc
$SER^{-1}25$	48.3a	12.0a	21.4bc	2.2b	22.1cde	2690.8bc
Awash Melka	44.0ab	7.9cd	19.4c	2.7ab	26.1bc	2576.5bc
$Awash^{-1}$	43.6ab	8.4bcd	40.3ab	3.0ab	16.3e	2476.3c
Nasir	46.6a	8.9bcd	11.4c	2.4ab	16.5e	2660.7bc
KAT-B9	25.6c	6.2d	14.4c	2.3b	35.5a	2686.1bc
Awash-2	47.6a	8.2cd	43.4a	3.3ab	18.3de	3426.8a
Awash Miten	37.6b	10.5abc	28.1abc	4.0a	19.9cde	3182.7ab
LSD5%	6.35	2.9	20.2	1.68	7.39	692.7
CV%	9.15	18.8	50.5	33.1	18.5	14.7
Sig.	*	*	*	*	*	*

Note: PH-plant height, PC-pod clearance from the ground, PPP-pods per plant, SPP-seeds per pod, SW-seed weight and GY-grain yield

Table 5. Response of large seed common bean varieties yield and yield components for irrigation

Genotypes	PH	FD	MD	PC	PPP	SPP	SWg	GY
DRK	32.6f	38e	83.6ab	9.3dc	12.1e	2.5abc	35ab	2147.9bc
GLP-2	50.0ab	41d	80.3b	12.0abcd	25.9ba	2.3bc	29.7b	2475.6abc
Goberasha	46.3bc	42c	83.6ab	11.6bcd	23.4abc	2.7ab	30.3b	2601.2ab
Deme	52.0a	43a	83ab	16.0a	25.8ab	2.5abc	30b	2342.2abc
IBADO	39.3d	42.3b	85ab	9.3cd	17.9bcde	2.4bc	34.6ab	2461.4abc
BFELS-5	38.3de	42c	88.6a	10.6cd	16.1cde	2.5abc	39.4ab	2097.2bc
AdamituluJidokombolcha	32.0f	41d	85.6ab	8.0de	22.1abcd	2.6abc	30.1b	1941.2c
SAB-736	29.3f	43a	82.6ab	4.7e	30.2a	2.6abc	30.5b	2272.4abc
Cranscope	48.6ab	42c	85.3ab	13.0abc	14.2de	2.5abc	41.8ab	2779.5a
Melkadima	41.3cd	38e	83.6ab	15.6ab	24.9abc	2.1c	29.8b	2207.4abc
BZ-2	33.6ef	38e	85.6ab	10.0cd	18.4bcde	2.6abc	36.4ab	2488.1abc
SAB-632	40.3d	43a	83.3ab	8.7de	10.9e	3.1a	45.9a	2122.8bc
LSD5%	5.48	0.28	7.8	4.1	8.9	0.6	14.4	629.8
CV%	8.1	0.4	5.5	22.6	26.2	14.6	24.8	16.1
Sig.	*	*	*	*	*	*	*	*

Note: PH-plant height, FD-flowering date, MD-maturity date, PC-pod clearance from the ground, PPP-pods per plant, SPP-seeds per pod, SW-seed weight and GY-grain yield

Plan for the next year:

The trail will be conducted in 2020 off season to get the required data at two seasons as planned.

Bd j j 4; Growth and Yield Response of Mungbean (*vignaradiata L.*) to different row spacing's and irrigation rate

Bd j j f j e ; July 2018 – June 2019

P ckfd j f ;

- To determine the appropriate row spacing for mungbean in irrigation production
- To identify the optimum crop water requirement for mungbean.

S f jcnfi f ; Fitsum M., Berhanu A. (Dr.), Ketema and Kasaye Abera

S f fe c ; Fitsum Merkeb
Zfb g f ; January - December 2019
T b g i f h f
The trail was conducted at Melkassa and Mehoni using mungbean variety N-26. Necessary data were collected and analyzed as planned to identify best spacing and irrigation rate for mungbean production in the lowlands of Ethiopia.
Ef jh ; split plot
U fb f ; 3 irrigation rates and 3 row spacing's
M db j ; Melkassa and Mehoni

S f m
The result indicated that except the pod length all the parameters were significantly (P<0.05) affected by the irrigation rate. The highest grain yield was recorded from 75% IR and no significant difference in RS.

Table 6. Growth, yield and yield components of mungbean as affected by the main effects of irrigation rate and row spacing are at Melkassa 2011 E.C offseason.

Treatment	Plant height (cm)	Pod Length (cm)	Seed per pod	Pod per plant	1000SW (g)	Grain yield (kg ha-1)
Irrigation rate						
100	39.0a	10.3	10.5a	23.8a	47.7a	2898.2ab
75	35.1b	10.2	9.7b	20.1b	39.7b	**3: 88/: b**
50	32.0c	10.8	8.4c	17.5c	35.5c	2863.0b
LSD	2.15	NS	0.63	2.32	2.49	95.3
Row spacing						
30	35.4ab	10.5	9.4	19.0b	40.3ab	2935.5
40	36.4a	10.3	9.8	22.8a	42.6a	2886.4
50	34.2b	10.5	9.3	19.6b	40.1b	2917.3
LSD	2.15	NS	NS	2.32	2.49	NS
CV%	6.22	8.49	6.85	11.5	6.21	3.34

kfd j rfi; Low moisture, heat stress and irrigated maize in Ethiopia
kfd f j e ; July 2019 to June 2020
Bd j j 2; Effects of nitrogen fertilizer rate on maize and bean growth & yield under different tillage and cropping system at MARC
Bd j j f j e ; July 2019 to June 2020
P ckfd j f ;

- To determine appropriate N rate that could reduce the N immobilization caused by the 100% crop residue retention study previously established at Melkassa
- To assess the performance of different cropping system with added N rate under contrasting tillage systems.
- To quantify economic and environmental benefit of rotation and intercropping

S f jc rfi f) *; Bahiru Tilahun, Getachew Jimayu, Feyera Merga & Dejene Abera
S f fe c ; Bahiru Tilahun
Zfb g f ; January - December 2019
T b g i f h f
The experiment was conducted as per the plan for the first year. Pre plant composite soil samples were collected and analyzed for soil physical and chemical properties. Crop data were analyzed for growth, yield and yield related parameters. Maize and bean yield and all the other parameters recorded were not affected by the interaction effect of factors. But maize and bean yield and yield components were significantly affected by the main effect of tillage types, nitrogen rate and cropping system.
Ef jh ; Split-split plot

U fb f ; 2 tillage practices (CP vs CA), 4 cropping systems (SM, SB, MBI & MBR) and 4 NR (0,20.5,41&61.5)

M db j ; MARC on station

S f m

Table 1. Maize growth, yield and its components as affected by tillage, Croppingsystemand Nitrogen rates

	LAI	SPAD	SW	BM	AGY	HI
Main plot (Tillage)						
CP	2.98	41.9	4179	9183	3136a	42.6
CA	2.43	39.9	3337	7744	2723b	40.5
LSD (0.05)	Ns	Ns	1454	1538.4	246	8.4
CV (%)	22.85	19.87	31.1	14.61	6.75	16.24
Sub-plot (Cropping system)						
SM	2.75	42.2	3591	8603	3183a	43.8a
MBI	2.67	39.6	3925	8324	2675b	39.4b
LSD	Ns	Ns	757	1004	197	3.2
CV (%)	22.8	15.23	25.12	14.29	8.36	9.57
Sub-Sub-plot (Nitrogen Rate (Kg/ha)						
N4 (61.5)	2.87	46.88a	4087a	9369a	3426a	42.4
N3 (41)	2.86	45.46ab	4048a	8738a	2933b	39.8
N2 (20.5)	2.8	38.42bc	3738ab	8818a	3168b	43.3
N1 (0)	2.31	32.88c	3159b	6929c	2190c	40.8
LSD (0.05)	Ns	7.28	777	861	236.9	3.9
CV (%)	28.5	15.79	18.4	9.04	7.18	8.26

Growth parameters like LAI were not affected by the main effects of tillage, nitrogen, cropping system and their interactions. The SPAD reading (chlorophyll) was significantly affected only by the main effect of nitrogen fertilizer rate.The highest maize chlorophyll (SPAD) concentration was from 61 kg N ha^{-1} rate followed by41 kg N ha^{-1}. Furthermore, yield and yield components of maize were significantly affected by the main effects of nitrogen rate. But only grain yield was affected by the main effects of tillage and cropping system. Grain yield was greater with conventional tillage and sole maize cropping system though higher land productivity was from maize-bean intercropping system (Table 1).

Table 2. Haricot bean growth, yield and yield components as affected by tillage, cropping system and nitrogen rates

	LAI	SW	BM	AGY	HI	TSW
Main plot factor (Tillage)						
CP	5.03	2019	4608	2588.4a	56.7	271.9
CA	4.57	1800	4208	2408.3b	58.1	256.9
LSD (0.05)	Ns	331.3	454.3	123.5	4	21.81
CV (%)	31.89	17.26	10.4	5.16	6.87	8.13
Sub-plot factor (Cropping system)						
MBR	4.71	2537a	5728a	3190.8a	55.88b	251b
SB	4.28	2326a	5413a	3086.6a	57.67a	267ab
MBI	5.4	866b	2084b	1217.7b	58.63a	275a
LSD	Ns	259	433.7	185.7	1.78	17.6
CV (%)	34.37	20.83	15.12	11.41	4.67	10
Sub-Sub-plot factor (Nitrogen Rate (Kg/ha)						
N4 (61.5)	4.95	2180a	4773a	2593a	54.89b	282a
N3 (41)	4.57	1711c	4170b	2459ab	59.11a	266ab
N2 (20.5)	5.29	2012b	4428b	2526ab	55.22b	256ab
N1 (0)	4.375	1735c	4261b	2416b	60.33a	254b
LSD (0.05)	Ns	149.2	284.5	175.2	1.78	26.64
CV (%)	26.22	11.59	9.55	10.42	4.58	14.9

Except the grain yield all growth, yield and yield related parameters of common bean were not affected by the main effect of tillage (Table 2). Bean grain yield was greater with conventional tillage practice (CP) compared to conservation tillage (CA). Yield and all yield related parameters were significantly affected by main effects of cropping system and nitrogen fertilizer rates. Stover, biomass and grain yield of common bean was higher for maize-bean rotation and sole bean as compared to maize-bean intercropping.

rb g i f f fb : Since this is a long-term conservation agriculture experiment with permanent plot, the trial will be continued under the new project.

Bd j j 3; Validation of plant population densities of maize varieties in CRV of Ethiopia
Bd j j f j e;

S f fe c ; Tewodros Mesfin
Zfb g f ; January - December 2019
T b g i f h f
The experiment was conducted as planned at Meiso and Fedis and the trial will be completed by 2020. The objective was to assess productivity of crop intensification options through incorporating different legumes into the sorghum-based system Determine the trade-offs between economic return-risks of double cropping systems
Ef jh ; The experimental design was a split-plot with cropping systems as main plots and three rates of N fertilizer application as subplots.
U fb f ; Cropping systems (main-plots treatment)
1. Local sorghum cultivar (LS)
2. Fallow–Short-cycle Sorghum cultivar (SCS)
3. Cowpea (CP)–SCS
4. Common beans (CB)–SCS
5. Mung bean (MB)–SCS

N fertilizer levels (sub-plots treatment)
1. 0 kg N ha^{-1}
2. 30 kg N ha^{-1}
3. 60 kg N ha^{-1}

M db j ; Mieso and Fedis (West and East Hararge Zone)

S f m
Overall, our results show that the double cropping systems resulted in higher sorghum grain yield at both study sies in both Meiso and Fedis (Fig 1).

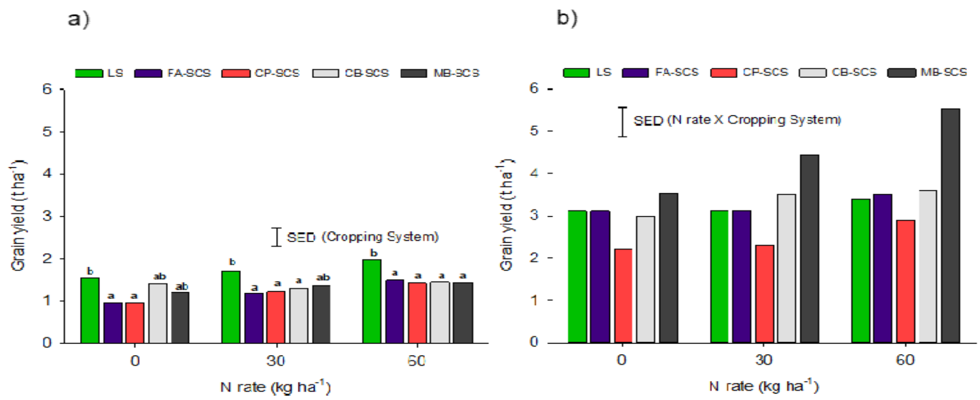


Fig 1. Effect of cropping system on grain yield at Meiso (a) and N rates by cropping systems on grainyield at Fedis (b)

The total productivity of the sequential double cropping system, such as CB–SCS or MB–SCS system, as the mean grain yield of early sorghum variety plus the common bean or mung bean mean grain yield was greater than the mean grain yield in the continuous fallow–sorghum system or long-season landrace (ca. 1000 to 1200 kg ha^{-1}) when averaged across the different level of N application in both systems (Fig. 2). Rotations also allow farming households to maintain a greater or equal chance of meeting household calorie and protein needs with their own production.

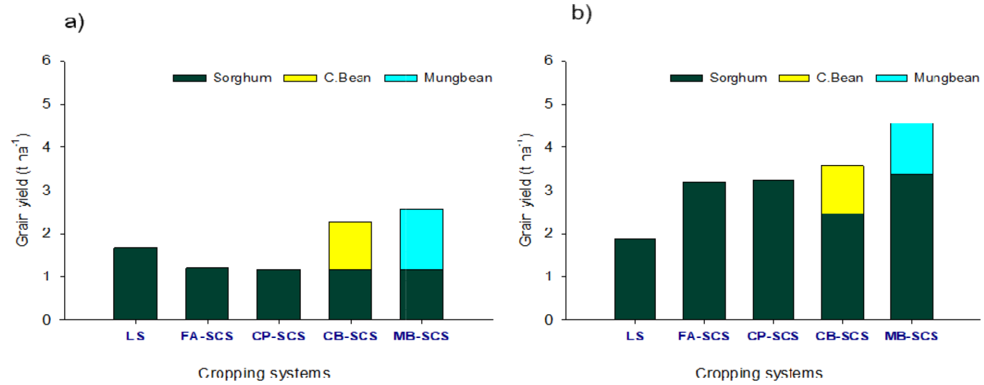


Fig 2. Effect of different cropping systems on total crop productivity when the grain yields of both
Preceding legumes and preceding sorghum grain yields combined at Meiso (a) and at Fedis (b) area

rb g i f f fb

The experiment is completed last year in 2019. The long-term benefit of introducing sustainable intensification of sequential legume - sorghum double cropping systems will further be verified from applying crop simulation modeling capability in assessing whether crop intensification options through sequential double cropping can lead to improved productivity, system profitability and financial risk for the semi-arid region of Ethiopian the face of variable and changing climates. The research work will be communicated through publications by submitting to the peer-reviewed journal publication sometimes this year.

kfd 3; Climate-resilient integrated nutrient and crop management practices

kfd f j e ; July 2017 - June 2020

Bd j j 2; Response of Sorghum Hybrid (ESH-1) to Different Plant Densities and N &P fertilizer Rates

Bd j j f j e; July 2017 - June 2020

P ckfd j f; To determine optimum plant density and application of inorganic N and P fertilizer rates for the recently released sorghum hybrid

S f jc rfi f ; Tewodros M, Mohammed S.

S f fe c ; Tewodros Mesfin

Zfb g f ; January - December 2019

T b g i f h f

The experiment was conducted as planned and will be completed by 2019 to draw a final conclusion in determining the optimal level of plant density and rates of N and P fertilizer. The objectives were to determine optimum plant density and application of inorganic N and P fertilizer rates for the recently released sorghum hybrid

Ef jh ; The experimental design was arranged as a factorial combination of three treatments in randomized block design (RCBD).

U fb f ; Five Nitrogen level (N; Kg ha^{-1}): *0, 23, 46, 69, 92*; Three Phosphorus level (P; kg ha^{-1}): *0, 20, 40*; Two Plant density (PD; plants ha^{-1}): *66,600* and *88,800*

$$Y_{ijkl} = \mu + Block_i + \underbrace{N_i + P_k + PD_l}_{\text{Main effects}} + \underbrace{(N.P)_{ik} + (N.PD)_{il} + (P.PD)_{kl}}_{\text{2-factor interactions}} + \underbrace{(N.P.PD)_{jkl}}_{\text{3-factor interactions}} + \varepsilon_{ijkl}$$

M db j ;Miesso (W. Hararge)

S f m

Only the main effect of year (Yr.), Nitrogen (N) and plant density (PD) was significant for grain yield (Table 2and Fig3a). The quadratic response to the main effect of N was also significant. The grain yield increased consistently increased up to 40 kg N ha^{-1} and start to drastically declined beyond that level. The three-way PD, ′N, and P interaction was not significant, and neither were any of its linear, quadratic polynomial responses. The non-significant three-way interaction may have been due to the almost parallel response of grain yield at each of the PD for all levels of N rates and at all P rates. Similarly, the response of grain yield to all P rates for each of the two PD and five N rates didn't show any cross-over effect or any change in magnitude across levels tested. In this data set, the two-way interactions (N x P) were significant (Table 1). Any conclusions depending on only main effects or combinations of main effects cannot be drawn when pertinent crossover interaction (COI) or interaction because of treatment rank change are significant. In this study, inconsistent responses to the P treatment relative to the different levels of N due to [COI]) (Fig 3b). Similarly, the two-way interaction of yr. and P was significant including the linear and quadratic responses of P in the yrx P interaction (Fig 3c). This shows that the response to the application of P is season-dependent.

Table 1. p value for grain yield (kg ha^{-1}) for main effects, two-way, and three-way interactions inan experiment that tested N and P fertilizer (0, 23, 46, 69 and 92 kg N ha^{-1} and 0, 20, and 40 kg P ha^{-1}) in 2 yr ondense and sparse plant density (66,600 and 88,800 plants ha^{-1}).

Main effect or interaction	† NDF	‡ DDF	P value		
				Partitioned contrasts§	
				Linear	Quadratic
Year (Yr)	1	4	0.021	0.05	
Nitrogen (N))	4	116	0.03		
Phosphorous (P)	2	116	0.458		
Plant density (PD)	1	116	0.002		
Yr x N	4	116	0.105	0.032	0.275
Yr x P	2	116	0.057	0.008	0.050
N x P	8	116	0.004		
Yr x PD	1	116	0.16		
N xPD	4	116	0.134		
P x PD	2	116	0.247		
Yr x N x P	8	116	0.063		
Yr x N x PD	4	116	0.151	0.078	0.039
Yr x P x PD	2	116	0.026		
N x P x PD	8	116	0.349		
Yr x N x P x PD	8	116	0.310		

Rates of N and/or P and are partitioned into linear, quadratic, and cubic polynomial Contrasts † NDF, numerator degrees of freedom, ‡ DDF, denominator degrees of freedom

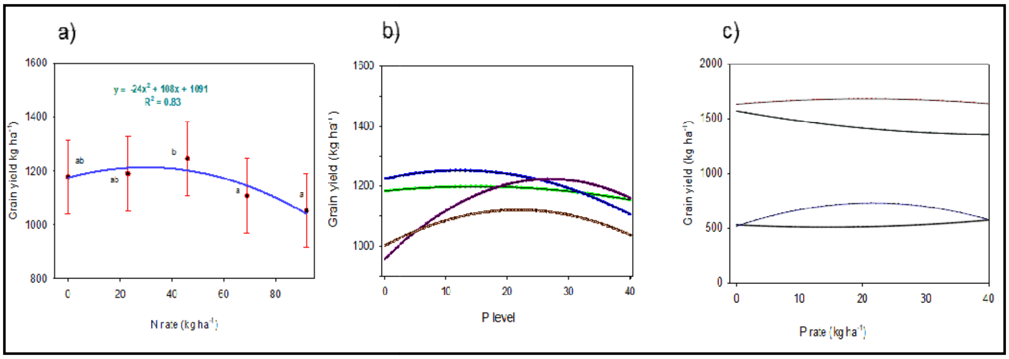


Fig 3. Effect of N fertilizer averaged across different P rates and plant density levels and two years on grain yield of sorghum (a), effect of P averaged over N and plant density levels (b),

and. quadratic responses of grain yield to P fertilizer level for Yr x PD x P interactions at Meiso

rb g i f f fb ;

The experiment will be completed by 2020 and the long-term benefit of introducing sustainable intensification of sequential legume-sorghum double cropping systems will further be verified from applying crop simulation modeling capability in assessing whether crop intensification options through sequential double cropping can lead to improved productivity, system profitability and financial risk for the semi-arid region of Ethiopian the face of variable and changing climates.

Bd j j 3; Exploring Genotype, Management, and Environmental Variables (GxExM) influencing Grain yield of Sorghum under Semi-Arid Environment of Ethiopia (21-12-32)

Bd j j f j e; July 2018 - June 2020

P ckfd j f; Evaluate the influence of different genotype, management, and environmental predictors on grain yields of sorghum, and to define the model that best describes the observed data using mixed-effects models.

S f jcrfi f ; Tewodros M, Mohammed S, H/Gebreal and Tadesse

S f fe c ; Tewodros Mesfin

Zf b g f ; January - December 2019

T b g i f h f

The experiment was conducted at three widely spread area in the semi-arid rift valley region in Ethiopia.

Ef jh ; The linear mixed-effects models to assess the influence of different predictor variables on grain yield. Residual maximum likelihood estimation was used to model variance in the response of total biomass, yield, grain number and weight, and tiller yield, for each trial to structural (block) and fixed (treatments and their interaction) effects (α=0.05). Initially, all statistical tests were performed using the ASReml package (Butler et al., 2007) in the R environment (R Core Team, 2017).

U f b f ;

Management predictors

1. Planting configuration: full configuration and single skip
2. Stand density: Normal and dense plant population
3. N fertilizer level: 0N and 50N kg ha^{-1}

Environmental predictors

1. Soil type (plant available water content; PAWC plus fertility status)
2. Rainfall during the crop cycle (in-season rain)

Genotype predictor

1. LAI at anthesis of cvs.;*Meko, Gambela*$^{-1}$*107, Teshale* and a hybrid; *ESH*$^{-1}$

M db j Mieso, Kobo and Sheraro (W. Hararge, N. Wollo and E. Tigrai Zone)

S f m

According to linear mixed model, assuming the three location and two years (2018 and 2019) as random terms, it was so interesting that there was four-way interaction effect for genotype by plant configuration, plant density and N rates (Table 3).

Table 3. GenStat's Linear Mixed Model (REML) analysis of the sorghum grain yield with a randomblock effect nested within location and a random error whose variance is constant over blocks and treatments

Fggfd	**/e/g/**	**G b j jd**	**e/e/g/**	**G**
Genotype (G)	3	2.12	6	0.199
Planting configuration (PC)	1	0.87	40	0.356
Plant density (PD)	1	0.18	40	0.674
N rate (N)	1	52.63	40	**=1/112**
G X PC	3	1.86	40	0.152
G X PD	3	0.69	40	0.565
PC X PD	1	0.62	40	0.435
G X N	3	0.62	40	0.607
PC X N	1	0.14	40	0.705
PD X N	1	2.35	16	0.145
G X PC X PD	3	2.05	40	0.122
G X PC X N	3	1.44	40	0.245
G X PD N	3	1.24	16	0.328
PC X PD X N	1	0.96	16	0.341
G X PC PD X N	3	7.77	16	**1/113**
	In a model with no four-factor information Dropping individual terms from full fixed model			
Fixed term	n.d.f.	F statistic	d.d.f.	F pr
G X PC PD X N	3	7.77	16	0.002
Covariance parameter estimate		Variance component	SE	
Rep (Location)		14322	43116	
Residual		127594	28531	

rb g i f f fb ;

The experiment is completed in 2019.The research result will be present at the national agronomy conference sometime in 2020.

Bdj j 4; Development of fertilizer and plant population management options for the newly released sorghum variety

Bdj j f j e ; July 2019 to June 2021

Pckfdj f; Determine optimum plant density and application of inorganic N and P fertilizer rates for the recently released sorghum hybrid

Sf jcrfi f) *; Tewodros M., Alemayehu B., Abraha A., and Welegerima G.

Sf fe c ; Tewodros Mesfin

Zfb g f ; January - December 2019

T b g i f h f

Ef jh

2/P . bj F f j f

The experimental design in all locations was a randomized complete block with a 2x2x3 factorial treatment structure and three replicates.

3/GUD jbm

A randomized block design was used to compare the various treatments.

U fb f

2/P . bj F f j f

Three treatment factors were plant density, variety and NP fertilizer rates. The treatment factors consisted of two plant densities (66,666 and 88, 888 plants ha^{-1}), (two early-maturing varieties (cvs. Melkam and Argyty) and three NP fertilizer rates (0 N–0 P, 23 N–10 P, and 46 N–20 P kg ha^{-1}).

3/GUD jbm

The treatments included were: 1) old locally adapted variety (cv. Melkam) along with current local farmers' practice; 2) newly released variety (cv. Argity) along with the current farmers' practice; and 3) new variety (cv. Argity) in combination with a row planting at 88, 888 plants ha^{-1}, and fertilizer application of 41 N and 16 P kg ha^{-1} along with tied-ridging for soil moisture retention

M db j ; 2. *On-station Experiment*-Erer, Kobo and Sheraro and **3/ *FTC trials.*** Fedis, Kobo and Sheraro

S f m

2/ P . b j F f j f

Physico-chemical characteristics of the three soils at the experimental sites in Erer, Kobo and Sheraro research stations are presented in Table 3. Composite soil samples of 6 to 10 cores for the 0- to 30-cm depth were collected for each site before planting and fertilizer application. Soil order is Vertisol (Table 3) with texture class of clay. The soil was of low soil organic matter by the Walkley-Black Method (Nelson and Sommers, 1996). Soil pH was near neutral with low P availability at Erer, while moderate to high level in Kobo and Sheraro site, respectively.

Table 3. Site information for three agronomic trials conducted in semi-arid sorghum production areas of western north-eastern and northern Ethiopia, 2019

Tj f f	F f	L c	Ti f b
Coordinates	8°22'N 42°19'E	12°16'N39°63'E	14°6′N38°17′E
Elevation, m	1,702	1,470	1,900
Soil type	Vertisol	Vertisol	Vertisol
Clay, g kg^{-1}	460	450	650
Silt, g kg^{-1}	160	425	210
Sand, g kg^{-1}	380	125	140
Textural class	Clay	Clay	Clay
pH H_2O (1:2.5)	7.8	6.3	6.6
Organic carbon, g kg^{-1}	3.7	9.2	12.9
Kjeldahl N, g kg^{-1}	0.7	1.5	0.8
Olsen available P, mg kg^{-1}	1.9	12	43.6
CEC, cmolc kg^{-1}	14.4	25.6	14.9

Rainfall at Erer and Kobo area is generally bi-modal. The short rainy season (March-May), locally known as *Belg*, is characterized by light and highly variable rainfall. The main rainy season (June–September) is locally called *Kiremt,* and provides more reliable, less variable (Fig 4).

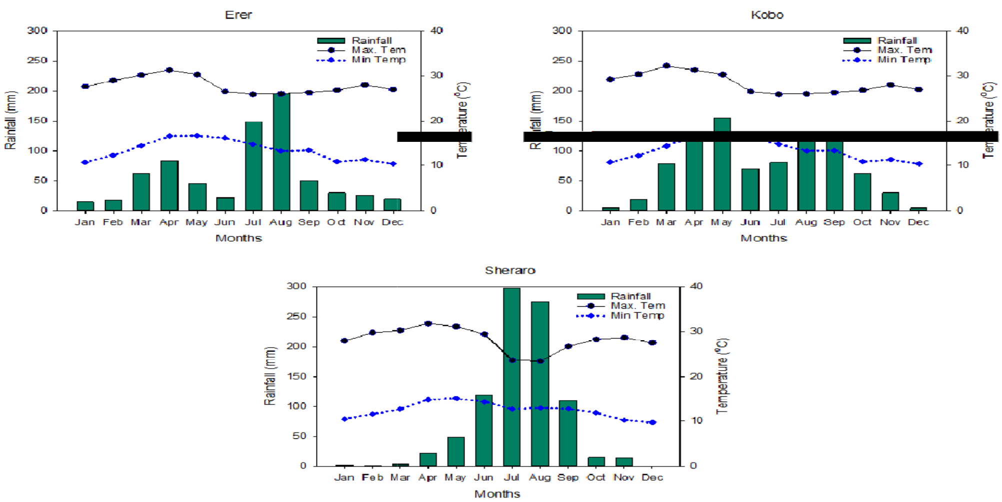


Fig 4. Climate at Erer, Kobo and Sheraro, Ethiopia (> 15 years average): mean monthly rainfall (bars) and mean monthly maximum and minimum temperatures sorghum is grown from July until October

Cumulative rainfall for the growing season at CRV ranged from 520 mm at Miesso to 540 mm at Kobo in 2019 (Fig. 5). Rainfall amount after planting between July and October was just 230 and 285 mm, respectively, at Fedis and Kobo. Approximately 80 and 75% of the rainfall fell in July and August at Fedis and at the other locations, respectively. Rainfall data for the 2019 season was not available for the Sheraro site.

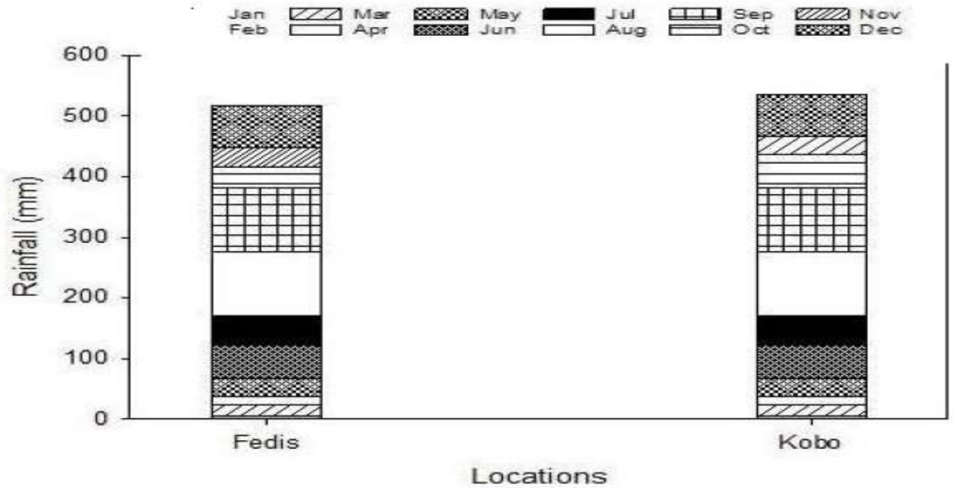


Fig. 5. Cumulative annual rainfall distribution at two sites in 2019 in Ethiopia.

For the on-station trials, the different plant populations are achieved by varying within plant spacing, which range from 0.15 to 0.20 m, the difference from one spacing to the other being 0.05 m. No fertilizer will be applied in the 0-0 kg ha^{-1} N-P treatment, which represents the management practiced by most farmers in the target areas. Based on the treatments, the NPS fertilizer was band applied at the time of sowing. In the 23 $^{-1}$0 kg ha^{-1} N-P and 46 -20 kg ha^{-1} N-P treatments, the quantity of N and P in NPS fertilizer was subtracted (i.e. 5 kg and 10 kg N ha$^{-1,}$ respectively) and an additional N from urea was side-dressed at the rates of 18 and 36 kg N ha^{-1}, respectively, at four to five weeks after emergence. Other cultural practices like weeding and plant protection methods were done uniformly for all experimental plots as per the local recommendations.Measurements and data, such as the date of emergence, stand count, date of heading, record of fall armyworm incidence and damage severity (e.g. in Oromiya, Erer and Amahara, Kobo), record of wind lodging (e.g. in Tigray, Sheraro), will be collected as per the trial protocol.
A three-way analysis of variance (ANOVA) to evaluate the effect of plant density, cultivar and NP fertilizer on phenology, biomass and grain yield and its component.

Y= Block + PD + V +NP + PD.V + PD.NP + V.NP + PD.V.NP+ error(Eq. 1)
The ANOVA combined over locations has an expanded model that includes location effects and interactions. For our example, the analyses of grain yield combined over locations are shown using the linear models

Y= Block (Loc) + PD + V +NP + PD. V + PD.NP + V.NP + PD.V.NP+ Loc. PD + Loc.V + Loc.NP +Loc.PD.V + Loc.PD.NP + Loc.V.NP + Loc.PD.V.NP + error(Eq. 2)
Heterogeneity in error variances between locations was assessed by fitting a model with locations, blocks within location, treatment as a fixed factor, and, calculating the residuals from that fitted model.

The ANOVA was first conducted for each location as a separate experiment (Table 4). A separate ANOVA at each location avoids issues related to heterogeneity of error variancesacross locations that occur with using a pooled residual error averaged over locations.

Table 4. Simple ANOVA for grain yield (kg ha^{-1}) at three locations

Source	Effect†	DF	Errer		Kobo		Sheraro	
			F (MS) ¥ value	P>F	F (MS) value	P>F	F (MS) value	P>F
Block	RE	2	-	-				
PD	F	1	6.93	*	<1	ns	15.43	***
V	F	1	<1	ns	7.40	**	1.42	Ns
NP	F	2	3.09	***	2.28	ns	1130	***
PD x V	F	1	<1	ns	4.04	ns	57.92	***
PD x NP	F	2	2.32	ns	2.55	ns	13.13	***
V x NP	F	2	3.4	ns	1.09	ns	7.08	**
PD x V x NP	F	2	10.88	***	1.30	ns	49.04	***
Error	RE	22	(57217)		(108103)¥		(7785)¥	

*† Effect Type: fixed (F) or random error (RE); ¥ F-values for fixed effect, MS values in parentheses for random effects. *Significant at the 0.05 probability level; ** Significant at the 0.01 probability level; *** Significant at the 0.001 probability level. PD=Plant density; V=Variety; NP=N-P fertilizer*

The ANOVA combined over locations has an expanded model that includes location effects and interactions. For the combined ANOVA analysis across the tested locations, the results (Table 5) showed that all the traits were affected by the main effects of location and variety, except for days to maturity. The main effects of treatments are presented in Tables 3. The only effects that were not significant for any of the traits tested were the main effect of PD, two-way interaction of V x NP, and the three-way interactions of Loc x PD x Var, Loc x PD x NP and Loc x Var x NP. The three-way PDxVxNP interaction was not significant. The grain yield was affected by the main effect of variety (V), NP fertilizer rate (NP), and by the two-way interactions of location (Loc) x plant density (PD), Loc x V, Loc x NP, PD x V, and PD x NP (Table 5). The lack of V x NP interaction was due to near parallel response of the varieties to the application of fertilizer even though yield levels differed. While statistically significant, the three-way interaction of PD x V x NP was not of agronomic significance as it accounted for less than 1% of the treatment-related variation in grain yield while NP rates overall accounted for 46% of the variation. (data not shown).

Table 5. p value for grain yield (kg ha^{-1}) for main effects, two-way, and three-way interactions in an experiment that tested two varieties (cvs. Melkam and Argity), three NP fertilizer rates (0N-0P, 23N-10P, and 46N-20P kg ha^{-1}), and sparse and normal plant densities

Effects	NDF†	DDF‡	Days to heading	Days to maturity	Plant height	Panicle length	Thousand kernel wt.	Grain yield
Location (Loc)	2	6	<0.001	0.723	<0.001	0.002	<0.001	<0.001
Block(Loc)			(19.42)	(1323)	(0.0820)	(0.00310)	(6.97)	(22269)
Plant density (PD)	1	66	Ns	ns	Ns	Ns	Ns	ns
Variety (V)	1	66	0.007	ns	0.011	<0.001	<0.001	0.011
NP fertilizer (NP)	2	66	Ns	ns	<0.001	Ns	0.01	<.001
Loc x PD	2	66	Ns	ns	0.018	Ns	Ns	0.018
Loc x Var	2	66	Ns	<0.001	0.035	<0.001	0.028	0.035
PD x Var	1	66	Ns	ns	0.002	Ns	Ns	0.002
Loc x NP	4	66	Ns	ns	<0.001	Ns	Ns	<.001
PD x NP	2	66	Ns	ns	<0.001	Ns	Ns	<.001
Var x NP	2	66	Ns	ns	Ns	Ns	Ns	ns
Loc x PD x Var	2	66	Ns	ns	Ns	Ns	Ns	ns
Loc x PD x NP	4	66	Ns	ns	Ns	ns	Ns	ns
Loc x Var x NP	4	66	Ns	ns	Ns	ns	Ns	ns
PD x Var x NP	2	66	Ns	ns	<0.001	ns	Ns	<0.001
Loc x PD x Var x NP	4	66	Ns	ns	<0.001	ns	Ns	ns
Residual			(13.70)	(7.483)	(0.0538)	(0.0009)	(10.60)	(59428)
Cv%			4.5	2.3	14.2	12.8	12.5	11.3

† NDF, numerator degrees of freedom of fixed effects; ‡ DDF, denominator degrees of freedom of fixed effects

The mean sorghum grain yields were 1867, 2210, and 2408 kg ha^{-1} at Fedis, Kobo and Sheraro, respectively. In the analysis averaged across location, application of 23 N^{-1}0 P kg ha^{-1} did result in yield gain over the no fertilized treatment by 623 kg ha^{-1} (Table 6). The simple effect for the V x NP interaction was significant for grain yield at Erer with cv. Argity but not with cv. Melkam having a significant 86% yield increase over zero NP treatment when it was applied with 23 N^{-1}0 P kg ha^{-1}, but with no significant yield increase for >23^{-1}0 N-P kg ha^{-1} applied. At Sheraro, grain yield was increased over no fertilized treatment with application of 23^{-1}0 and 46-20 N-P kg ha^{-1}, by 40-81% for cv. Argity and 90^{-1}32% for cv. Melkam, respectively. The Loc × NP interaction was significant (Table 6) with a relatively large response to NP, with an average yield advantage of 1411 kg ha^{-1} and 770 kg ha^{-1} for Sheraro and Erer, respectively, and a relatively low response to NP, with an average gain in yields of 243 kg ha^{-1} for Kobo (Table 6). There was no response to fertilizer application at Kobo, which is in the north-eastern part of Ethiopia. And the lack of greater response to applied N-P fertilizer was probably from the soil water deficit because of the poor rainfall distribution at around flowering stage that caused the major yield-limiting factor for sorghum at Kobo.

Table 6. Effect of PD x V x NP on sorghum grain yields at Errer and Sheraro and effect of variety on grain yield of sorghum at Kobo site.

Location	Effects				
	Density	Variety	N-P Fertilizer (kg ha$^{-1)}$		
			0N-0P	23N^{-1}0P	46N-20P
	Normal	Argity	1308	2438	1547
Errer		Melkam	1679	1637	1934
	Sparse	Argity	1601	2011	2396
		Melkam	1894	2177	1780
F-test			18.84		
LSD (0.05)	PD x V x NP		423		
CV%			3.7		
			0N-0P	23N^{-1}0P	46N-20P
	Normal	Argity	1601	2011	2396
Sheraro		Melkam	1368	2780	3532
	Sparse	Argity	1594	2454	3390
		Melkam	1380	2452	2829
F-test			49.04		
LSD (0.05)	PD x V x NP		149.4		
CV%			13.7		
			0N-0P	23N^{-1}0P	46N-20P
	Normal	Argity	1973	2247	2500
Kobo		Melkam	1763	2480	2243
	Sparse	Argity	2317	2570	2550
		Melkam	2140	1988	1753
F-test			18.84		
LSD (0.05)	V		227.3		
CV%			14.9		

PD=Plant density; V=Variety; NP=N-P fertilizer

The four-way interaction effect of Loc x PD x Var x NP was only significant for the plant height in the combined ANOVA (Table 6). The two-way interactions of PD x V, and PD x NP, as well as the three-way interaction of PD x V x NP were only significant for plant height (Table 6). The two-way interaction of Loc x V that were common across most parameters was shown (fig 6a-d). The location by variety interaction was significant for days to maturity with variety at Sheraro with 6% earlier maturity compared with the other two sites (i.e. Kobo and Erer (Fedis)). The newly released cultivar, cv. Argity, was generally taller than the common and locally adapted variety, cv. Melkam. While the panicle of cv. Melkam was generally longer than cv. Argity. When compared across locations, Argity was taller and Melkam was shorter at Sheraro than at the other sites. The panicle length for both cv. Argity and cv. Nelkam were greater at Fedis than the other two sites. The significant difference in kernel weight at Kobo and Sheraro sites with larger kernel size for cv. Argity than cvMelkam. The comparable yield of cv. Argity when compared with cv. Melkam might be associated withlarge kernel size that compensate the yield increase of cv.Melkam from more kernel per panicle.

Soil properties, rainfall amount or distribution, planting date, and previous crop were not related to the maximum trial grain yield, the yield without fertilizer, yield responses to applied NP, or the economic profitability. The results do not indicate that site properties can be used to estimate the economic benefit of fertilizer on a site or site-season basis. The soil test results indicated that response to applied P was unlikely at Sheraro and Kobo while a response at Erer might have occurred with a higher yield level.

rb g i f f fb ; the trial will continue this year

Bd j j j rfi 5; Characterize sorghum trial environments in the dry lowlands of Ethiopia characterized for enabling more effective extension to dry lowland production regions

Bd j j f j e ; July 2019 to June 2022

P ckfd j f; To characterize sorghum trial environments in the dry lowlands of Ethiopia.

S f jc rfi f) *; Tewodros M.

S f fe c ; Tewodros Mesfin

Zfb g f ; January - December 2019

T b g i f h f

Major mechanistic crop models will be used to prescribe the set of target locations and future production environments (TPEs) where varieties and hybrids developed by sorghum breeding program will be grown. Prediction of genotype performance in a TPE informs a selection by predicting future performance, averaged over several farms and seasons. The use of TPE is critical in rainfed and low resource-use agriculture, where seasonal weather variations, soil quality and depth, and management differences abound, causing GxExM interactions that hamper simultaneous genetic and agronomic progress toward improved system productivity and resilience. Yet phenotypic variation in target environments, genetic correlation and trait heritability in test and target environments determines selection efficiency and the size of realized genetic gain. This element is critical for modernizing the crop breeding. This will enable in Identifying genetic traits or agronomic management alterations that enhance crop/system productivity/resilience/cash return and/or reduce the risk, and design target plant ideotypes or crop agronomic packages, or cropping systems.

The first objective was too characterizing EIAR’s sorghum trial sites to better understand the type of environment they experienced in terms of water availability or to determine main drought patterns and, to identify the genetics, agronomic practices, or their combinations that improve system productivity and resilience within each TPE

The other objective was to classify its production systems through target population of environments (TPEs) in order to identify representative testing locations for precision selection, technology spillover and for speeding-up breeding cycles.

Ef jh

To represent the sorghum cropping system in the dry lowlands Ethiopia, the major production areas (Oromiya, Amhara, and Tigray regions). Simulations is performed for the 30 sites over 30 yr. of historical climatic data, with the calibrated sorghum varieties of varying maturity, using the Agricultural Production Systems Simulator (APSIM) crop model (Wang et al., 2002; Keating et al., 2003). A first set of simulations will be run to identify representative sowing dates over long periods and soil water content at sowing for each site according to farmer local practices, soil characteristics and preceding rainfall. Based on these conditions at planting, a second set of simulations will be run to characterize the drought patterns that sorghum crop experience at these sites. Finally, a third set of simulations will be performed for an early-, mid-, and late-maturing genotype to determine the impact of maturity on drought pattern.

U fb f

2/ Gj j rb j ;Ef f j b j g j h j jf

Soil characteristics wereobtained from a database generated by local experts at the respective sites and from Ethiosis Map of the Ethiopian Agricultural Transformation Agency (ATA) or from the FAO website (http://soilgrids.org/site) or from APSIM website (https://www.apsim.info/swe/) using soil water express tool. From this initial set of simulations, sowing dates each representing at least 20% of sowing opportunities will be identified for each region. As soil water content at sowing might be mainly uniform across sowing dates, at least three unique initial soil water conditions will be used for the second set of simulations. The levels of initial soil water will be chosen to each represent 20% of the conditions encountered during the planting window for the considered site, over 30 yr.

3/ Tfd e j rb j ; Di b bd f j b j b e drb jgjdb j g fb bm e hi b f)f j f f *

Based on information obtained from the initial simulations (date and soil water content at sowing), a second round of simulations will be run to characterize the seasonal drought patterns occurring at the 30 sites across dry lowlands where sorghum production is dominating. Apart from various crop traits such as grain yield and plant biomass, the APSIM model generated a water-deficit index (‘water supply/demand ratio’). This index indicates the degree to which the soil water extractable by the roots (‘water supply’: Ws in mm) is able to match the potential transpiration (‘water demand’: Ws in mm).

The water-deficit index is defined as the ratio between Ws and Wd, and is capped between 1.0 (no water stress) and 0.0 (no water available to the crop). For each environment (defined by a site, year, sowing date and initial soil water), this daily index is centered around flowering and averaged over 100°Cd from emergence to 450°Cd after flowering, after which senescence greatly reduced plant transpiration and can thus lead to an ‘artificial’ increase of the water-deficit stress. Note that APSIM still accounts for water stress in these conditions but, as leaf area has dropped, the impact of stress is mediated through the decrease in biomass accumulation and substantial re-translocations among organs.
The partitioning clustering function (clara) in the R statistical package (R Development Core Team, 2011) is used to cluster the seasonal water-deficit pattern into four environment types (ETs). The method minimized the sum of dissimilarities between the stress-index pattern of each environment of the TPE and the median situation of the ET they related to. An average pattern of water-deficit index is calculated to describe each ET. The occurrence of each ET is interpreted for the different regions with respect to the sowing dates and initial soil moisture situations, and over time.A Pearson’s chi-squared test is applied to identify significant differences between individual seasons and long-term periods of > 30 yr in terms of the occurrence of drought ETs at the national level.

4/ Ui j e j rb j ; Tfb bm e hi b f g hf f j i d b j h b j

To evaluate the impact of maturity on the seasonal drought pattern, a different set of simulations will be run with the same conditions as the second set for a quick-maturing, mid-maturing and a slow-maturing variety. For each simulation, their seasonal patterns will be classified based on which previously defined ET they will be most similar to, that is, based on the minimum sum of squared differences for the considered water deficit pattern compared with the water-deficit pattern of the previously defined ETs
M db j ; Melkassa

S f m

As part of simulation modeling run for E characterization activity, weather data of the recent five years of Kobo and Sheraro was collected and cleaned before it was annexed to the existing database of “iMashilla” project for APSIM use, The soil water related data of Erer site was determined and this will be used for characterizing the area as one of the key sorghum multi-trial sites. The destructive plant sample and yield data from field trials at Erer, Kobob and Sheraro in 2019 will be used to setup APSIM for the purpose of better understanding thetype of environment experienced in terms of water availability or determining the typical drought patterns for specific sorghum adaptation analysis through exploring the productivity–risk trade-offs for the combinations of genotype and management options in different environments. This will help in identifying optimal genotype and management combinations to realize seasonal yield potential in different environments.

rb g if f fb ; All modelling work including environment characterization for the sorghum multi-environmental variety trial siteswill be started in two weeks’ time in consultation with research counterparts in Australia. The third activity on application of simulation modeling to exploit G×E×M interactions for improving sorghum-based cropping systems in dry lowlands Ethiopia will follow after the work on TPEs analysis that would assist as a stepping stone toeffectivelyquantify G x E x M interactions using long-term simulation using APSIM model.In total, 20 locations will be characterized by their climate (historical records of more than 30 years) and by a soil typical of their region (chosen in consultation with local agronomists and the available ‘Ethiosis’ Map). To identify representative sowing dates and initial soil moisture at each site, an initial set of simulations will be performed over 30 yr. using the APSIM crop model. Historical daily climate data (solar radiation, maximum temperature, minimum temperature and rainfall) will be gathered for 30 sites across the dry lowlands of sorghum growing area, from the various research stations and National Meteorological Agency.For each simulation, the input from local agronomist will be considered for determining timing of possible planting events for sorghum, and the soil moisture at each planting event to occur based on a region-specific set of criteria. A maximum of three to five sowing opportunities will be considered per season in each site.

Warm Season Vegetable Crops Research Program

Tesfa Benalfew
E-mail: tesfa25@gmail.co; Tel: +251912688864

S f fb di df : Crop Research
h b : Warm Season Vegetable Crops Research Program
kf d J: Development and Promotion of Warm Season Vegetable Crops Varieties for Different Growing Conditions and Purposes
kf d f j e: July 2017- June 2020
Bd j j j rfi)2*; Hot pepper variety verification trial for fresh and dry pod purpose
Bd j j f j e: July 2017 - June 2020
P ckf d j f; To release potential hot pepper varieties with high green and/dry pod yield, acceptable pod quality and tolerance soil born diseases.
S f jc rfi f ; Melkamu H.,Yosef A., Jibicho G., Tesfa B., Gebeyehu W., Dessie G., Etenesh G.,
S f fe c ; Melkamu Hinsermu
f j e gS f : January - December 2019
T b g f fb di gj e j h
Ef jh ; None for management purpose we used; 5 m x 10 m with two replications, plots size of 100 m^2.Spacing of 70 cm x 30 cm between rows and plants, respectively was used.
U fb f ; Four hot pepper genotypes including the standard check varieties
M db j ; Melkassa, Wonji (Eflora), Koka (Ethio veg fru), Fogera (on station and on farm)

S f m

Verification field trials consisting of two candidates with two standard checks hot pepper varieties were evaluated by NVRC in 2019 during main season at different five locations; i.e., Melkassa, Wonji (Eflora), Koka (Ethio veg fru), Fogera (on station and on farm). Summary of green pod yield and dry pod yield and vegetative growth and pod quality characteristics of hot pepper at different five locations is expressed in Table 1, 2 and 3, respectively. Rivival (233 q/ha) and PBC-602 (205.6 q/ha) gave the highest total green pod yield in average of five locations as compared to two standard checks; Melka Awaze and Markofana. Similarly, the highest dry pod yield was also recorded from PBC 602 (29 q/ha) followed by Rivival (27.2 q/ha) as compared to two standard checks. Consequently, Rivival and PBC-602 gave the highest green and dry pod yield and acceptable pod characteristics (color, size, pungency) (Tables 1, 2 &3). Generally, all genotypes able to express their potential at [Koka (Ethio veg Fru and Wonji (Elfora)], but at some other locations such as Fogera (on farm), their performance was poor mainly due to poor crop management. Therefore, two candidates is an important; Rivival could be used as dual purpose (green and dry pod production) for green pod 'dark green color' and acceptable color for dry pod 'brown color' and acceptable pod size; while PBC-602 could be recommended only for green pod with 'green pod color' and high pungency. PBC-602 is relatively tolerant to wilt diseases and virus as compared to the two standard check varieties. So, we are waiting the decision NVRC for releases.

Table 1: Vegetative and pod characteristics of hot pepper varieties at across five locations in 2019

No.	Varieties	DF	PH	PW	PNP	PL	PD	PWT	PU	GPC	DPC
2	Rivival	46.3	50.2	52.4	58	9.9	1.9	2.2	M	DG	B
3	PBC-602	47	62.1	59.4	95	12.1	1.2	1.8	H	G	R
4	Melka Awaze (check)	47	78.5	65.2	52	9.5	1.6	1.9	M	G	R
5	Marko fana (check)	48	61.6	52.2	15	9.4	2	2.2	M	G	B

*DF: Days to 50% flowering, PNP: Pod number per plant, PL: Pod length (cm), PH: Plant height (cm), PW: Plant width (cm), PD: Pod diameter (cm), PWT: Pod wall thickness (mm), GPC: Green pod color, DPC: Dry pod color, PU: Pungency, DG: Dark green, G: Green, B: Brown, R: Red

rb g i f f fb : Hot pepper breeder seed will be multiplied.

Bd j j 3; Screening and evaluation of rootstock varieties against fusarium wilt for grafting and compatibility study in hot pepper
Bd j j f j e; January 2017 - June 2020
P ckfd j f; To screen root stock genotypes for soil borne disease (Fusarium spp.) resistance that would be used as rootstock for pepper (C. annum L.) and to evaluate the compatibility of resistant rootstocks genotypes with pepper scion (Variety: Mareko Fana)
S f jcrfi f ; Jibicho G., Endrias G/K., Shimeles A., Tesfa B.
S f fe c ; Jibicho Geleto
f j e gS f : January - December 2019
T b g i f h f
Nine selected Capsicum species were sown and under nursery for evaluation of compatibility with scion material (Mareko Fana) at Melkassa
Ef jh ; RCBD
U fb f ; 9 genotypes
M db j ; Melkassa

S f m
The result is not yet obtained. The trial is under nursery stage.
rb g i f f fb ; Grafting and compatibility study will be conducted by using selected genotypes at Melkassa in the screen house during 2020 off season and finally recommendation will be given on the compatible root stock varieties.

Bd j j 4; Screening of Tomato Genotypes to Salt Stress
Bd j j f j e; 2017 - 2020
P ckfd j f;
- To evaluate germination response of tomato varieties for various salinized irrigation waters under laboratory conditions
- To evaluate yield of tomato varieties under different salinized irrigation waters under greenhouse conditions

S f jcrfi f ; Edossa Itissa, Shimels A., Gebeyehu W., Jibicho Geleto, Birhan Abera, Tesfa Binalfew,
S f fe c ; Edossa Etissa
f j e gS f : January - December 2019
T b g i f h f
Ef jh ; RCBD
U fb f ; 10
M db j ; Adama (Melkassa and Wonji)

S f m
Eleven OPV and three hybrid released/registered tomato varieties were evaluated for salt tolerance
Generally, salinity induced in the form of NaCl had a pronounced effect on tomato varieties resulting in a considerable decrease in germination percentage, germination speed and germination index.
With increase in salt concentration, all the germination parameters were significantly reduced and in the salinity of 5dSm$^{-1,}$ the reductions were higher (Table 4)
Regarding the variety's response to different salinity levels, significant differences were observed among the varieties. Melkashola and ARP tomato D2 selected as tolerant varieties. It could be concluded that these varieties could be cultivated without much loss up to 3 dSm^{-1}
rb g i f f fb ; Completed

Bd j j 5; Okra Variety Trial
kfd f j e; 2017 - 2020

S f jcrfi f ; Tesfa Binalfew, Jibicho Geleto, Gebeyehu W., Shimels A., Birhan Abera
S f fe c ; Tesfa Binalfew
f j e gS f : January - December 2019
T b g i f h f
Ef jh ; RCBD
U fb f ; 14 Varities
M db j ; Melkassa, Pawe

S f m

Elevenokra germplasms among the accessions collected from different parts of Ethiopia (Beneshangul and Gambella). These accessions were characterized, evaluated and purified since 2012 and evaluated through NVT at Pawe and Melkassa in 2017, 2018 and 2019 by designed and replicated evaluated. Consequently, these candidate lines M-27C and M-14A with high pod yield and quality are identified for on farm variety verification. M-27C characterized medium size plant with very large green tender fruits and very high yield per unit area. M-14A is medium size plant with erect main stem and high fruit yield and number per unit area. Both lines don't have laterals. They have downy fruits with good taste (see below Table 1 & 2).

Table 1: Marketable pod yield (Qt/ha) at Melkassa and Pawe in 2017, 2018 & 2019 under rainfed and supplemental irrigation (Melkassa) conditions

O /	Hf f	3128			3129			312:			P f bm
		Melkassa	Pawe	Combined	Melkassa	Pawe	Combined	Melkassa	Pawe	Combined	
1	B.Humera (check)	111d	13.87c	62.5d	24.5d	35.69b	30.1d	94.6c	33.87bc	64.2d	52.2e
2	M-10B	196bcd	37.53abc	116.8bc	73.9cd	45.29b	59.58cd	176.1abc	45.3b	110.7bc	95.6bcd
3	M-12E	302a	25.7bc	163.9a	166.4a	48.23b	107.31a	201.8ab	37.07bc	119.4abc	130.1a
4	M-13A	162.3cd	28.01abc	95.2cd	97.9bc	53.24b	75.56abc	148.1bc	33.2bc	90.6cd	85.9d
5	M-14A	316.5a	44.28abc	180.4a	71.7cd	57.07b	64.41bcd	233.6a	78.21a	155.9a	133.5a
6	M-17A	240.8abc	50.42ab	145.6ab	110.2abc	40.28b	75.24abc	131.2bc	36.57bc	83.9cd	101.5bcd
7	M-24B	234.9abc	54.66ab	144.8ab	72.8cd	54.94b	63.85bcd	103.2c	35.29bc	69.3d	92.5cd
8	M-27C	274.1ab	59.35a	166.7a	92.3bc	107.42a	99.85ab	169.9abc	98.34a	134.1ab	133.5a
9	M-30A	230.1abc	56.37ab	143.2ab	136.7abc	38.95b	87.83abc	230.5a	17.69c	124.1abc	118.3ab
10	P-08	251.1abc	39.6abc	145.4ab	103.3bc	72.8ab	88.06abc	165.2abc	39.91bc	102.5bcd	112.8abc
11	P-2P1	262.6ab	28.92abc	145.8ab	152.2ab	74.04ab	113.13a	155.2abc	34.29bc	94.7bcd	117.8ab
	F-test	**	**	**	*	*	*	**	**	**	**
	LSD	81.1	17.2	57.4	57.1	39.4	47.3	72.7	23.5	51.4	52.5
	Mean	234.6	39.8	137	100.1	57	79	164.5	44.5	104.4	107
	CV	20.3	25.3	25.4	33.5	40.6	36.5	25.8	31	29.9	30.4

N.B. At Melkassa supplemental irrigation was applied while at Pawe only rain fed and harvest frequency was limited

Table 2: The Response of Vegetative and pod characteristics of okra genotypes evaluated at Pawe and Melkassa, 2010-2012 E.C.

Treatment	Days to Fist harvest (Maturity)	Number of branches per plant	Average Fruit weight (gm)	Fruit number per plant	Fruit yield per plant (kg)	Plant height (cm)	Average Fruit length (cm)	Average Fruit width (mm)	Number of ridges per fruit
B.Humera	69.01g	2.486bcd	11.03c	26.85	1.551	123.4bc	12.91c	17.25f	5.08f
M-10B	72.09fg	2.766b	22.13b	25.74	2.957	113.2c	11.12c	25.74a	8.275bcd
M-12E	81.84bc	3.292ab	31.11a	25.34	4.18	108.4c	14.89bc	20.62cde	8.891b
M-13A	77.17de	2.819ab	24.72ab	21.42	2.672	165.9a	17.72ab	20.16def	8.714bc
M-14A	74.09ef	1.881cd	26.72ab	30.26	4.465	116.9bc	11.83c	24.82a	8.357bcd
M-17A	75.59def	1.793d	28.88ab	21.08	3.539	125.8bc	18.68a	21.63bcde	8.896b
M-24B	78.09cde	2.946ab	27.7ab	20.92	3.563	161.7a	13.16c	23.59abc	6.3e
M-27C	72.75fg	2.659bc	32.89a	27.05	4.374	107.9c	20.72a	23.11abcd	9.634a
M-30A	92.08a	3.686a	25.1ab	29.59	3.602	146ab	13.93c	23.75ab	8.179cd
P-08	79.42cd	3.279ab	27.72ab	23.92	3.566	161.9a	12.3c	24.21ab	8.714bc
P-2P1	83.84b	3.132ab	25.94ab	26.99	3.737	178.1a	14.26bc	19.5ef	7.998d
F-test	**	**	**	NS	NS	**	**	**	**
LSD	3.725	0.789	7.246	11.26	3.713	29.367	3.325	2.775	0.565
Mean	77.81	2.79	25.81	25.38	3.47	137.21	14.68	22.22	8.09
CV	7.3	42.9	42.7	67.5	16.5	32.5	34.4	19	10.6

Means followed by the same letter within a column are not significantly different at 5 % level of significance

rb g i f f fb ; Best performing 2 genotypes will be verified on farm and on research stations

Bd j j 6; Introduced Okra Variety Verification Trial
kfd f j e; 2017 - 2020
S f jc rfi f ; Tesfa Binalfew, Birhan Abera, Jibicho Geleto, Gebeyehu W., Shimels
S f fe c ; Tesfa Binalfew
f j e gS f : January - December 2019
T b g i f h f
Ef jh ; Single plot
U fb f ; 3 okra variety
M db j ; Melkassa and Wonji, Pawe, Werer

S f m

Both candidate varieties gave higher yield over the check. The candidate variety ML-OK-16 gave 138.16 qt/ha and 139.61qt/ha marketable and total yield respectively; whereas, Spinless gave 114.12 qt/ha and 115.55 qt/ha marketable and total average yield respectively (Table 5). In all the varieties the proportion of unmarketable yield is very small and not significant.

Candidate variety ML-OK-16 found to be characterized with higher number of primarily branches (8) and the tallest variety (241.9cm). It has whitish non-ridged fruits and downy fruits. Spineless is medium tall plant (153.9cm) with 5.5 average numbers of primarily branches. It has downy and green fruits with an average ridge of 7.2 per fruit (Table 6.

Table 5: Yield performance of okra varieties, 2019.

No	Varieties	Locations	Marketable Yield (Qt/ha)	Unmarketable yield (Qt/ha)	Total Yield (Qt/ha)
1	ML-Ok-16	Melkassa on station	130.75	0.11	130.87
		Wonji on farm	141.07	2.7	143.77
		Pawe on station	150.5	1.3	151.8
		Pawe on farm	143	1.5	144.5
		Werer on station	125.5	1.6	127.1
		Average	138.16	1.44	139.61
2	Spinless	Melkassa on station	120.14	0.81	120.95
		Wonji on farm	89.36	1.08	90.44
		Pawe on station	130.57	1.1	131.67
		Pawe on farm	115.5	1	116.5
		Werer on station	117	1.2	118.2
		Average	114.52	1.04	115.55
3	Bamya-Humera	Melkassa on station	77.14	0.31	77.45
		Wonji on farm	67.33	0.64	67.97
		Pawe on station	80.6	0.9	81.5
		Pawe on farm	75	0.78	75.78
		Werer on station	60	0.6	60.6
		Average	72.01	0.64	72.66

Table 6: Average qualitative performance of okra varieties

Varieties	primary Branch per plant	Plant height (cm)	Average Fruit length (cm)	Average Number of ridges per fruit	Average fruit weight (gm)	Pubescences	Fruit color
ML OK 16	8	241.9	13.338	0	15.545	Downy	Whitish green
Spinless	5.5	153.9	12.64	7.2	18.4625	Downy	Green
Humera	7	164.75	14.0245	5.15	13.6125	Downy	Green

rb g i f f fb ; the two candidate varieties are expected to be released for production; breeder seed multiplication will proceed

Bd j j 7; Summer Squash Variety Verification Trial
Bd j j f j e; 2017 - 2020

S f jc rfi f ; Tesfa Binalfew, Jibicho Geleto, Gebeyehu W., Shimels A., Birhan Abera

S f fe c ; Tesfa Binalfew

f j e gS f : January - December 2019

T b g i f h f

Ef jh ; Single plot

U fb f ; 3 squash variety

M db j ; Melkassa and Wonji, Debre ziet, Kulumsa

S f m

The candidate lines ZK-15 and JP-10 were introduced from America. These lines were evaluated at different locations in 2017 & 2018. These materials were evaluated under Ethiopian conditions for two seasons at different locations namely Melkassa, Debrezeit and Kulumsa. Consequently, these candidate lines are found early maturing with high fruit yield and quality for on farm verification.

In 2019 cropping season variety verification trial was conducted at Melkassa, Kulumsa, Debre ziet and Holeta and evaluated by national variety release technical committee. The report for variety verification trial presented as below. The experiment was conducted from early June 2017 to September 2019.
Average yield performance: The candidate variety JP-10 gave 247.5 q/ha and 289.51 q/ha marketable and total average yield respectively; whereas, ZK-15 gave 215.87 q/ha and 248.61 q/ha marketable and total average yield respectively (Table 7&8). The yield performance of both varieties was low at Debrezeit research center may be due to lack of crop management and crop protection activities when compared to other testing sites. In terms of unmarketable yield, JP-10 recorded about 18% while ZK-15 recorded 16% unmarketable yield. Both varieties had comparable average fruit thickness, fruit length and average fruit weight. Besides, the varieties had similar inner color, shape, internal structure and texture. However, in terms of days to maturity, ZK-15 is earlier than JP-10 by 5-7 days.

Table 7: Yield performance of summer squash genotypes across locations during, 2019.

No	Cultivars	Locations	Marketable Yield (Qt/ha)	Unmarketable yield (Qt/ha)	Total Yield (Qt/ha)
		Melkassa on station	357.08	121.88	478.96
1	**[L.26**	Wonji on farm	171.78	24.56	196.34
		Kulumsa on station	260.19	0.64	260.83
		Debrezeit on station	79.97	16.62	96.59
		Debrezeit on farm	210.32		210.32
		B f bhf	**326/98**	**51/: 4**	**359/72**
		Melkassa on station	356.25	157.87	514.12
2	**K .21**	Wonji on farm	153.99	35.56	189.55
		Kulumsa on station	179.12	0.71	179.83
		Debrezeit on station	142.11	16.16	158.27
		Debrezeit on farm	405.8		405.8
		B f bhf	**358/56**	**63/68**	**39: /62**
3		Melkassa on station	408.77	53.56	462.33
	Crbdl	Wonji on farm	200.59	5.93	206.53
	cfb	Kulumsa on station	308.72	0.19	308.92
	)di fdl *	Debrezeit on station	133.8	142.43	142.43
		Debrezeit on farm	222.22		222.22
		B f bhf	**365/93**	**61/64**	**379/59**

rb g i f f fb ; the two candidate varieties are expected to be released for production; breeder seed multiplication will proceed

kfd JJ: Multiplication and Promotion of Warm Season Vegetable Crop Technologies for Different Agro-ecologies

kfd f j e: July 2017 - June 2020

Bd j j j rfi)2*; Breeder Seed Multiplication of Onion
Bd j j f j e: July 2017 - June 2020
P ckfd j f: to increase and avail adequate initial seeds of onion varieties.
S f jc rfi f ; Melkamu H., Tesfa B., Jibicho G., Tesfa B., Gebeyehu W., Etenesh G., Beshadu T.
S f fe c ; Melkamu Hinsermu
f j e gS f : January - December 2019
T b g h f
Ef jh ; single plot
U f b f ; Two onion varieties (Nasik Red and Nafis)
M db j ; Melkassa (on-station)

S f m
Two released onion varieties (Nasik Red and Nafis) were planted in total area of $1500m^2$ in 2019 during rainy season at Melkassa Agricultural Research Centre for bulb productions. Two onion varieties bulbs were planted for onion seed productions in distance isolation for breeder seed multiplication. Now two onion varieties are in good performance at flowering stage under field conditions.
rb g i f f f b ; As usual, seed increase and adequate breeder seed of released onion varieties will be produced.

kfd JJJ; Development of Warm Season Vegetable Crops Varieties for Different Growing Conditions and Purposes
kfd f j e; January 2017 - June 2020
Bd j j 2; Breeder Seed Multiplication of Capsicum
Bd j j f j e; January 2017 - June 2020
P ckfd j f; To produce sufficient quantity of breeder seed for capsicum crop varieties
S f jc rfi f ; Jibicho G., Shimeles A., Tesfa B., Gebeyehu W., Melkamu H., Birhan
S f fe c ; Jibicho Geleto
f j e gS f : January - December 2019
T b g i f h f
Two released hot pepper varieties were planted in this off season and currently at fruiting stage at Melkassa. Besides, one chilli and one hot pepper varieties are at nursery and will be planted soon at Melkassa.
Ef jh ; Single plot
U f b f ; 7 breeder seed
M db j ; Melkassa

S f m
No results were obtained so far as the trial is not yet harvested.
rb g i f f f b ;
Capsicum breeder seed multiplication activity will be continuing in the new project too.

Bd j j 3; Breeder Seed Multiplication of Tomato
Bd j j f j e; January 2017 - June 2020
P ckfd j f; To produce sufficient quantity of breeder seed for tomato crop varieties
S f jc rfi f ; Gebeyehu W., Jibicho G., Shimeles A., Tesfa B., Melkamu H., Birhan
S f fe c ; Tesfa Binalfew
f j e gS f : January - December 2019
T b g i f h f
Ten released tomato varieties were planted in this off season and seed extracted and dried.
Ef jh ; Single plot
U f b f ; Single plot (10 varieties)
M db j ; Melkassa

S f m

Table 9. Type and amount of tomato varieties multiplied

Variety name	Amount multiplied (gm)
ARP Tomato D2	982
Fetan	1594.6
Metadel	2260
Eshet	5060
Bishola	1993.8
Melkashola	1000.2
Melkassalsa	1707.4
Chali	498.6
Miya	1481.4
Gelilema	1056.2
Total	17634.2

rb g i f f fb ;
Multiplication of tomato varieties will proceed depending on the demand.

kf d j rfi; Variety Development of Cool Season Vegetable Crops
kf d f j e; January 2017 - June 2020
Bd j j j rfi; Breeder Seed Multiplication and maintenance of Chinese cabbage
Bd j j f j e; January 2017 - June 2020
P ckf d j f; to multiply and maintain the breeder seed of Chinese cabbage varieties
S f jc rfi f ; Jibicho G., Tesfa B., Gebeyehu W., Shimeles A., Birhan A
S f fe c ; Jibicho Geleto
f j e gS f : January - December 2019
T b g i f h f
The breeder seed of available Chinese cabbage genotypes was multiplied and maintained at Melkassa in 2019/20 off season.
Ef jh ; j hrfi m
U f b f ; 4 breeder seed
M db j ; Melkassa

S f m
A total of 30 kg breeder seed of two released varieties and two other germplasms was multiplied and maintained at Melkassa in 2019/20 off-season.
rb g i f f fb ; Maintenance and breeder seed multiplication activity will be continuing in the new project.

kf d JW; Variety Development of Cool Season Vegetable Crops
kf d f j e; January 2017- June 2020
Bd j j 2; Breeder Seed Multiplication and maintenance of Pak choi
Bd j j f j e; January 2017 - June 2020
P ckf d j f; to multiply and maintain the breeder seed of Pak choi varieties
S f jc rfi f ; Gebeyehu W., Jibicho G., Tesfa B., Shimeles A., Birhan A., and Melkamu H.,
S f fe c ; Tesfa Binalfew
f j e gS f : January - December 2019
T b g i f h f
The breeder seed of available pak choi varieties were multiplied and maintained at Melkassa in 2019/20 off season.
Ef jh ; single plot
U f b f ; 2 variety
M db j ; Melkassa

Sf m

A total of 0.95 kg breeder seed of two released varieties were multiplied at Melkassa in 2019/20 off-season.

rb g if f fb ; Maintenance and breeder seed multiplication activity will be continuing in the new project.

kfd W: Introduction of the high productivity variety in solanaceae crop and development of customized cultivation technology

kfd f j e: January 2018 - December 2020

Bdj j jrfi)2*; Introduction, collection and characterization of capsicum germplasms

Bdj j f j e; January 2018 - December 2020

Pckfdj f: to introduce, collect, characterize and evaluate capsicum germplasms for pod characters, yield and disease and insect pest reactions

Sf jcrfi f ;Melkamu H., Shimels A. Tesfa B., Jibicho G., Endiras G., Gebeyehu W., Etenesh G., Beshadu T., Tesfaye W.

Sf fe c ; Melkamu Hinsermu

f j e gSf : January - December 2019

T b g h f

Ef jh ; Single plot, augmented design

U fb f ; 60 capsicum germplasms

M db j ; Melkassa on station

Sf m

Under this activity, 160 germplasms were acquired from Ethiopian Biodiversity Institute (EBI) and planted for evaluation. These activities were planted during the rainy season for evaluation (early to June); however, most of the accessions were susceptible to wilt (*Fusarium* wilt) and no data was collected. From these 60 genotypes were selected and planted again under irrigated condition at Melkassa Agricultural Research Centre. Capsicum genotypes clustered into three groups i.e., for green pods 26 genotypes, for dry pods 17 and for chilli 24 were selected for further maintenance and evaluation

rb g if f fb : further selection among each accession will be made and maintenance breeding will be executed; and continues until uniform and distinct genotypes obtained.

Bdj j jrfi)3*; Evaluation and selection of Korean pepper breeding lines (RDA) in Ethiopia`

Bdj j)Tf .J*; Evaluation of hot pepper genotypes for green purposes

Bdj j f j e; January 2018 - December 2020

Pckfdj f: to evaluate Korean breeding lines (RDA) for adaptation, pod characteristics, yield and diseases and insect pest reactions

Sf jcrfi f ; Melkamu H/- Shimels A. Tesfa B., Jibicho G., Endiras G., Gebeyehu W., Etenesh G., Beshadu T.,Tesfaye W.

Sf fe c ; Melkamu Hinsermu

f j e gSf : January - December 2019

T b g h f

Ef jh ; RCBD design with three replications

U fb f ; Ten genotypes with two standard checks

M db j ; Melkassa, Wonji (Elfora)

Sf m

Field trials consisting of ten genotypes with two standard checks of hot pepper varieties were evaluated in 2019 during rainy season at Melkassa Agricultural Research Center and Wonji (Elfora)/ Summary of vegetative and quality characteristics and green pod yield combined across locations is presented in Table 4 and 5, respectively. Hot pepper genotypes; CCA.323

(28.72 t/ha), Mr. Lee no.3 selex (26.10 t/ha), CCA.984-A (25.73 t/ha) and CCA.321 (19.03 t/ha) were the highest yielder in green pod yield combined across locations. These genotypes with green and dark green pod yield and acceptable pod characteristics (color, size, pungency) (Table 10&11) were identified for on evaluation sites. These genotypes are relatively tolerant to wilt diseases and virus as compared to the standard check varieties.

Table 10. Combined vegetative performance and green pod quality of hot pepper genotypes at MARC and Wonji,2019

Genotypes	DF	PH (cm)	PW (cm)	PNP	PL (cm)	PD (cm)	PWT (cm)
CCA.984-A	53.3cd	68.3a	55.0abc	44.6bc	10.9cd	1.6cd	0.2fg
CCA.3617	55.3ab	52.1c	38.4e	36.1c	10.3def	1.5d	0.23a
CCA.323	52.6de	58.6b	58.4a	93.6a	9.1g	1.7b	0.20b-e
Mr. Lee no.3 selex	53.3cd	51.9cd	62.1a	100.3a	11.2bc	2.0a	0.21a-d
Jins' Joy	52.0de	50.9cd	59.0a	40.3c	10.7cde	1.7bc	0.16fg
Susan Joy	53.0de	49.6cd	58.7a	41.8bc	12.6a	1.6cd	0.18d-g
CCA.3288	53.6bcd	43.0e	37.9e	62.5b	9.9efg	1.3e	0.15g
PBC.830-2	55.6a	51.2cd	57.0ab	40.3c	11.2bc	1.7b	0.21abc
PBC.308	53.0de	45.8de	48.9cd	34.0c	11.8ab	1.8b	0.17efg
ACC.321	52.6de	60.1b	50.9bcd	40.3c	9.8ef	1.7b	0.19b-e
Melka Awaz (check)	52.0e	69.4a	58.6a	37.50c	9.7fg	1.6cd	0.18c-e
Markofana (check)	55.0abc	60.2b	43.3de	38.0c	9.7fg	1.9a	0.22ab
Mean	53.36	55.14	52.36	50.81	10.61	1.72	0.19
F-test	**	***	***	***	***	***	***
CV	2.06	6.69	8.32	25.73	4.47	3.54	9.62

*DF: Days to 50% flowering, PNP: Pod number per plant, PL: Pod length (cm), PH: Plant height (cm), PW: Plant width (cm), PD: Pod diameter (cm), PWT: Pod wall thickness (cm)

Table 11. Combined MY and TY (t ha-1) of green pod hot pepper genotypes at MARC and Wonji,2019

Genotypes	MY (t ha-1)			TY (t ha-1)		
	MARC	Wonji	Combined	MARC	Wonji	Combined
CCA.984-A	18.67ab	30.11ab	24.39abc	19.85ab	31.60ab	25.73ab
CCA.3617	9.98de	26.50abc	18.25cde	10.31de	29.08ab	19.69cd
CCA.323	22.62a	34.02a	28.32a	22.71a	34.72a	28.72a
Mr. Lee no.3 selex	22.62a	29.11abc	25.71ab	22.41ab	29.78ab	26.10ab
Jins' Joy	14.89bcd	24.33bcd	19.62b-e	15.38bcd	25.22b	20.30bcd
Susan Joy	17.94abc	15.87d	16.90de	17.94abc	15.87c	16.91cd
CCA.3288	16.80a-d	24.86a-d	20.83bcd	17.43a-d	26.84ab	22.14bc
PBC.830-2	11.54cde	24.26bcd	17.91de	11.55cde	25.26ab	18.41cd
PBC.308	7.10e	21.18cd	14.14e	7.58e	23.96bc	15.77d
ACC.321	6.0e	31.33ab	19.02cde	7.0e	31.33ab	19.03cd
Melka Awaze (check)	10.88de	26.47abc	18.69cde	11.52cde	27.32ab	19.42cd
Markofana (Check)	7.16e	26.86abc	17.02de	7.19e	27.86ab	17.53cd
Mean	13.88	26.24	20.07	14.16	27.40	20.81
F-test	***	*	**	***	*	**
CV	29.32	21.21	18.60	29.97	19.81	16.94

rb g i f f fb ; Four hot pepper genotypes i.e.,CCA.984-A, CCA.323, Mr. Lee no.3 selex and CCA.321 had better growth, yield, quality and tolerant wilt. So, these genotypes will be advanced for variety trial for green pod purposes

Bd j j)Tf JJ*; Evaluation of hot pepper for dual (green and dry pod) purposes
Bd j j f j e; January 2018 - December 2020
P ckfd j f: to evaluate Korean breeding lines (RDA) for adaptation, pod characteristics, yield and diseases and insect pest reactions
S f jc rfi f ; Melkamu H., Shimelis A. Tesfa B., Jibicho G., Endiras G., Gebeyehu W., Etenesh G., Beshadu T., Tesfaye W.
S f fe c ; Melkamu Hinsermu
f j e gS f : January - December 2019
T b g h f

Ef jh ; RCBD design with three replications
U fb f ; Four genotypes with two standard checks
M db j ; Melkassa, Wonji (Elfora)

S f m

Field trials consisting of four genotypes with two standard checks of hot pepper varieties were evaluated in 2019 during rainy season at Melkassa Agricultural Research Center and Wonji (Elfora)/ Summary of vegetative and quality characteristics and green and dry pod yield combined across locations is presented in Table 12,13&14, respectively. Hot pepper genotypes; Sewon No.3 (25.91 t/ha), Wangang No.2 (16.60 t/ha) and Wangang No.1 (16.57 t/ha) were the highest yielder in green pod yield combined across locations. Similarly, the highest dry pod yield was also recorded from Sewon No.3 (34.9 q/ha), Wangang No.2 (26.38 q/ha) and Wangang No.1 (23.72 q/ha). These genotypes with green and dark green pod yield and acceptable pod characteristics (color, size, pungency) (Table 6) were identified for on evaluation sites. These genotypes are relatively tolerant to wilt diseases as compared to the standard check varieties.

Table 12. Combined vegetative performance and quality of hot pepper genotypes for dual purpose at MARC and Wonji during 2019

Genotypes	DF	PH (cm)	PW (cm)	PNP	PL (cm)	PD (cm)	PWT (cm)
Sewon No.3	55.6^{bc}	67.2^{a}	55.4	67^{a}	11.2^{a}	1.7^{b}	0.18^{d}
Wangang No.1	54.5^{c}	53.9^{cd}	53.6	33^{b}	10.3^{b}	1.6^{bc}	0.27^{a}
Wangang No.2	55.6^{bc}	52.2^{d}	56.4	35^{b}	9.8^{b}	1.7^{b}	0.22^{ab}
Wangang No.3	57.6^{a}	58.4^{bcd}	48.7	54^{a}	9.7^{b}	1.5^{c}	0.19^{cd}
Melka Awaze (check)	56.3^{ab}	62.7^{ab}	57.3	58^{a}	10.1^{b}	1.6^{b}	0.21^{bcd}
Markofana (check)	57.0^{ab}	60.8^{abc}	43.9	33^{b}	9.8^{b}	1.8^{a}	0.23^{ab}
Mean	56.14	59.24	52.61	47.08	10.2	1.7	0.22
F-test	**	**	NS	**	**	***	**
CV	1.42	6.47	10.18	19.12	3.65	3.33	9.24

DF: Days to 50% flowering, PNP: Pod number per plant, PL: Pod length (cm), PH: Plant height (cm), PW: Plant width (cm), PD: Pod diameter (cm), PWT: Pod wall thickness (cm)

Table 13. Combined MY and TY (t/ha) of hot pepper genotypes for green pod purposes at MARC and Wonji during 2019

Genotypes	MY (t ha-1)			TY (t ha-1)		
	MARC	Wonji	Combined	MARC	Wonji	Combined
Sewon No.3	22.28a	28.28a	25.28a	22.30a	29.53a	25.91a
Wangang No.1	8.27c	24.7abc	16.48bc	8.27c	24.92abc	16.60bc
Wangang No.2	6.19c	26.28ab	16.23bc	6.20c	27.00ab	16.57bc
Wangang No.3	7.90c	19.00c	13.45c	20.00c	20.00c	14.00c
Melka Awaze (check)	16.15b	20.94bc	18.54b	16.95b	21.40bc	19.18b
Markofana (check)	7.47c	19.91bc	13.69c	7.47c	20.60bc	14.0c
Mean	11.34	23.19	17.28	11.51	23.90	17.71
F-test	**	*	**	**	*	**
CV	16.89	15.77	13.59	18.16	15.25	14.10

Table 14. Combined MY and TY (t/ha) of hot pepper genotypes for dry pod purposes at MARC and Wonji during 2019

Genotypes	MY (q ha-1)			TY (q ha-1)		
	MARC	Wonji	Combined	MARC	Wonji	Combined
Sewon No.3	32.56a	35.64ab	34.09a	34.19a	46.14a	34.91^{a}
Wangang No.1	8.68c	35.87ab	22.27cd	11.57c	38.31a	23.72^{cd}
Wangang No.2	10.05c	42.14a	26.09bc	10.62c	43.32a	26.38^{bc}
Wangang No.3	7.63c	30.10b	18.87d	8.41c	38.31a	19.26^{d}
Melka Awaze (check)	23.23b	38.32ab	30.78ab	24.31b	39.44a	31.32^{ab}
Markofana (check)	10.21c	10.61c	10.41e	10.54c	13.03b	10.57^{e}
Mean	15.39	36.47	23.75	16.61	32.11	**35/45**
F-test	**	**	**	**	**	
CV	21.23	19.61	13.28	24.14	19.60	**25/72**

OC. MY-Marketable yield, TY-Total yield

rb g i f f fb ; Three hot pepper genotypes i.e.,Sewon No.3, Wangang No.1 and Wangang 2 had better growth, yield, quality and tolerant wilt. So, these genotypes will be advanced for variety trial for dual purposes

Bd j j j rfi 4/ Introduction, collection and characterization of capsicum germplasms
Bd j j f j e; January 2018 - December 2020
P ckfd j f: to introduce, collect, characterize and evaluate capsicum germplasms for pod characters, yield and disease and insect pest reactions
S f jc rfi f ; Melkamu H., Shimels A. Tesfa B., Jibicho G., Endiras G., Gebeyehu W., Etenesh G., Beshadu T., Tesfaye W.
S f fe c ; Melkamu Hinsermu
f j e gS f : January - December 2019
T b g h f
Ef jh ; Single plot, augmented design
U fb f ; 60 capsicum germplasms
M db j ; Melkassa on station

S f m
rb g i f Gf b f; Germplasms with high yield and quality will be evaluated in designed experiment across locations

Bd j j 5; Evaluation of chilli genotypes for yield and quality
Bd j j f j e; January 2019 - June 2021
P ckfd j f; To evaluate the chili genotypes for yield and quality
S f jc rfi f ; Jibicho G., Tesfa B., Shimeles A., Gebeyehu W., Melkamu H., Birhan A, Endrias G/Kiristos
S f fe c ; Jibicho Geleto
f j e gS f : January - December 2019
T b g i f h f
Nine chilli genotypes with standard check variety (PBC 712, Saenglyuk 213, CCA 3468, CCA3331, CCA4-O-1, MSH-1-Selex, PBC 142, PBC 481-selex, CCA 982A, and Melka Dera (Check)) were evaluated for yield and pod quality at Melkassa and Wonji Elfora in 2019 main season. All necessary data were collected, analyzed and better performing genotypes were selected to further evaluation at multi- location.
Ef jh ; RCBD
U fb f ; 10 genotypes
M db j ; Melkassa and Wonji Elfora

S f m
Based on dry pod yield, quality and disease reaction PBC 481-selex, CCA 3468, PBC 142, MSH-1-Selex and CCA 3331 were selected and promoted to variety trial stage (Table 15).

Table 15: Marketable and total dry pod yield (q/ha) of chili genotypes at Melkassa and Wonji in 2011 under rain fed and supplemental irrigation

Genotypes	Marketable dry pod yield (q/ha)			Total dry pod yield (q/ha)		
	Melkassa	Wonji	Combined	Melkassa	Wonji	Combined
CCA 3468	28.3a	70.6ab	49.4ab	29.12a	73b	51.1ab
CCA 3331	28.0a	81.3ab	54.6ab	28.89a	83.1ab	56ab
PBC- 481 selex	26.5a	60.6bc	43.5bc	27.16a	62.5bc	44.8bc
MSH-1selex	24.0ab	88a	56a	25.23a	101a	63.1a
Melka dara	21.7a	73.8ab	47.8ab	19.33abc	45cd	32.2cd
PBC 142	17.8abc	41.7cd	29.7de	13.10bcd	37.6cd	25.4de
CCA 982 A	12.5bcd	33.3d	22.9ef	9.02cd	24.7de	9.5f
saengiyluk 213	8.7cd	9.4e	9g	8.9cd	10e	16.8ef
PBC 712	8.5cd	21.9de	15.2fg	5.51d	84ab	44.8bc
CCA 4-0-1	4.8d	66ab	35.4cd	22.49ab	74.5ab	48.5b
Mean	18.059	54.7	36.36	18.874	59.6	39.21
F-test	**	**	**	**	**	**
CV (%)	23.16	14.82	17.3	21.87	15.5	17.88
LSD (5%)	12.239	23.702	12.191	12.077	27.014	13.592

rb g i f f fb ; The selected material will be further evaluated under variety trial stage at multi location

Bd j j 6; Multiplication, demonstration and promotion of pepper and tomato
Bd j j f j e; July 2018 - June 2021
P ckfd j f; To multiply, demonstrate and promote pepper and tomato technologies
S f jc rfi f ; Jibicho G., Shimeles A., Gaddisa E., Tesfa B., Gebeyehu W., Melkamu H., Birhan A.
S f fe c ; Jibicho Geleto
f j e gS f : January - December 2019
T b g i f h f
The breeder seed of improved tomatoes was multiplied at Melkassa in 2019/20. Besides, one hot pepper and one chili breeder seed multiplication is under way at Melkassa in 2020 off season. Site selection for demonstration and promotion of improved tomatoes and capsicum technologies is also under way at Hetosa and Adami Tullu districts.
Ef jh ; Non replicated
U fb f ; 5 (2 capsicum and 3 tomatoes)
M db j ; Melkassa, Lode-Hetosa, AdamituluJidokombolcha

S f m

- A total of 5 (five) kg breeder seed of improved tomato varieties was produced.
- In collaboration with KOPIA project, MARC and Lode Hetosa district agricultural office, a field day event was organized on October 25, 2019 at Lode Hetosa (Gerde Bosa kebele) district to demonstrate and promote tomato technologies. A total of 56 participants (13 females) of which 40 farmers and 6 researchers, 3 technicians and support staff, 7 experts and development agents were participated.
- As a result, Melka Shola tomato variety was selected by participated farmers due to its vigorous growth, adaptation, fruit yield, quality, disease tolerance and market preference (for long distant market).

rb g i f f fb
Demonstration and promotion of tomato and capsicum technologies will be done 2020.

kf d WJ; Inclusive and Sustainable Value Chains Development in Oromia- Development of Processing Tomato Value Chain through Technical and Technological Support of Smallholder Farmers in Central Rift Valley, Ethiopia
kf d f j e; January 2017 - June 2020
Bd j j 2; Capacity building of research and stakeholders on processing tomato value chain
Bd j j f j e; January 2017 - June 2020

P ckfd j f; To build the capacity of research and stakeholders through provision of facilities and technical support

S f jcnfi f ; Jibicho G., Tesfa B., Yosef A., Gebeyehu W., Shimeles A.

S f fe c ; Jibicho Geleto

f j e gS f : January - December 2019

T b g i f h f

- Capacity of stakeholders has been strengthened through local visit and study tours to research centre, industrial park, private vegetable seedling producing company and private commercial vegetable production farm.
- Preparation of production guideline on processing tomato is under way.

Ef jh ; Not applicable

U fb f ; Not applicable

M db j ; Melkassa

S f m

- One local visit was made to Bulbula Agro-Industrial Park, Flora Vege vegetable seedling production PLC in Dugda district, Ethio Vege Fru private commercial vegetable production farm by participating 41 key stakeholders from farmers' primary Coops, Development agents, East Showa Zone BoANR, Bora, Dugda and AdamituluJidokombolchaDugda districts BoANR experts and researchers from Melkassa agricultural research center.
- 90 percent of preparation of processing tomato production and management guideline is accomplished.

rb g i f f fb ;

- Completion of preparation of processing tomato production guideline for users
- Conducting consultative workshop and seed fair at Melkassa Agricultural Research Center

National Tropical Fruit Crops Research Program

Girma Kebede
E-mail: agirmak99@yahoo.com; Tel: +251911798342

S f fb di df ; Crop
h b ; Tropical Fruit Crops National Research Program
kf d j rfi2; Development and promotion of banana (*Musa spp.*) technologies in Ethiopia
kf d f j e; July2020 - June 2023
Bd j j 2; Pre-extension and popularization of banana varieties in Ethiopia
Bd j j f j e: July 2015 - June 2020
P ckf d j f ; To enhance production and productivity of banana through demonstration of improved technologies
f f jc rfi; Fitsum Miruts, Tesfaye Gugissa, Girma Kebede and Merkebu A.
S f fe c ; Merkebu A.
Zf b g f ; January - December 2019
T b g i f h f
Ef jh ; farmers plot
U fb f ; Banana varieties (Gaint Cavendish, Williams, Poyo, Dwarf Cavendish) and farmers
M db j ; Fentale, Lume , Semen shewa, and Awash river basin

S f m
Pre-extension demonstration work was carried out in Central rift valley and Semen Shewa districts. Potential area Selection was carried out in collaboration with DAs and experts.More than 6929 conventionally and TC multiplied banana suckers were demonstrated for 12 male and 4 female farmers. Moreover, multidisciplinary team of researchers from Melkassa delivered training to a total of 368 trainees of which 126 male and 41 female model farmers, 58 male and 11 male development agents, and 30 male and 9 female experts on improved banana production and management.
Based on the planting materials delivered and training given for expertise, development agents and farmers were awarded, got knowledge and skill about how to handle and manage their banana plantations.
rb g i f f fb : Further demonstration will carried out by agricultural extension and communication team.

Bd j j 3; Evaluation of introduced banana germplasm for high yield and quality fruit
Bd j j f j e; July 2016 - June 2020
P ckf d j f ; To evaluate and select best performing banana varieties
f f jc rfi; Asmare D, Girma K, Merkebu A
S f fe c ; Merkebu A.
Zf b g f ; January - December 2019
T b g i f h f
Ef jh : Single plot
U fb f : 29 Banana Germplasm
M db j ; Melkassa

S f m
Twenty-nine desert and cooking banana germplasms were introduced from Belgium and USA which are established at MARC. Candidate genotypes were selected and preceded to national variety trail based on their yield and yield components

The genotypes showed total fruit yield performance ranged from 2 to 115 tone/ha. The highest total fruit yield (115 t/ha) was recorded by the FHIA=25=ITC1418 followed by FHIA=17=ITC1264 (41 t/ha), Kitarasa=ITC1451 (37 tone/ha) and Naine de Chine=ITC0178 (37 t/ha). Whereas the lowest total fruit yield per hectare was recorded by Ibwi=ITC1464 (2 t/ha) followed by Med size (5 t/ha), Lkaika and Thai (Aka kluaykhay) (6 t/ha). Four genotypes, Cocos=ITC0451, Gros Michel=ITC0484, Koutri=ITC0720 and Pisangumbuk=ITC0686 were not producing fruit yield. This might be associated for their being late maturing. The rest genotypes were provided total fruit yield that ranged from 9 to 30 t/ha as shown in Ttable1.The highest marketable fruit yield per hectare was recorded by FHIA=25=ITC1418 (107.2 t/ha) followed by FHIA=17=ITC1264 (26). There was no marketable fruit yield recorded from (Aka kluaykhay), Fai palagi=ITC1059, FHIA=23=ITC1265 andIbwi=ITC1464 Thai.genotypes.

Table **2**. Evaluation of introduced banana germplasm for high yield and quality at MARC 2019/20

Bddf j	**gm f j h i b f j h**	**N b l f bc rfi**		**V b l f bc rfi**		**U bm**		**N b l jfm j (t/ha)**	**U bm jfm j (t/ha)**
		No.	wt. (Kg)	No.	wt. (Kg)	No.	wt. (Kg)		
Lkaika	143	96.00	2.75	50.00	1.10	146	3.85	4.4	6
Med size	167	24.00	3.20	4.00	0.20	28	3.40	5.1	5
Ice cream	133	120.00	8.83	63.50	5.52	184	14.35	14.1	23
Cuban Yellow	130	37.00	4.00	32.20	1.84	69	5.84	6.4	9
FHIA=18 hybrids	124	137.00	3.98	114.15	3.67	251	7.65	6.4	12
Suce(french for sugar)	95	79.50	5.00	53.46	2.81	133	7.81	8.0	12
Thai (Aka kluaykhay)	114	0.00	0.00	151.50	4.00	152	4.00	0.0	6
Cuban Red (Dwarf)	111	109.00	12.50	73.67	5.18	183	17.68	20.0	28
Suce sugar	137	180.00	5.60	132.60	12.00	313	17.60	9.0	28
Naine de Chine=ITC0178	111	224.00	8.80	190.67	14.40	415	23.20	14.1	37
ITC0547	125	145.50	9.60	101.60	5.08	247	14.68	15.4	23
Dwarf parfitt=ITC0548	99	183.00	3.50	150.63	10.20	334	13.70	5.6	22
Fai palagi=ITC1059	105	0.00	0.00	144.50	18.50	145	18.50	0.0	30
Giant parafit=ITC1246	161	146.50	5.50	144.00	12.04	290	17.54	8.8	28
FHIA=17=ITC1264	129	212.67	16.28	131.00	9.47	344	25.75	26.1	41
FHIA=23=ITC1265	93	0.00	0.00	204.00	12.00	204	12.00	0.0	19
Nam=ITC1303	122	146.50	7.47	41.67	1.30	188	8.77	11.9	14
Nante=ITC1353	73	80.00	4.00	120.50	4.67	201	8.67	6.4	14
FHIA=25=ITC1418	148	238.00	67.00	22.00	5.00	260	72.00	107.2	115
Kitarasa=ITC1451	110	159.00	35.50	71.25	4.83	233	23.32	22.9	37
Ntebwa=ITC1461	89	202.50	8.17	71.00	2.05	274	10.22	13.1	16
Suu=ITC1462	142	101.80	13.84	64.67	2.24	166	16.08	22.1	26
Ntindii I=ITC1464	95	151.00	2.60	140.75	5.40	292	8.00	4.2	13
Ibwi=ITC1464	123	0.00	0.00	94.50	1.50	95	1.50	0.0	2

rb g i f f fb ; Candidate genotypes were selected and promoted to national variety trail

Bd j j 4; Maintenance of banana varieties and germplasm for future use
Activity period: July 2016 - June 2020
P ckfd j f ; To maintain banana varieties and germplasm for future use
f f jc rfi; Girma K, Merkebu A, Asmare D
S f fe c ; Girma K.
Zfb g f ; January - December 2019
T b g i f h f
Fifty-eight registered, recommended, locally collected and introducedbanana genotypes (dessert and cooking) are being maintained. And all necessary data and filed management is in good progress.
Ef jh ; Single plot
U fb f : 58 banana genotypes
M db j ; Melkassa

S f m
Plant growth performance parameters, yield, quality and abiotic/biotic resistance data are being taken as showed in table 2.

Table 2: Growth and yield performance of maintenance banana varieties and germplasm

Variety	Flowering to harvesting	Bunch (kg)	No. of hands	Marketable fingers No.	Marketable fingers Wt (kg)	Unmark. No.	Unmark. Wt (kg)
Horn	170	3	5	51	2	1	0
Americani	157	19	9	99	15	24	2
Ambo-3	165	25	9	123	21	15	2
Chinese Dwarf	138	28	11	161	25	14	1
Dinke-2	156	26	11	73	16	86	8
Lady finger	159	25	11	149	21	21	2
Dwarf Cavendish	152	26	10	115	19	40	5
paracidoAlrey	158	14	8	33	4	85	9
Kamaramasenge	124	3	6	60	2	0	0
Green Red	157	23	14	149	20	43	1
Ambo-2	167	22	8	110	20	7	1
Poyo	160	26	10	95	21	22	4
AmbowhaSelle	137	13	8	124	11	0	0
Dinke-1	163	19	7	80	15	10	2
Williams -1	175	21	9	67	12	58	7
Willams-2	148	14	7	0	0	104	13
Ducasse Hybrid	140	19	12	128	14	54	3
AmbowohaSelle-2	154	26	7	91	21	12	3
Butuza	173	23	7	107	20	7	1
Robusta	141	28	9	133	26	2	0
Williams Hybrid	162	24	9	128	22	0	0

U fb f ; Registered banana varieties
M db j ; Melkassa

S f m
The improved banana varieties that were given to the users have improved the nutritional status, help as income generation and change the microclimate of the end users.
rb g i f f fb : multiplication of improved banana variety will continue.

Bd j j 6; Determination of NPK fertilizers rate for banana in selected AGP-II districts of Ethiopia
Bd j j f j e; July 2015 - June 2020
P ckfd j f : To determine the optimum rate of NPK fertilizer for banana at its growing areas and to see the NPK fertilizer interactions in respect of banana response to the fertilizers
f f jc rfi: Mesfin, Girma K, Asmare D, Merkebu A
S f fe c ; Girma K.
Zfb g f ; January - December 2019
T b g i f h f
The trail that are planted at Melkassa and Kokais under good condition and all necessary management practices are underway, since the collected data is not enough to show the potential of the cultivars in response to NPK fertilizers the trail will continue for more one year.
Ef jh : RCBD
U fb f ; 18 treatments
M db j ; Melkassa and Koka

S f m
The trial planted at two locations (Melkassa and Koka) analyzed data indicates no significant difference between the treatments, except the fruit diameter for recorded parameters (table 3).

Table 3: Determination of NPK fertilizers rate for banana

Treatment	FHD	BWT (kg)	HN	MARFN	MARWT (kg)	FDM (cm)	FLG (cm)	PLTDM (m)
N1P1K1	137.18^{b}	22.248^{ab}	9.637^{ab}	87.69^{bc}	14.682^{bc}	2.2810^{bc}	8.543^{bc}	0.7454^{ab}
N1P1K2	162.83^{a}	29.363^{a}	10.562^{a}	143.51^{a}	24.852^{a}	3.8977^{a}	14.366^{a}	0.7845^{a}
N1P2K1	154.52^{ab}	25.151^{ab}	10.097^{ab}	109.70^{abc}	19.087^{abc}	3.0726^{ab}	11.352^{ab}	0.7686^{ab}
N1P2K2	153.56^{ab}	27.271^{a}	9.833^{ab}	117.44^{ab}	21.225^{ab}	2.7837^{bc}	11.048^{ab}	0.7442^{ab}
N1P3K1	156.64^{a}	24.479^{ab}	9.620^{ab}	101.27^{abc}	17.541^{abc}	2.6642^{bc}	10.298^{bc}	0.7365^{ab}
N1P3K2	153.41^{ab}	23.410^{ab}	9.223^{ab}	79.27^{bc}	13.881^{bc}	2.4304^{bc}	8.581^{bc}	0.7232^{ab}
N2P1K1	158.64^{a}	26.058^{ab}	9.774^{ab}	113.41^{ab}	19.884^{abc}	2.5768^{bc}	10.076^{bc}	0.7308^{ab}
N2P1K2	165.86^{a}	25.857^{ab}	9.981^{ab}	123.54^{ab}	20.689^{abc}	2.9958^{ab}	11.721^{ab}	0.7261^{ab}
N2P2K1	157.03^{a}	25.233^{ab}	9.700^{ab}	106.83^{abc}	19.157^{abc}	2.6700^{bc}	11.010^{ab}	0.7327^{ab}
N2P2K2	159.00^{a}	27.530^{a}	9.593^{ab}	119.59^{ab}	20.726^{abc}	2.9704^{ab}	11.178^{ab}	0.7341^{ab}
N2P3K1	155.82^{ab}	22.368^{ab}	9.550^{ab}	95.15^{bc}	15.173^{bc}	2.5183^{bc}	9.437^{bc}	0.7208^{ab}
N2P3K2	151.72^{ab}	18.925^{b}	9.205^{ab}	65.33^{c}	12.067^{c}	1.7330^{c}	6.813^{c}	0.7002^{b}
N3P1K1	159.20^{a}	25.707^{ab}	9.702^{ab}	111.95^{abc}	20.486^{abc}	2.9173^{ab}	10.327^{bc}	0.7181^{ab}
N3P1K2	151.82^{ab}	24.254^{ab}	10.150^{ab}	96.70^{bc}	17.600^{abc}	2.2239^{bc}	8.819^{bc}	0.7295^{ab}
N3P2K1	153.51^{ab}	21.717^{ab}	9.588^{ab}	83.07^{bc}	14.641^{bc}	2.2148^{bc}	8.344^{bc}	0.7026^{b}
N3P2K2	147.53^{ab}	21.729^{ab}	9.069^{b}	85.90^{bc}	15.185^{bc}	2.3069^{bc}	8.310^{bc}	0.7175^{ab}
N3P3K1	157.50^{a}	26.527^{ab}	9.717^{ab}	106.23^{abc}	19.127^{abc}	2.7950^{b}	10.538^{abc}	0.7339^{ab}
N3P3K2	157.40^{a}	28.009^{a}	9.752^{ab}	120.00^{ab}	22.548^{ab}	3.1201a^{b}	11.807^{ab}	0.7419^{ab}
Signif	NS	NS	NS	NS	NS	*	NS	NS
LSD	18.9	7.83	1.37	46.67	8.91	1.05	3.93	0.08
CV	7.34	19.05	8.51	27.12	29.41	23.74	23.36	6.55

rb g i f f fb ; further evaluations will be carried out.

Bd j j 7: Influence of sucker retention phase and cutting height of parent pseudostem on follower suckers yield and yield components of banana.

Bd j j f j e; July 2018 – June 2021
P ckfd j f ; To examine the effect of sucker retention stages and cutting height of parent pseudostem on follower suckers yield and yield components of banana.
f f jc rfi; Asmare D, Girma K, Awoke M, Gezahagn
S f fe c ; Asmare D.
Zfb g f ; January - December 2019
Ef jh : RCBD
U fb f ; 16 (4 sucker retention stages and 3 cutting height)
M db j ; Melkassa, A/Minch

S f m

Plant vegetative performance parameters, yield, quality and abiotic/biotic resistance data are being taken.Data analysis result will show non significance difference between the treatments for the recorded parameters (table 4).

Table 4: Influence of sucker retention phase and cutting height of parent pseudostem on follower suckers, yield and yield components of banana at MARC 2019/20.

Treatment	FHD	BWT (kg)	HN	MARN	MARWT (kg)	FDM (cm)	FLG (cm)	PLTDM (m)	PLTHT (m)	PLTLV
F1B1	150.37	27.245	10.100	111.34	16.431	2.8594	10.537	0.7865	2.4856	10.989
F1B2	148.73	28.678	10.422a	61.32	14.776	2.3328	9.108	0.7922	2.6872	10.189
F1B3	165.69	32.380	9.922	100.58	19.620	2.9778	10.652	0.7912	2.5883	10.278
F2B1	166.51	30.386	10.078	125.50	22.673	3.2144	12.084	0.7597	2.4628	10.400
F2B2	153.63	33.311	11.061	129.92	23.467	3.2206	11.749	0.7941	2.4883	10.078
F2B3	150.26	31.214	9.833	125.80	22.782	3.5478	12.277	0.7882	2.5100	10.044
F3B1	165.06	26.933	10.667	117.78	16.944	3.0278	11.517	0.7739	2.3250	10.889
F3B2	148.53	30.314	9.911	102.43	19.071	3.0072	10.657	0.7853	2.4889	9.472
F3B3	147.90	29.273	10.633	99.89	16.322	2.3978	8.796	0.8024	2.6633	10.122
F4B1	157.83	28.839	9.944	119.17	20.828	3.2056	11.496	0.7750	2.3428	10.667
F4B2	139.06	25.367	10.111	85.72	14.839	2.5333	9.217	0.7894	2.3300	11.167
F4B3	146.50	30.878	10.444	108.72	19.933	3.0500	11.333	0.7689	2.4578	11.167
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
LSD	23.63	6.29	1.37	58.68	9.53	1.35	5.10	0.05	0.2	0.85
CV	9.10	12.57	7.90	32.28	29.67	27.00	27.95	3.47	4.72	10.00

F1 = Non inflorescence B1 = H1 =200 cm
F2 = Emerge Inflorescence B2 = H2 =100 cm
F3 = End of inflorescence B3 = H3 = 0 cm
F4 = Fruit maturity

rb g i f f fb : further evaluation will be carried out.

kfd 3; Development and promotion of papaya technologies for various purpose in Ethiopia
Bd j j 2; Pre-extension and popularization of papaya varieties in Ethiopia
Bd j j f j e; July 2007 – June 2020
P ckfd j f ; To enhance production and productivity of papaya through demonstration of improved technologies
f f jc rfi; FitsumMiruts, Wegayehu A., AsmareDagnew, TesfayeGugissa, Girma
S f fe c ; Girma K.
Zfb g f ; January - December 2019
T b g i f h f

The pre extension demonstration of papaya technology has been done with selection of potential Kebeles in collaboration with DAs and experts. More than 8000 papaya seedlings were demonstrated for a total of 31 farmers of them 24 male and 9 female and 2 kg papaya seed was distributed to different users. The technology has demonstrated in Dodota, Dugda,

Dugda, Sire, Boset and Adam districts. Additionally, multidisciplinary team of researchers from Melkassa delivered training to those trainees (368) of papaya production.

Ef jh ; Farmers plot

U fb f ; Released papaya variety and farmers

M db j ; Dodota, Dugda, Dugda, Sirea, Boset and Adam districts

Sf m

In the area where papaya demonstration is done farmers are benefited nutritionally, economically and also contribute for good microclimate. Currently the farmers are comparatively managing their farm based on the training given. And thus, the farmers demanded for more planting materials.

rb g if f fb : The demonstration work will continued by agricultural exitension and communication program team.

Bd j j 3; Papaya national variety trial

Bd j j f j e; July 2016 – June 2020.

P ckf d j f; To evaluate and select superior papaya varieties

f f jc rfi; Girma K, Asmare D, Merkebu A, Wakuma B, Jemmal I.

Sf fe c ; Girma K.

Zfb g f ; January - December 2019

T b g if h f

The papaya variety trial is in good progress in the filed and all necessary management is well done. The trial will be completed in 2013.E.C.

Ef jh ; RCBD

U fb f ; Six dioecious papaya varieties

M db j ; Melkassa, Assossa and Mehoni

Sf m

Six dioecious papaya varieties (Wn-139, L# 532; WN-140, L # 484; KK-102 L # 214; MK-114, L # 164; MK114, L # 177; Gergedy-3, L # 159)and one check (MK-121, L # 516) were planted at Melkassa,Werer, Assossa and Mohoni to understand the performance of the varieties in RCBD design with three replication. All papaya genotypes showed highly significant difference at analysis of variance revealed significant ($p < 0.05$) differences in the parameters studied (Table 1).

Table 1: yield and vegetative performance of papaya genotypes tested at Melkassa, 2019/20

Variety name	Tree height at first flower (cm)	Internodes length (cm)	Girth at 30 cm above ground (cm)	Canopy spread (cm)	Marketable yield (t/ha)	Total yield (t/ha)	Diam (cm)	Len. (cm)
WN-139 L#532	117.70	6.00	39.66	168.00	98.4	98.97	275.2	226.2
WN-140 L#484	165.33	6.33	34.66	188.33	122.4	125.4	368.0	225.4
KK-102 L#214	139.33	7.00	21.66	161.33	118.1	120.5	372.6	266.7
Mk-114 L#164	197.00	7.66	30.66	145.33	57.6	58.5	256.3	158.8
Mk-114 L#177	143.67	5.00	30.66	146.33	88.0	91.1	313.7	202.6
Gergedi-3 L#159	121.00	5.00	28.66	144.67	115.5	116.8	399.4	258.8
MK-121 L#516	122.33	6.00	20.00	163.00	137.0	146.7	447.4	216.5
CV	4.84	4.81	16.13	6.93	15.98	16.15	12.88	11.19
F-test	***	***	**	**	***	***	**	**
LSD	13.1	0.525	8.44	19.68	29.92	31.01	79.61	44.23

rb g if f fb ; candidate variety will be recommended.

Bd j j 4; Maintenance breeding of papaya varieties and germplasm for future use

Bd j j f j e; July 2016– June 2020

P ckf d j f : To maintain papaya varieties and germplasm for future use

f f jc rfi: Asmare D, Merkebu A, Girma K

Sf fe c ; Girma K.

Zfb g f ; January - December 2019
T b g h f
The maintenance breeding of papaya varieties and germplasm trials in good progress in the field and all required management is well done.
Ef jh ; Single plot
U fb f ; 115 Papaya genotypes
M db j ; Melkassa

S f m

Papaya genotypes that include (85 dioecious and 30 hermaphrodites) were collected and introduced some years back and maintained through controlled pollination for eight generation having six plants per each genotype was maintained at Melkassa. To maintain the genetic purity of the accession continuous controlled pollination techniques is being practiced. All the necessary yield and yield component parameters have been collected and documented as shown in Table 5. However, a few hermaphrodite genotypes (CMF-019, L#84;MK-107,L#401; Sunrisolo; ThilandHerma; Mamao Sunrise Solo, L#118; which have low bearing potential, L#36 and Gergedi-3, L #158,) have encountered problem of continuation to next generation due to low seed set. The performance of the genotypes is indicated in Table 2.

Table 2: Growth and yield characteristics of maintenance breeding of papaya germplasm for future use

Variety	Sex (H/F)	Height to first flower (cm)	Total height at first flow. (cm)	Girth at 30 cm above ground (cm)	Canopy spread (cm)	Leaf no. per tree
CMF 078 L# 56	H	52	100	23	163	25
KK-103 L # 446	H	110	176	28	181	24
MK-121 L # 516	H	98	178	24	198	23
CMF 021 L# 74	H	80	137	19	156	19
Hacar 208 L# 9	H	92	150	19	177	24
CMF 075 L# 61	H	86	157	22	167	20

B & # - # 1 1 9 $ e7 176 77 1cc 26 15B 7# 1cc M

Multiplication of improved papaya varieties under in good progress nevertheless, there is difficulty to get pure papaya breed seed due to inconsistencyof the weather condition that result high flower abortion and also teft problem in papaya filed.

Ef jh ; Single plot

U fb f ;Three released papaya varieties

M db j ; MARC

Sf m

10516 seedling and 1570 g papaya seeds were multiplied and disseminated (three released hermaphrodite papaya varieties

rb g if f fb ;Multiplication of improved papaya variety will continue/

kfd 4; Maintenance breeding of other tropical fruit crops germpalsm

Bd j j 2; Collection, introduction and evaluation of passion fruit germplasm for fresh and processing purposes

Bd j j f j e; July 2016 – June 2020

P ckfd j f :To collect and evaluate passion fruit accessions for different purpose

f f jc rfi; Merkebu A, Asmare D, Girma K

Sf fe c ; Merkebu A

Zfb g f ; January - December 2019

T b g if h f

Efforts have been made by planting passion fruit trail in new field at Melkassa and currently the trail is under good condition.

Ef jh : Single plot

U fb f ; Seven genotypes

M db j ; Melkassa

Sf m

Six passion fruit genotypes collected from Uganda, Africa Juice and around Melkassa are being established and evaluated. The highest marketable fruit yield of (5138 gm/plant) was recorded from genotype FB 200 followed by Uganda 2. Whereas the lowest marketable fruit yield (900g /plant) was recorded from FB Purple. There was also great variation among genotypes for fruit mean juice volume per fruit and the highest fruit juice volume (137 ml) per fruit was recorded from variety purple red followed by FB200 (134 ml), while the lowest (77) fruit volume was recorded from variety FB purple. The genotypes had also great difference on mean total soluble solid (TSS) content of fruits. The highest TSS (4.00) was recorded for FB 200, whereas the lowest was (8) from FB Purple.

Table 6: Yield and yield components of passion fruits genotypes for fresh and processing

Genotype name	No.	Weight (g/plt)	No.	Weight (g/plt)	% Unmak	Length (cm)	Width (cm)	Juice volume (ml/fruit)	TSS (%)
FB Purple	8	900	2	153	14.5	8	6	77	8
Uganda -1	21	3313	4	756	11	9	8	128	11
FB 300	12	2155	2	384	15.1	10	7	134	11
FB 200	21	5138	4	497	8.8	8	7	126	13
Uganda 2	38	4029	11	1630	28.8	9	7	123	11
Purple red	14	1764	5	921	34.3	10	8	137	11

rb g if f fb : In addition, further collection and introduction of genotypes will be carried out to strength germplasm base.

National Subtropical Fruit Crops Research Program

Girma Kebede
E-mail: agirmak99@yahoo.com; Tel: +251911798342

h b ; Subtropical Fruit Crops National Research Program
kfd j rfi 2; Development and Promotion of Avocado Fruits Technologies for Various Purposes in Ethiopia
kfd f j e; July 2020 - June 2023
Bd j j 2; Clonal propagation for selection of avocado rootstock to root rot (*Phytophthora cinnamomi*) and desire characters
Bd j j f j e; July 2016 - June 2020
P ckfd j f ;

- To build up clonal propagation protocol for avocado rootstocks and assess desirable characteristics
- Screening of avocado germplasm that exhibits tolerance/resistance to *Phytophthora cinamomi* (root rot) of avocado

S f jc rfi f ; Wegayehu A, Girma K, Edossa E, Agernesh M
S f fe c ; Agernesh M
Zfb g f ; January - December 2019
T b g i f h f
U fb f ; five avocado rootstock genotypes)Duke-7, Wondogenet, Zeway, Dale-1 and Dale-2)
Ef jh ; single plot
M db j ; Melkassa

S f m
The seeds of rootstocks were planted for grafting of the desired rootstock genotypes in the pot. When the seedlings reached 0.8 to 1.2 cm diameter size, they were grafted with the variety to be rooted at about 10 cm from the ground. It was made close to the soil level as much as possible to facilitate routine operations. At bud burst (after the graft union fully healed) plants were placed in an etiolating room (darkroom). Twenty-five plants of each five avocado genotypes (Duke-7, Wondogenet, Zeway, Dale-1 and Dale-2) were used for etiolation. Of these 25 plants, 11 to 17 were etiolated. The etiolated avocado genotypes were wounded and treated with IBA to produce roots and with this stepthe experiment was finalized.
There was a marked difference among the genotypes in production of etiolated shoots, and rooted plants. A range of one to eight (5.9 to 53.3%) of the etiolated plants produced roots at the collars. Those genotypes which were not treated with IBA produced a large mass of callus tissues at the wound site with either very light or zero root growth.
rb g i f f fb ; theactivity is completed with available preliminary information and optimization of etiolation and rooting procedures should need further investigation under better physical facilities.

Bd j j 3; Pre-Scaling-Up of Improved Avocado Varieties in Ethiopia
Bd j j f j e; July 2018 - June 2020
P ckfd j f; To enhance production and productivity of avocado through wider scaling up of improved technologies
S f jc rfi f ; Fitsum M, Girma K, Agernesh M, Edossa E, Asmare D, Bedru B (Melkassa), Fruit and Research Extension teams of Wondogenet ARC
S f fe c ; Girma K,
Zfb g f ; January - December 2019
T b g i f h f

U fb f ; six released avocado varieties
Ef jh ; single plot
M db j ; Melkassa and Arba Minch

S f m

The activity has been designed to establish a strong communication and feedback mechanisms among stakeholders. Focus group discussion was conducted with technical experts and farmers who have been using improved avocado varieties in Minjar, Efratana Gidim and Arsi zone to study the perspective of avocado technology users in the Districts. In2011 fiscal year 2615 improved and grafted avocado varieties were dissiminated for end users., such as Adama town, Adama district (Wake Tiyomia and WonjiKuriftu kebeles), Lume (Dibandiba kebele), Dugda (Dugda), Boset (Doni),Kersa Malema (South west Shewa), Agarfa TVET College, FDRE President's Office and Chiro ARC

Individual farmers, private organizations and other sectors have access for the technology demonstratedon how to use improved variety, the management aspect starting from hole preparation to the final fruit harvest. Moreover, awareness will be created for individual farmers and different NGO's on nursery and field management operations. In addition to this, training on grafting techniques will be deliverable.

rb g i f f fb ; Further demonstration will be done by extension team.

Bd j j 4; Collection, introduction and evaluation of resistant/tolerant rootstocks to avocado root rot (*Phytophthora cinnamomi*)
Bd j j f j e; July 2015 - June 2020
P ckfd j f; To introduce, collect and evaluate resistant/tolerant avocado rootstock for *Phytophthora* root rot disease
S f jc rfi f ; Edossa E, Agernesh M, Asmare D, Girma K; Fruit team of Jimma ARC
S f fe c ; Agernesh M.
Zfb g f ; January - December 2019
T b g i f h f
U fb f ; three avocado rootstock varities (Zeway, Tibila and Duke-7)
Ef jh ; single plot
M db j ; Melkassa and Jimma

S f m

Introduced avocado rootstock variety Duke-7 which is known for its tolerance to *Phytophthora cinnamomi* along with two locally collected rootstock genotypes (Zeway and Tibila) have been planted on single observation plots. Ten grafted plants of each genotype have been established in the field. Vegetative performances data were taken. Recommended agronomic and field practices have been applied.

Based on their vegetative performance,Tibila rootstock variety showed the highest plant height (4.7m), girth below the grafted union (105cm), girth above the union (108cm) and canopy spread (6.1m), while Duke-7 variety recorded the smallest tree height (2.8m), girth below the grafted union (44.9cm), girth above the union (43.4cm) and canopy spread (1.7m). in contrast with the two varieties, AdamituluJidokombolcha rootstock variety showed intermediate vegetative performance character (table 1).

Table 1. Vegetative performance of root stock avocado varieties at MARC in 2019/2020

Variety	Plant height (m)	Girth measurement		Canopy spread (m)
		Below (cm)	Above (cm)	
Duke 7	2.8	44.9	43.4	1.7
Tibila R/S	4.7	105.0	108.0	6.1
AdamituluJidokombolcha R/S	3.1	60.0	61.0	3.0
Mean	3.53	69.97	70.8	3.6

rb g i f f fb ; the activity was completed with available information.

Bd j j 5; Adaptation and verification of introduced commercial avocado varieties
Bd j j f j e; July 2015 - June 2020
P ckfd j f; To test the adaptability and register commercial varieties of avocado varieties with high yield, biotic and abiotic resistance and quality to different avocado growing AEZs
f f jc rfi; Edossa E, Agernesh M, Asmare D, Girma K; Fruit teams of DebreZeit, Jimma, Tepi and Wondogenet ARCs
S f fe c ; Edossa E
Zfb g f ; January - December 2019
T b g i f h f
U fb f ; six introduced commercial avocado varieties
Ef jh ; RCBD
M db j ; Melkassa and Jimma

S f m

Five introduced commercial avocado varieties (Chaquate, Simmonds, Jose Antonio, AL-I, and AL-II) and a standard check (Hass) have been planted in 2014 using RCBD with three replications at Melkassa, DebreZeit, Jimma, Wondogenet and Tepi Agricultural Research Centers. Six grafted seedlings were used per experimental plot with 7m x 7m spacing. Data for vegetative, yield, quality and abiotic/biotic resistance parameters were taken.
All the introduced varieties showed good vegetative growth and development. The highest tree height (4.20m) and girth below the union (62.33m) was recorded by AL -1 ,while the lowest tree height was recorded by Jose Antonio (2.80m) .Hass variety showed the highest girth above the grafted union (56.67m) .Chaquate exhibited a wide canopy spread with (4.20m) and the lowest girth above the grafting union (45m) (Table 2).

Table 2/ Vegetative performance of introduced avocado varieties at MARC in 2019/2020

varieties	Tree height (m)	Girth below union (cm)	Girth above union (cm)	Canopy spread (m)
Al-1	4.20^{a}	62.33^{a}	47.33^{b}	3.67^{abc}
Al-2	3.83^{a}	60.00^{abc}	45.67^{b}	3.87^{ab}
Chaquate	3.06^{b}	61.00^{ab}	45.00^{b}	4.20^{a}
Hass	3.00^{b}	56.67^{abc}	56.67^{a}	3.43^{bc}
Jose Antonio	2.80^{b}	50.67^{bc}	50.00^{ab}	3.67^{c}
Simmonds	2.97^{b}	51.67^{c}	46.67^{b}	3.20^{bc}
Cv	10	12.05	9.38	11.8

rb g i f f fb ; the activity will be requested for extension from July 2012 – June 2014 E.C for further evaluation including yield parameters.

Bd j j 6; Collection, introduction and evaluation of commercial avocado varieties and genotypes
Bd j j f j e; July 2015 – June 2020
P ckfd j f; To collect and evaluate avocado accessions for high yield, quality fruits and rootstock purpose
f f jc rfi; Edossa E, Agernesh M, Asmare D, Girma K
S f fe c ; Edossa E
Zfb g f ; January - December 2019
T b g i f h f
U fb f ; 27 local and introduced collections of avocado varieties
Ef jh ; single plot
M db j ; Melkassa and Jimma

S f m

22 local avocado collections and 5 introduced avocado varieties were planted on a single observation plot at Melkassa research centre.3 – 5 grafted plants were used per variety/accession with a 5x5 square planting system and plant vegetative performance parameters, yield, quality and abiotic/biotic resistance data are being taken. Recommended agronomic and field practices are being followed.

A locally collected and introduced avocado variety for rootstock and scion were showed good vegetative performance. Vegetative performance parameters data are being taken. Recommended agronomic and field practices are being followed.

Table 3/ Average vegetative performances of introduced scion/rootstock avocado varieties and collections at Melkassa,2019/2020 set -1

Variety	Tree height (m)	Canopy spread (m)	Girth above union (m)	Girth below union (m)
Duke-7	2.80	1.70	0.43	0.44
Ashdod-7	4.92	3.70	0.56	0.49
Ashdod -17	3.62	2.53	0.48	0.43
Fair Child	3.98	2.80	0.50	0.54
Dagarga	2.26	1.61	0.35	0.31
Jimma-7	3.53	3.63	0.53	0.51
Rayan	2.58	3.08	0.57	0.49
Mean	3.38	2.72	0.49	0.46

rb g i f f fb ; further evaluation of the performances of both introduced and local collections of avocado scion/rootstock varieties/genotypes will continue.

Bd j j 7; Field maintenance of commercial avocado (*Persia americana*M.) Varieties and genotypes

Bd j j f j e; July 2015 – June 2020

P ckfd j f ;

- To conserve locally available and introduced genotypes and varieties of avocado
- To enhance the genetic base of avocado for further variety improvement programs

f f jc rfi; Edossa E, Agernesh M, Asmare D, Girma K; Fruit teams of Jimma, Debre Zeit and Wondogenet ARCs

S f fe c ; Agernesh M

Zfb g f ; January - December 2019

T b g i f h f

U fb f ; Six registered avocado varieties

Ef jh ; RCBD

M db j ; Melkassa, Jimma, DebreZeit, Wondogenet

S f m

Six registered avocado varieties (Hass, Ettinger, Nabal, Fuerte, Pinkerton and Bacon) were planted in RCBD folded design at Melkassa agricultural Research Centre. Ten grafted plants were used per variety/accession with a 7 x 7 square planting system and plant vegetative performance parameters, yield, quality and abiotic/biotic resistance data are being taken. Recommended agronomic and field practices are being followed.

Six released avocado varieties (Hass, Ettinger, Nabal, Fuerte, Pinkerton and Bacon) are being maintained under field condition for the purpose of scion bud-stick sources.

rb g i f f fb ; maintenance of the genotype will continue.

Bd j j 8: Field evaluation of phenology (growth cycle) and fruiting season of released avocado varieties

Bd j j f j e; July 2016 – June 2020

P ckfd j f: To study the phenological cycle of improved avocado varieties

f f jc rfi; Edossa E, Agernesh M, Girma K, Asmare D
S f fe c ; Edossa E
Zf b g f ; January - December 2019
T b gS f fb di h f ;
U f b f ; six registered avocado varieties
Ef jh ; RCBD
M db j ; Melkassa

S f m
Six registered avocado varieties (Hass, Ettinger, Nabal, Fuerte, Pinkerton and Bacon) were planted in RCBD folded design at Melkassa research centre. Ten grafted plants were used per variety/accession with a 7 x 7 square planting system and plant vegetative performance parameters, yield, quality and abiotic/biotic resistance data are being taken. Recommended agronomic and field practices are being followed.

Most varieties of avocado flowering at MARC concentrated in November. However, some avocado varieties such as Ettinger and Hass started flowering in late September and peak flowering occurred in October. In all avocado varieties, vegetative flushing occurred at the same time with flowering. Peak avocado harvesting was made in September. Generally, the data indicated phenological trend varies throughout months in the year and some differences observed among varieties.
rb g i f f fb ; the activity requested for extension from July 2012 – June 2013 E.C for further evaluation on phenological trends.

Bd j j 9; Multiplication of improved varieties of avocado
Bd j j f j e; July 2016 – June 2020
P ckf d j f ;

- To multiply/propagate true to type initial planting material of improved avocado varieties
- To build the capacity of technical staffs and stakeholders on improved multiplication and propagation of avocado.

f f jc rfi; Girma K, Agernesh M, Edossa E; Fruit teams of Wondogenet and Kulumsa ARCs
S f fe c ; Girma K.
Zf b g f ; January - December 2019
T b gS f fb di h f ;
Design: single plot
M db j ; Melkassa, Wondogenet and Kulumsa

S f m
Six released avocado scion varieties (Bacon, Ettinger, Fuerte, Hass, Nabal and Pinkerton) were multiplied by grafting onto adapted local avocado rootstocks (Tibila and Zeway) using cleft/wedge grafting technique at MARC. The rootstocks were raised in 25cm x 35cm wide poly bags under 60% shade net-house conditions. When they reached appropriate stage, scion varieties were grafted. In the fiscal year 2011 E .C, 6,725 grafted avocado seedlings and 6,100 scion sticks were distributed to the different parts of the country
Treatments: six released avocado varieties
Different parts of the country get access for improved and grafted avocado seedling as an initial material whichinsuressustainability production.
rb g i f f fb ; The activity extended from July 2012 – June 2015 E.C t to multiply released varieties for research purpose and planting material source.

kf d j rfi JJ; Development and Promotion of Mango Fruits Technologies for Various Purposes in Ethiopia

Bd j j 2; Study on the salt tolerance of polyembryonic mango rootstocks cultivars
Bd j j f j e; July 2018 – June 2019
P ckfd j f ;

1. To asses spatial and temporarily soil salinity/sodicity in the mango orchards in the Rift Valley of Ethiopia
2. To identify the relative tolerance of potential mango rootstocks varieties to salinized water on the
3. seed germination
4. To identified the relative tolerance of potential mango rootstocks varieties to salinized soil media

f f jc rfi; Edossa E, Agernesh M, Asmare D, Girma K; Fruit team of Mehoni ARC
S f fe c ; Edossa E/
Zf b g f ; January - December 2019
T b gS f f b di h f ;
U f b f ; six mango varieties with six salt levels.
E f jh ; strip plot
M db j ; Melkassa and Mehoni

S f m

Five local accession of introduced mango varieties (W3, N1, Sabre,NE6 ,apple mango and NE2) with standard check 'Sabre' under five (5) salt levels such as (6ds/m (96 g of sodium chloride),10ds/m (200g of sodium chloride),8ds/m (160g of sodium chloride),2ds/m (32g of sodium chloride), 4ds/m (64g of sodium chloride)) each dissolved in 25L of awash water and 'Awash water' check were planted in 2018 using Strip plot Design at Melkassa research centers. Vegetative performance parameters such as germination percentage data are being taken.

There was significant variation between the six varieties used for the experiment. The highest germination percentage was recorded for sabre variety (90.28%), followed by W3 (85.42%) variety wise. While the highest plant height and diameter was recorded for W3 variety (table .1). Inversely the variation of different level of salt does not indicate as such variation and non-significant difference among them. This might be due to the nature of mango seed which follow imbibition at the early stage and does not affected by toxic environment as indicated in table 2.

Table 1: variety (Vertical strip) vegetative performance at MARC 2019/20

Variety	Plant Height	Plant Diameter	Germinated percent
W3	26.602a	4.1106a	85.417 ab
NE1	25.273 ab	3.98 ab	83.333 ab
NE6	21.699ab	3.8644 ab	68.75 b
Sabre	20.089 ab	3.7156 ab	90.278a
Apple m.	20.048 ab	3.73 ab	77.083 ab
NE2	19.897 b	3.1406 b	48.611 c
Cv	25.72	19.33	19.79

Table 2: Salt level (horizontal strip) vegetative performance at MARC 2019/20

Salt Levels	Plant Height	Plant Diameter	Germinated percent
8dsm-1	24.855	4.0478	81.25
6dsm-1	23.641	3.76	75.694
2dsm-1	22.728	3.711	79.861
10dsm-1	22.641	3.9939	70.139
Awash River	20.088	3.5117	72.222
4dsm -1	19.655	3.4567	74.306
Cv	31.51	25.46	27.33

rb g i f f fb : the activity was completed with available information.

Bd j j 3; Pre-scaling up of improved mango varieties in Ethiopia
Bd j j f j e; July 2018 – June 2020
P ckfd j f; To enhance production and productivity mango through wider scaling up of improved technologies
S f jc rfi f) *; Fitsum M, Girma K, Agernesh M, Edossa E, Asmare D, Bedru B (Melkassa), Fruit and Research Extension teams of Pawe and Arba Minch ARC
S f fe c ; Agernesh M
Zfb g f ; January - December 2019
T b gS f fb di h f ;
U fb f ; four released mango varieties
Ef jh ; j hrfi m
M db j ; Melkassa, Pawe and Arba Minch

S f m

The activity was designed to establish a strong communication and feedback mechanisms among stakeholders. Focus group discussion is planned to be conducted in May – June with technical experts and farmers who have been using improved mango varieties in Minjar, EfratanaGidim and Arsi zone to study the perspective of mango technology users in the Districts. In the year 2011, 2,701 grafted mango seedlings were disseminated to; Adama town, Adama district (Wake Tiyomia and WonjiKuriftu kebeles), Lume (Dibandiba kebele), Dugda (Dugda), Boset (Doni), Kersa Malema (Southwest Shewa), Agarfa TVET College, FDRE President's Office, and Chiro Agricultural Research Center.

Individual farmers, private organizations and other sectors have access for the technology demonstrated on how to use improved variety, the management aspect starting from hole preparation to the final fruit harvest. Moreover, awareness will be created for individual farmers and different NGO's on nursery and field management operations. In addition to this, training on grafting techniques will be deliverable.

rb g i f f fb ; The activity was completed with subtropical research program and registered under extension research program.

Bd j j j rfi 4; Mango (*Mangifera indica* L.) variety adaptation and verification
Bd j j f j e; July 2016 - June 2020
P ckfd j f;

- To test the adaptability and register commercial varieties of mango varieties with high yield, biotic and abioticresistance and quality to different mango growing AEZs

S f jc rfi f) *; Edossa E, Girma K, Agernesh M, Asmare D, Fruit team of Arba Minch Agricultural Research Center
S f fe c ; Girma K
Zfb g f ; January - December 2019
T b g h f ;
U fb f ; five introduced commercial mango varieties and one registered mango variety as check
Ef jh ; RCBD
M db j ; Melkassa and Arba Minch

S f m

Five introduced commercial mango varieties (Van Dyke, Haden, Brooks, Spring field and Indica R-120) and a standard check 'Apple Mango' were replanted in 2017 using a folded RCB Design with three replications at Melkassa and Arba Minch (2016) research centers. Six grafted seedlings were used per experimental plot with a 5 x 5 square planting system. Plant vegetative performance parameters are being taken.

All varieties establish well currently and vegetative data was recorded for all introduced varieties.The highest tree height of (2.25m) was recorded for Indica R-120, while the lowest mean tree height was recorded for Vandike (1.8 m).similarly Indica R-120 showed the highest girth below and above the grafted union (25.69 cm, 21.15cm) in reference with spring field (20.87 cm, 16.63cm) consequently. The highest canopy spread was also recorded for Indica R-120 (2.20 m) followed by Haden (1.97m) (Table 3).

Table 3: Vegetative performance of introduced mango varieties at MARC in 2019/20

Variety	Tree height (m)	Canopy spread (m)	Girth below union (cm)	Girth above union (cm)
Apple mango	1.93^{c}	1.83^{bc}	22.30^{b}	19.33^{ab}
Brooks	1.97^{bc}	1.73^{bc}	22.30^{b}	18.30^{b}
Haden	2.10^{ab}	1.97^{ab}	25.47^{a}	19.90^{a}
Indica R-120	2.25^{a}	2.20^{a}	25.69^{a}	21.15^{a}
Spring Field	1.83^{c}	1.63^{c}	20.87^{b}	16.63^{c}
Van Dike	1.80^{c}	1.57^{c}	21.50^{b}	17.67^{bc}
CV	6.23	8.01	5.35	4.36

rb g i f f fb ; Further evaluation of the performances of mango varieties will continueand the activity extended from July 2012 – June 2014 E.C for remaining yield data.

Bd j j Uj rfi 5; Collection, introduction and evaluation of mango germplasm for fresh market and processing
Bd j j f j e; July 2016 - June 2020
P ckfd j f ;

- To collect and/or conserve naturalized mango genotypes and varieties of mango
- To enhance the genetic base of mango for variety improvement

S f jc rfi f) *; Edossa E, Agernesh M, Asmare D, Girma K
S f fe c ; Agernesh M
Zf b g f ; January - December 2019
T b g h f ;
U f b f ; two collection set (Set-I with 18 and Set-II with 21 genotypes)
Ef jh ; single plot
M db j ; Melkassa

S f m
Two sets of locally collected mango collections (Set-I with 18 and Set-II with 21 genotypes) in single observation.
All locally collected and introduced mango genotypes will established well and in good progress. Plant vegetative performance parameters are being taken and all agronomic practices will be followed.
B/ Tf .J b h d rffd j
rb g i f f fb ; further evaluation of the performances of mango genotypes will continue/

Bd j j j rfi 6; Field maintenance of commercial mango (*Mangiferaindica*) varieties and genotypes
Bd j j f j e; July 2015 - June2020
P ckfd j f ;

1. To conserve locally available and introduced mango genotypes and varieties at suitable mango growing agro-ecologies
2. To enhance the genetic base of mango for variety improvement
3. To establish a database for mango germplasm collections

S f jc rfi f) *; Edossa E, Agernesh M, Asmare D, Girma K, Fruit teams of Assosa and Arba Minch Agricultural Research Centers
S f fe c ; Edossa E
Zfb g f ; January - December 2019
T b g h f ;
U fb f b e ef jh ; One released (Apple mango) and three registered mango varieties (Keitt, Kent and Tommy Atkins) at Melkassa in**;** RCBD with three replication
M db j ; Melkassa, Assosa, Arba Minch

S f m
Trees of the four mango varieties (Apple mango, Keitt, Kent and Tommy Atkins) are being maintained at MARC under field conditions for the purpose of scion bud-stick sources.
rb g i f f fb ; field maintenance of thegenotypes will continue.

Bd j j Uj rfi 7; Evaluation of high-density planting system on mango (*Mangiferaindica*)
Bd j j f j e; July 2018 - June 2020
P ckfd j f ;

- To evaluate the effects of high-density planting on Apple mango trees
- To identify the best population of Apple mango trees

S f jc rfi f) *; Girma K, Edossa E, Agernesh M, Asmare D.
S f fe c ; Edossa E
Zfb g f ; January - December 2019
T b g h f ;
U fb f ; four planting density
M db j ; Melkassa

S f m
Grafted apple mango seedlings have been planted in four different planting densities (7m x 7m; 7m x 4m; 6m x 4m; 4m x 3m) RCBD folded design with three replications in June 2019. Apple mango variety and Sabre rootstock have been used for the field trial.
All seedlingsestablished well on the field and in a good progress currently.
rb g i f f fb : Proper field management operations will be carried out and all necessary data will be taken for performance evaluation.

Bd j j j rfi 8; Evaluation of phenology (growth cycle) and fruiting season of released mango varieties
Bd j j f j e; July 2016 - June 2020
P ckfd j f;

- To study the phenological cycle of improved mango varieties

S f jc rfi f) *; Edossa E, Agernesh M, Asmare D, Girma K
S f fe c ; Edossa E
Zfb g f ; January - December 2019
T b g h f ;
U fb f ; four released mango varieties
Ef jh ; RCBD
M db j ; Melkassa

S f m
Four released/registered varieties (Apple mango, Tommy Atkins, Kent and Keitt) have been used for this experiment in RCBD folded design with three replicates. Plant vegetative performance parameters are being taken and data were collected for flushing, flowering and fruit set of the fruit.

Mango started flowering in November for most varieties and ended in February. However, this year Apple mango and Tommy Atkins flowered early while Keitt and Kent mango varieties flowered lately. All mango varieties produced vegetative flush in October and November. Except Tommy Atkins all other mango varieties were ready for harvesting in July. Fruits from Tommy Atkins mango variety were harvested in June.

rb g i f f fb ; All necessary data recording will continue for further evaluation.

Bd j j j rfi 9; Multiplication of improved varieties of mango

Bd j j f j e; July 2016 - June 2020

Pckfd j f ;

- To multiply/propagate true to type initial planting material of improved mango varieties
- To build the capacity of technical staffs and stakeholders on improved multiplication and propagation of mango

Sf jc rfi f) *; Girma K, Agernesh M, Edossa E (Melkassa), Fruit teams of Arba Minch and Pawe Agricultural Research Centers

Sf fe c ; Girma K

Zfb g f ; January - December 2019

T b g h f ;

One released (Apple mango) and two registered (Tommy Atkins and Kent) mango scion varieties were multiplied by grafting onto adapted polyembryonic local mango rootstock genotypes using wedge/cleft grafting technique at Melkassa Agricultural Research Center. The rootstocks were raised in a 25cm x 35cm poly bags under 60% shade net house conditions. When they reached appropriate stage, scion varieties were grafted. A total of 7,000 mango rootstock seedlings were raised at MARC on growth media with proportion 2:1:1 ratio of top soil, sand and well decomposed manure/compost respectively. These mango seedlings were grafted of these, 5,725 successful grafted mango seedlings (4,711 Apple mango, 374 Tommy Atkins, and 640 Kent) were obtained for dissemination.

U fb f ; three registered mango varieties

Ef jh ; j hrfi m

M db j ; Melkassa, Pawe and Arba Minch

Sf m

Different parts of the country get access for improved and grafted avocado seedling as an initial material for different research purposes which insure sustainability production. Additionally, Training on grafting techniques and nursery management was provided to public and private growers

rb g i f f fb ; About 10,000 grafted mango seedlings will be multiplied/

kfd .4; Development and Promotion of Citrus Technologies for Different Purposes and Agro-ecologies of Ethiopia

Bd j j Uj rfi 2; Adaptation and verification of pummelo (*Citrus grandis*) varieties

Bd j j f j e; July 2016 - June 2020

Pckfd j f ;

- To test the adaptability and register commercial varieties of pummelo varieties with high yield, biotic and abiotic resistance and quality to different citrus growing AEZs
- To enhance the genetic base of pummelo for variety improvement programs

Sf jc rfi f) *; Asmare D, Edossa E, Agernesh M, Girma K, Fruit team of Mehoni Agricultural Research Center

Sf fe c ; Asmare D

Zfb g f ; January - December 2019

T b g h f ;

Four introduced commercial pummelo varieties (Dwarf Chandler, Dwarf Tahitian, Bosworth and Pomlit) have been planted in 2016 using RCBD with three replications at Melkassa and

Mehoni Agricultural Research Centers. Four seedlings budded onto *C. volkamariana* were used per experimental plot with 5m x 5m planting spacing. Vegetative data were recorded.
U fb f ; Four introduced commercial avocado varieties
Ef jh ; RCBD
M db j ; Melkassa and Mehoni

S f m
All introduced pummelo variety showed good vegetative performance. Based on their vegetative performance, the highest tree height was recorded for D. Chandler pummelo variety and the lowest tree height was recorded for D. Tahitian (238.50 cm).Besworth pink variety showed the highest canopy spread (195.83) while,D.Chandler have the lowest tree canopy spread. Similarly, Besworth pink recorded the highest girth below the grafted union and above the union (34.33m) and (28.03) consequently (Table-1).

Table 1/ Vegetative performance of introduced pummelo varities at MARC in 2019/20

Variety	Height (cm)	Canopy (cm)	Girth	
			Below(cm)	Above (cm)
Besworth Pink	283.50[a]	195.83[a]	34.33a	28.03a
D. Chandler	291.60[a]	130.87b	27.96a	23.80ab
D. Tahitian	238.50[a]	149.17ab	28.40a	21.26b
Pomlit	238.80[a]	189.60a	29.60a	23.36ab
CV	13.41	16.68	14.87	13.73

rb g i f f fb ; Further evaluations of the performances of pummelo varieties willcontinue and the activity needs two-year extension.

Bd j j 3; Adaptation and verification of lemon (*C. Limon* L.) varieties
Bd j j f j e; July 2016 - June 2020
P ckfd j f ; To test the adaptability and register commercial varieties of lemon varieties with high yield, biotic and abiotic resistance and quality to different citrus growing AEZs
S f jc rfi f) *; Asmare D, Edossa E, Agernesh M, Girma K, Fruit teams of Assosa and Mehoni Agricultural Research Centers
S f fe c ; Asmare D
Zfb g f ; January - December 2019
T b g h f ;
Four introduced commercial lemon varieties (Lemon Eureka, Limonoria Lisbon, Allen Eureka -and Frost Eureka) have been planted in 2015 using RCBD with three replications at Melkassa, Assosa and Mehoni Agricultural Research Centers. Four seedlings budded onto *C. volkamariana* were used per experimental plot with 5m x 5m spacing. Vegetative data were recorded.
U fb f : Four introduced commercial lemon varieties
Ef jh ; RCBD
M db j ; Melkassa, Assosa and Mehoni

S f m
As of the vegetative performance of introduced commercial limon varietyindicated in table,the highest tree height was recorded for Allen Eureka (366.67m) and the lowest tree height (251.27m) was recorded by Limonoria Lisbon.Allen eureka also showed the highest canopy spread (table-2).the highest girth above the grafted union and below the grafted union was recorded by Lemon eureka,while the lowest girth above the grafted union and below the grafted union was recorded by Frost eureka.

Table 2. Vegetative performance of introduced lemon varities at MARC, 2019/20

Variety	Height (cm)	Canopy (cm)	Girth	
			Below(cm)	Above (cm)
Allen Eureka	366.67a	383.33a	46.70ab	40.67ab
Frost Eureka	260.03a	259.60a	32.53b	30.26b
Lemon Eureka	352.53a	369.60a	47.93a	44.16a
Limonoria Lisbon	251.27a	276.43a	34.70ab	31.36b
CV	21.58	23.24	18.90	17.26

rb g i f f fb ; Further evaluation of the performances of the lemon varieties will continue.

Bd j j j rfi 4; Adaptation and verification of Mexican (*C. aurantifolia* Swing) and large fruited lime (*C. latifolia* tan) varieties

Bd j j f j e: July 2016 - June 2020

P ckfd j f ;

- To test the adaptability and register commercial varieties of lime varieties with high yield, biotic and abiotic resistance and quality to different citrus growing AEZs
- To enhance the genetic base of lime for variety improvement programs

S f jc rfi f) *; Asmare D, Edossa E, Agernesh M, Girma K, Fruit team of Mehoni Agricultural Research Center.

S f fe c ; Asmare D.

Zf b g f ; January - December 2019

T b g h f ;

Four introduced commercial lime varieties (Bears, Big lime, Lime seedless and Tahitian lime) have been planted in 2015 using RCBD with three replications at Melkassa and Mehoni Agricultural Research Centers. Four seedlings budded onto *C. volkamariana* were used per experimental plot with 5m x 5m spacing. Data for vegetative performances were recorded.

U f b f ; Four introduced commercial lime varieties

Ef jh ; RCBD

M db j ; Melkassa and Mehoni

S f m

All lime varieties showed good vegetative performance. The highest plant height was recorded for lime seed (373.20cm), while the lowest tree height was recorded by bears (274.92cm) variety. Big lime exhibits the highest canopy spread (382.10cm), girth below the grafted union and above the grafted union. The lowest girth below the grafted union and

- To evaluate citrus genotypes and varieties with high yield, biotic and abiotic resistance and quality to different citrus growing AEZs

S f jc rfi f) *; Asmare D, Edossa E, Agernesh M, Girma K
S f fe c ; Asmare D
Zfb g f ; January - December 2019
T b g h f ;
Twenty-three citrus varieties and genotypes have been planted on single observation plots at MARC. Four plants budded onto *C. volkamariana* were used per variety with 6m x 6m spacing. Vegetative data were recorded. Recommended agronomic and field practices have been applied.
U fb f ; twenty-three citrus genotypes
Ef jh ; single plot
M db j ; Melkassa

S f m
All introduced citrus germplasms perform well on the field.
Table 4/ Vegetative performances of introduced citrus germplasm at Melkassa, 2019/20

Genotype	Plant height (m)	Canopy spread (m)	Girth size above the union (cm)	Girth size below the union (cm)
Citrus Macrophylla	2.53	3.55	42	39
Duncan Grape	2.85	2.98	51	57
Frost Eureka	2.77	3.48	54	53
Idii	3.73	2.45	43	51
Lemon Eureka	2.95	3.05	38	47
Madame Vinus	2.80	3.33	53	56
Pineapple Sweet Orange	2.82	3.18	47	62
Parson's Special Mandarin	3.08	3.18	56	62
Pomelo	2.80	2.93	41	49
Ponkan Mandarin	3.15	2.43	48	51
Rough Lemon	2.85	3.70	58	58
Rubidoux	2.58	2.20	37	40
Rus Orange	3.20	2.67	49	54
Sour Orange	2.43	2.47	34	40
Sweet Orange	2.77	2.37	43	49
Sweet Pomlet	3.23	3.55	59	63
Tangelo Grande	2.95	3.68	52	56
Tangerine Orange	3.50	3.10	54	57
Tangelo Orlando	2.95	3.18	56	59
Tangelo Tangor	2.60	2.65	59	62
Valencia Orange	2.05	2.00	39	44
Mean	2.89	2.96	48	53

rb g i f f fb ; Adapted and well performed citrus varieties will be promoted to multi-location variety trials.

Bd j j j rfi 6; Collection, establishment and evaluation of naturalized citrus (*Citrus* spp. L.) genotypes
Bd j j f j e; July 2018 - June 2020
P ckfd j f ;

1. To collect and conserve genotypes/commercial varieties in various areas of the country for future germplasm enrichment programs.
2. To study the extent of *Citrus* spp. genetic diversity available of naturalized population and introduced genotypes/commercial varieties.

S f jc rfi f) *; Asmare D, Girma K, Edossa E, Agernesh M (Melkassa), Fruit team at Mehoni Agricultural Research Center
S f fe c ; Asmare D

Zfb g f ; January - December 2019
T b g h f ;
Survey and exploration were planned to be conducted in various citrus production belts of the country to identify *Citrus* spp. and document their diversity representing important scions and rootstocks. Field selected scion woods were budded on rootstock seedlings for each collection in shade net house and field planted at Melkassa as non-replicated single plot observation trial.
U fb f ; eleven citrus genotypes
Ef jh ; single plot
M db j ; Melkassa, Mehoni

S f m
In-situ characterization and field collections were made from Upper Awash, Ethiopian Sugar Corporation (ESC) fruit field at Abadir (Methara), Tony farm (Dire Dawa), ShewaRobit, Mersa and Tis Abalima . Scion woods were taken from selected trees and were budded onto *C. volkamariana* and field planted at MARC. An observation was also made on rootstocks that have dwarfing characteristics and hence collections were made from Tony farm and Tis Abalima which were introduced by Italians.

Table 5/ Collected and established naturalized citrus genotypes at Melkassa, 2019/20

Genotype	Collection sites	Number of established trees in the field	Purpose
CAR1220 Citrange	North Wello (Tis Abalima)	3	Rootstock
Mersa-01	North Wello (Mersa area)	1	Scion
Mersa-04 S. orange	North Wello (Mersa area)	4	Scion
Mersa S. orange	North Wello (Mersa area)	3	Scion
Shewa Robit-08	North Shewa (Amhara)	4	Scion
Shewa Robit-09 S. orange	North Shewa (Amhara)	2	Scion
Tis Abalima 05 S. orange	North Wello	1	Scion
Tis Abalima-07	North Wello	3	Rootstock
Troyer Citrange	Tony farm (Dire Dawa)	4	Rootstock
YeferenjLomi	Methara Sugar Estate (Abadir)	4	Scion
Yeferenj Mandarin	Methara Sugar Estate (Abadir)	1	Scion

rb g if f fb ; Further collection will be carried out.

Bd j j Uj rfi 7; Field maintenance of *Citrus* spp. varieties and genotypes
P ckfd j f ;

- To conserve locally available and introduced *Citrus* spp. genotypes and varieties
- To enhance the genetic base of *Citrus* spp. for variety improvement
- To establish a database for citrus germplasm collections

Bd j j f j e; July 2015 – June 2020
S f jc rfi f) *; Asmare D, Edossa E, Agernesh M, Girma K, Fruit team of Mehoni Agricultural Research Center
S f fe c ; Asmare D
Zfb g f ; January - December 2019
T b g h f ;
Forty-two commercial citrus scion varieties (17 sweet orange, 15 mandarin, three lemon, two lime, four grapefruit and one tangerine) and 12 rootstocks have been planted on single observation plots at Melkassa and Mehoni Agricultural Research Centers. Four plants budded onto *C. volkamariana* were used per variety with 5m x 5m and 6m x 6m spacing for scions and rootstocks respectively. Data for vegetative performances were recorded. Recommended agronomic and field management practices have been applied for both maintenance blocks.
U fb f ; Forty- two commercial scion varieties

Ef jh ; single plot
M db j ; Melkassa and Mehoni

S f m

The citrus scion varieties have been replanted at new research field as the old maintenance stock showed declining symptoms at MARC. The varieties generally showed good establishment except for mandarins that needed for replanting. The rootstock varieties are being maintained in the old maintenance block, and grafted seedlings are ready for new establishment.

B/ T ff P b hf

Average performances recorded for vegetative parameters are presented in Table 6. Olinda Valencia recorded the highest tree height of 2.95 m, followed by Hamlin with 2.9 m tall. The shortest plants were recorded for Jaffa (0.95 m), Carter Naval (1.33 m) and Shamute (1.34 m). The variety Ruby had the widest canopy size (3.21 m), followed by Ruby Blood (2.85 m). Jaffa and Shamute varieties had smaller trees with canopy sizes of 0.65 m and 0.81 m, respectively. Jaffa and Ruby varieties showed the highest girth diameters below and above the budding unions (Table 6. Jaffa, Carter Naval and Shamute showed the least vigor meriting further investigation on their dwarfing nature and compatibility.

Table 6. Vegetative performances of sweet orange varieties at Melkassa, 2019/2020

Variety	Plant height (m)	Canopy spread (m)	Girth above union (m)	Girth below union (m)
Campbell Valencia	2.58	2.48	0.32	0.39
Carter Naval	1.33	1.15	0.27	0.31
Cutter Valencia	2.31	2.61	0.34	0.39
Frost Naval	2.61	2.38	0.31	0.36
Frost Valencia	2.66	2.41	0.36	0.41
Hamlin	2.90	2.73	0.37	0.43
Jaffa	0.95	0.65	0.42	0.47
Olinda Valencia	2.95	2.63	0.37	0.42
Pineapple	2.53	2.33	0.33	0.39
Ruby	2.73	3.21	0.44	0.45
Ruby Blood	2.91	2.85	0.37	0.41
Shamute	1.34	0.81	0.25	0.34
Skagus Bonanza	2.34	2.24	0.31	0.36
Temple Orange	2.45	2.05	0.27	0.32
Valencia Rhugs	2.59	2.80	0.29	0.36
Valencia Rhode	2.65	2.34	0.27	0.35
Washington Naval	2.74	2.65	0.32	0.38
Mean	2.39	2.25	0.33	0.38

C/ N b eb j

Average performances recorded for vegetative parameters of mandarin varieties are presented in Table 7.. The variety Dancy recorded the highest tree height of 2.74 m, followed by Temple Mandarin with 2.49 m tall. The shortest plants were recorded for Tangor (1.0 m), Murcott (1.11 m) and Ponkan (1.14 m). The variety Dancy had the widest canopy size (2.63 m), followed by Temple Mandarin (2.01 m). Ponkan, Fremont and Tangor varieties had smaller trees with canopy sizes of 1.04 m, 1.05 m and 1.06 m, respectively. Mineola and Trovita varieties showed higher girth diameters above the budding unions, while Orlando and Tangor had smaller above the union girth size. On the other hand, Dancy, Ponkan and Temple Mandarin showed larger below the union girth sizes. Several varieties showed bigger girth size above than below the budding unions, which may be an indication of incompatibility of scions with the rootstock (Table 7). Murcott and Tangor also showed the least vigor meriting further investigation on their dwarfing nature.

Table 7. Vegetative performances of mandarin varieties at Melkassa, 2019/2020

Variety	Plant height (m)	Canopy spread (m)	Girth above union (m)	Girth below union (m)
Clementine	1.73	1.34	0.20	0.27
Dancy	2.74	2.63	0.28	0.34
Fairchild	1.75	1.25	0.21	0.23
Fremont	1.74	1.05	0.20	0.22
Kara	1.88	1.13	0.35	0.22
Lee Tangerine	1.56	1.50	0.16	0.19
Murcott	1.11	0.63	0.12	0.13
Nova	1.61	1.48	0.23	0.28
Osceolia	1.95	1.73	0.24	0.28
Ponkan	1.14	1.04	0.20	0.33
Satsuma	1.49	1.71	0.20	0.21
Temple Mandarin	2.49	2.01	0.31	0.33
Trovita	1.44	139	0.50	0.22
Mineola	1.50	1.50	0.58	0.21
Orlando	1.25	1.35	0.17	0.19
Tangor	1.00	1.06	0.18	0.19
Mean	1.65	1.43	0.26	0.24

C. Limes

Average performances recorded for vegetative parameters of lime varieties are presented in Table 8. More vigor was recorded for the variety Bears in all the parameters than the Mexican lime (Table 8).

Table 8. Vegetative performances of lime varieties at Melkassa, 2019/20

Variety	Plant height (m)	Canopy spread (m)	Girth above union (m)	Girth below union (m)
Bears	3.31	3.30	0.44	0.47
Mexican	2.18	2.18	0.29	0.31
Mean	2.75	2.74	0.37	0.39

E/ Mf

Average performances recorded for vegetative parameters of lemon varieties are presented in Table 9. The variety UCR Improved recorded the highest tree height (2.75 m) and canopy diameter (3.23 m), followed by Allen Eureka with 1.91 m tree height and 1.95 m canopy width. The variety Limonoria Lisbon had shorter trees (1.24 m) with narrower canopy size (0.94 m). Limonoria Lisbon and UCR Improved varieties showed higher girth diameters above the union and UCR Improved and Limonoria Lisbon below the budding union, respectively. The variety Limonoria Lisbon showed also showed the least vigor meriting further investigation on their dwarfing nature.

Table 9. Vegetative performances of lemon varieties at Melkassa, 2019/20

Variety	Plant height (m)	Canopy spread (m)	Girth above union (m)	Girth below union (m)
Allen Eureka	1.91	1.95	0.23	0.27
Limonoria Lisbon	1.24	0.94	0.44	0.32
UCR Improved	2.75	3.23	0.39	0.46
Mean	1.97	2.04	0.35	0.35

F/ H b f g j

Average performances recorded for vegetative parameters of grapefruit varieties are presented in Table 10. The variety Red Blush recorded higher tree height (1.73 m) and canopy diameter (1.80 m), followed by Red with 1.25 m tree height and 1.40 m canopy width. The shortest plants were recorded for Shamber (1.01 m) with the narrowest canopy size (1.01 m). Red Blush variety showed higher girth diameters above and below the budding unions. Shamber variety showed the least vigor meriting further investigation on their dwarfing nature and compatibility with *C. volkamariana.*

Table 10.Vegetative performances of grapefruit varieties at Melkassa, 2019/20

Variety	Plant height (m)	Canopy spread (m)	Girth above union (m)	Girth below union (m)
Red Blush	1.73	1.80	0.25	0.30
Reed	1.25	1.40	0.17	0.16
Shamber	1.01	1.01	0.12	0.15
Star Ruby	1.14	1.15	0.16	0.19
Mean	1.28	1.34	0.18	0.20

G/ Dj dl

Ten introduced citrus rootstocks that include Brazilian sour orange, Citrumelo, Cleopatra mandarin, Estes, Etrog citron, Mexican lime, Pineapple sweet orange, Rangpur lime, Sactoncitrumelo, Volkameriana, Willow leaf mandarin and Ornamental lemon were established in the old block. However, after establishment all trees of Etrog citron and Rangpur lime died due to unknown reason. Grafted seedlings for the eight citrus rootstocks are ready for establishment in new foundation block.

rb g i f f fb ; The field maintenance of citrus scions and rootstocks will continue.

Bd j j j rfi 8; Multiplication of improved citrus varieties
Bd j j f j e; July 2018 - June 2020
P ckfd j f ;

- To multiply/propagate true to type initial planting material of improved citrus varieties
- To build the capacity of technical staffs and stakeholders on improved multiplication and propagation of citrus.

S f jc rfi f) *; Asmare D, Girma K, Agernesh M, Edossa E
S f fe c ; Asmare D
Zfb g f ; January - December 2019
T b g h f ;

Improved variety of lime was multiplied by budding onto *C. volkamariana* rootstock seedlings at MARC. The rootstocks were raised in 25cm x 35cm poly bags under 60% shade net house conditions. When the rootstock seedlings reached appropriate stage, scion variety buds were budded.

U fb f ; Bears lime
Ef jh ; Single plot
M db j ; Melkassa

S f m

A total of 500 *C. volkamariana* rootstock seedlings were raised on growth media with proportion 2:1:1 ratio of top soil, sand and well decomposed manure/compost respectively. These citrus rootstock seedlings were budded with Bears lime variety. Of these, 420 successful budded lime seedlings were obtained for dissemination.

rb g i f f fb : 1,000 budded seedlings of improved citrus varieties will be multiplied.

kfd 5; Maintenance breeding of different subtropical fruit crops
Bd j j j rfi 2/ Field maintenance of grapevine (*Vitisvinifera*) varieties and genotypes
Bd j j f j e; July 2015 - June 2020

Objectives:

- To conserve locally available and introduced grapevine genotypes and varieties
- To enhance the genetic base of grapevine for variety improvement

To establish a database for grapevine germplasm collections

S f jc rfi f) *; Girma K, Edossa E (Melkassa), Fruit team of DebreZeit Agricultural Research Center

S f fe c ; Girma K
Zfb g f ; January - December 2019
T b g h f ;
A total of 84 introduced and locally collected table, rasin, and wine (red and white) grapevine varieties and genotypes have been planted on single observation plots at Melkassa and Debre Zeit Agricultural Research Centers. Five rooted cuttings were used for planting per each variety/genotype with 2.5m x 2m spacing.
U fb f ; Eighty-four introduced and locally collected grape vine varieties
Ef jh ; Single plot
M db j ; Melkassa and DebreZeit

S f m
The maintenance field of the grapevine varieties and genotypes at MARC is in good condition. However, three of the 84 grapevine varieties/genotypes failed to establish in the field. Planting materials of rooted cuttings for these varieties/genotypes are being prepared for re-establishment. All the necessary agronomic and field management practices for the maintenance block have been carried out as per the current production recommendations.
rb g if f fb ; The field maintenance of the grapevine varieties and genotypes will continue and vegetative, yield, and quality performances the grapevine materials will be further evaluated.

Bd j j j rfi 3; Maintenance of different fruit crops (Ziziphus, pomegranate, fig, lychee, longan, olive, carob and noni) for further study
Bd j j f j e; July 2015 - June 2020
P ckfd j f ;

- To conserve locally available and introduced genotypes and varieties of subtropical fruit crops
- To enhance the genetic base of variety improvement of subtropical fruit crops

S f jc rfi f) *; Girma K, Edossa E
S f fe c ; Girma K.
Zfb g f ; 2020 G.C
Zfb g f ; January - December 2019
Different high value fruit crops such as pomegranate, fig, Ziziphus, olive and others have been planted at MARC on single plots with appropriate spacing. These fruit crops collections were characterized using IPGRI descriptors and data on agronomic performance and fruit quality parameters were taken.
U fb f ;Seven pomegranates, 8 fig, 7 Ziziphus, 8 olive, 1 lychee, 1 longan, 1 carob and 2 noni genotypes and varieties
Ef jh ; Single observation
M db j ; Melkassa

S f m
Seven pomegranates, 8 fig, 7 Ziziphus, 8 olive, 1 lychee, 1 longan, 1 carob and 2 noni genotypes and varieties are being maintained under field conditions at MARC. All the necessary agronomic and field management practices for the maintenance block have been carried out as per current production recommendations.
rb g if f fb ; The field maintenances of these high value fruit crops varieties/genotypes will continue and some promising genotypes will be promoted to further profound study based on preliminary information.

Bd j j j rfi 4; Field maintenance of guava (*Psidiumguajava*) varieties and genotypes
Bd j j f j e; July 2015 - June 2020
P ckfd j f ;

- To conserve locally available and introduced guava genotypes and varieties
- To enhance the genetic base of guava for variety improvement
- To establish a database for guava germplasm collections

S f jc rfi f) *; Girma K, Edossa E, Agernesh M, Asmare D
S f fe c ; Agernesh M
Zfb g f ; January - December 2019
T b g h f ;
Three processing type guava varieties: Psi guajava (Beaumant), Psi guajava (Kahaakala) and Psi guajava (Walakea), which were introduced in 1991, and five locally collected fresh type guava genotypes (Nura Era, 70.512, Hirna, 70.513 and Sodere) have been planted on single observation plots. Eight to ten clonal seedlings were used for planting per each variety/genotype with 6m x 6 m spacing. Recommended agronomic and field practices have been applied.
U fb f ; Three processing type guava varieties and five locally collected fresh type guava genotypes
Ef jh ; single plot
M db j ; Melkassa

S f m
The three processing type guava varieties are characterized by their high acid content and pink or pale color (typical guava processing quality). Whereas, the fresh type genotypes have low acid content and they are consumed as fresh fruit. All the eight guava varieties and genotypes are being maintained at MARC under field conditions.
rb g i f f fb ; The field maintenance of the guava varieties and genotypes will continue/

Bd j j j rfi 5; Field maintenance of cazamiroa varieties and genotypes
Bd j j f j e; July 2015 - June 2020
P ckfd j f ;

- To conserve locally available and introduced cazamiroa genotypes and varieties
- To enhance the genetic base of cazamiroa for variety improvement
- To establish a database for cazamiroa germplasm collections

S f jc rfi f) *; Edossa E, Agernesh M, Asmare D, Girma K
S f fe c ; Edossa E.
Zfb g f ; January - December 2019
T b g h f ;
Four local cazamiroa collections (Sep, 56, 64, Sodere), each budded onto three different rootstocks (8, 37 and 66), were planted on single plots with 6m x 6m spacing at MARC. Vegetative data were recorded. All the necessary field management practices for the maintenance block have been carried out as per current production recommendations
U fb f ; four locally collected cazamiroavarities
Ef jh ; single plot
M db j ; Melkassa

S f m
Four local genotypes of cazamiroa (Sep, 56, 64, Sodere) have been maintained at MARC under field condition. The vegetative performances of the Cazamiroacollections are presented in Table 11. Genotype 56/66 gave the highest plant height (6.92 m) while genotype Sodere/66 had the shortest trees (4.1 m). Genotypes Sodere/8 and Sodere/66 gave the widest (7.6 m) and the narrowest (2.1 m) canopy sizes, respectively. Genotypes Sodere/8 and 64/8 had the highest girth measurements (1.23 m). Genotype Sodere/66 had the smallest trees (Table 11). In general, rootstocks 8 and 66 have shown high vigor and dwarfing nature, respectively.

Table 11. Vegetative performances of cazamiroa collections at Melkassa, 2019/2020

Variety/line	Plant height (m)	Canopy diameter (m)	Girth measurement (m)
Sep/8	5.83	6.02	0.73
Sep/37	5.80	5.98	0.77
Sep/66	6.30	5.17	0.87
56/8	5.82	5.50	0.82
56/37	5.07	4.89	0.61
56/66	6.92	4.85	0.75
64/8	5.80	5.50	1.23
64/37	4.77	4.33	0.79
64/66	6.10	5.20	0.75
Sodere/8	6.40	7.60	1.23
Sodere/37	5.10	5.50	0.87
Sodere/66	4.10	2.10	0.50
Mean	5.67	5.22	0.83

rb g i f f fb ; The field maintenance of the cazamiroa collections will continue. Vegetative, yield, and quality performances will be further evaluated.

Mulate Zerihun
Email: mulatezerihun@yahoo.com; Phone: +251 918597350

S f fb di df ; Food Science and Nutrition Research
kfd j rifi 2: Physio-chemical Profiling and Characterization of Agricultural Products
kfd f j e; July 2017 - June 2021
Bd j j j rifi 2; Extraction of pectin from the pomelo fruit peel and its utilization for jam and jelly making
Bd j j f j e; July 2018 - June 2020
P ckfd j f ;

1. To extract pectin from pomelo fruit peel waste
2. To utilize pectin extract in the production of jam and jelly and assessment of the product physicochemical quality

S f jc rifi f ; Mulate Z., Mulugeta T., Segedu B and Banchu A.
S f fe c ; Mulate Zerihun
Zfb g i f f ; January - December 2019
T b g i f h f

S f m

A total of six pomelo fruits were collected from Melkassa agricultural research centers. The sample preparation, including peeling and others were done through the standards preparation process. In addition, a total parameter such as total weight, peel weight, pulp percentage, peel thickness, diameter, length, P^H, Acidity TSS, and color have been done. The method selection and validation were conducted. The extraction of pectin from pomelo fruit included the yield extraction ration were analysis. The physical-chemical analysis of pomelo fruit was presented in Table 1. Based on the result obtained from the peel to pectin ratio; R-2, T-3 was showed the highest percentage of peel and R-3, T-6 was showed the lowest peel percentage compared with other varieties. This indicated that R-2, T-3 variety was shown the highest pectin extract described in Table 2.

Table 1. Analyzed physicochemical parameters of six varieties of pomelo

Wb jf jf	**U bm f jhi**	**f f m f jhi**	**m f jhi**	**f f m f df bhf**	**f f mi jdl f**	**E jb f f**
S.6- U.3	942.87ef	343.13c	591.33e	36.39b	20.07cd	140.04bc
S.4- U.7	976.23de	201.43f	675.17c	20.63de	22.01c	141.55b
S.4/U.6	1259.57b	339.30c	917.33a	26.94cd	25.33a	148.10ab
S.3- U.2	1466.63a	649.97a	804.73b	44.32a	23.45bc	156.47a
S.4-U.5	658.20f	277.10d	374.33f	42.10ab	22.03c	129.39d
S.3- U.4	1141.70c	533.07b	602.20cd	46.69a	24.37ab	140.83bc
N fb	1074.20	390.67	660.85	36.18	22.88	142.73
DW	6.72	5.31	7.05	1.23	0.87	1.80
Tjh jgjdb df	***	***	***	***	**	**
Wb jf jf	Length	Juice volume	PH	Acidity	TSS	Colour
S.6- U.3	124.91de	336.00cd	3.96a	7.43e	8.57ab	Rose
S.4- U.7	137.51cd	364.67c	3.36ab	15.04ab	7.07bc	Rose
S.4/U.6	146.51ab	528.33a	3.35ab	16.48a	8.33ab	Rose
S.3- U.2	156.22a	431.67b	3.75a	12.06c	9.90a	White
S.4-U.5	124.81de	146.67f	3.78a	12.98c	6.13cd	Rose
S.3- U.4	142.41bc	283.33e	3.81a	11.68cd	6.83c	White
N fb	138.73	348.45	3.67	12.61	7.81	
DW	2.94	3.42	0.64	0.84	0.56	
Tjh jgjdb df	**	***	Ns	**	**	

Table 2. Amounts and percentages of pectin extracted from orange and lemon

Code	Sample(g)	Dried product(g)	Filter paper(g)	Yield (%)
1.1	5	1.924	2.123	38.48
5.1	5	2.398	2.387	47.96
7.1	5	1.726	2.14	34.52
9.1	5	1.36	0.594	27.2
4.1	5	1.211	1.801	24.22
6.1	5	2.56	1.956	51.20
3.1	5	1.211	1.906	24.22
8.1	5	1.512	1.946	30.24

rıb g i f f fb

The pectin characterization and full write up will be done.

Bd j j j rıfi 3; The effect of different agro-ecology and ripening stages on oil yields and its nutritional profile of selected Avocado fruit.

Bd j j f j e; July 2018 - June 2021

P ckfd j f

- To assess the effect of different agro-ecology and ripening on oil yields and its nutritional profile
- To analyze the fatty acid profile and nutritional content of the selected avocados fruit

S f jc rıfi f 0 ; Mulate Z., Mulugeta T. and Demirew A

S f fe c ; Mulate Zerihun

Zfb g i f f ; January - December 2019

S f fe c ; Mulate Zerihun

T b g i f h f

S f m

The ripening date, Texture, color, total weight, seed weight, peels weight, pulp weight, juice volume, TA, TSS, and pHof each avocado variety was determined (Table1and 2). The physicochemical analysis (protein, Ash, moisture and fat) of fifteen avocado varieties were conducted under laboratory condition followed the standard procedures and presented in Table 3. As the result obtained the Furite variety has highest fat content compared to other varieties. The data were recorded on as fruit (P^H, TSS, TA, and Color, ripping date, Texture juice volume, sensorial quality, peel weight, pulp weight and seed weight.). The sensory analysis was performed on selected eight avocado varieties by using seventeen semi- trained panelists of MARC staff members. The sensory quality attributes (appearance, color, aroma, taste, mouth feel and over all acceptability) were evaluated presented in Table 4. Based on the mean value of sensory evaluation obtained Hass and Pinkerton varieties were showed the highest overall acceptance and L-2 variety was showed the lowest overall acceptance among the eight varieties.

Table 1**;** Analysis of physiochemical results of released avocado varieties

Avocado Varieties	Days	Volume	TSS	PH	TA
Simmonds	6+22b-d	426.67+64.29e	6.83+0.38b	6.83+0.55a	3.13+1.30ab
AL-2	8+3.61a-c	445+18.3de	6.87+6.8b	6.9+0.1a	3.13+0.058ab
Ettinger	4.33+0.58d	247.2+42.84g	3.8+0.69f	3.87+0.64c	2.67+0.51b
Bacon	5.33+0.58cd	271.9+10.68fg	4.2+0.17ef	4.2+0.17c	3.3+0.17ab
Pinkerton	6.333+0.58b-d	278.1+0fg	4.87+0.0.67de	5.37+1.22b	3.47+0.12a
Furite	7+1b-d	278.1+0fg	4.97+0.12de	5.63+0.23b	3.4+0a
AL-1	8.33+2.89ab	319.8+75.54f	5.57+0.29cd	5.93+0.23b	3.17+0.06ab
Hass	7.33+2.08a-c	339.57+13.11f	5.4+0cd	5.8+0b	3.33+0.35ab
Nabal	7.67+0.58a-c	510.67+77.37cd	5.4+0cd	5.8+0.26b	3.43+0.06a
Choguette	8+1a-c	466.33+58.53de	5.4+0cd	5.8+0b	3.47 +0.06a
DZ1	10+1a	549.4+1.22c	5.03+1.62de	6.87+0.32a	3.03+0.21ab
DZ3	10+2a	1200+5a	6.33+0.46bc	6.8+0.52a	3.2+0ab
DZ4	10+1a	633.3+33.29b	8.27+0.46a	7.1+0.17a	2.9+0ab
Mean	7.56	458.93	5.61	5.92	3.20
CV	6.43	9.13	10.19	7.78	12.79
Significant	***	***	***	***	***

Table 2: Analysis of physiochemical results of released avocado varieties

B dbe b jf jf	U bm fjhi)h*	ffm fjhi)h*	m fjhi)h*	Tffe fjhi)h*
Simmonds	510.7 +14.47c	45.8+13.98e	415.67 +31.47b	49.93 +2.31c
AL-2	517.87 +7.15c	49.4+3.6de	418.77+3.05b	49.57+0.35cd
Ettinger	287.67 +49.83e	27.43+4.73f	232.67+40.3g	27.53 +4.73d
Bacon	316.5+12.47e	30.2+1.21f	255.9+10.05fg	30.3+1.21cd
Pinkerton	323.7+0e	30.9+0f	261.7+0fg	31+0cd
Furite	323.7+0e	30.9+0f	261.7+0fg	31+0cd
AL-1	465.2+61.32d	54.53+10.28d	321.97+26.1d	87.93+24.65b
Hass	429.8+0d	48.6+0de	306.9+0de	73.7+0b
Nabal	429.8+0d	48.6+0de	306.9+0de	73.7+0b
Choguette	429.8+0d	48.6+0de	306.9+0de	73.7+0b
DZ1	547.5+0.5c	76.17+0.45c	283.27+0.45ef	76.67+1.62b
DZ3	996.67+0.49a	184.37+0.06a	566.07+8.60a	131.03+39.59a
DZ4	594.2+0.2b	109.63+0.55b	380.17+4 1.37c	74.63+9.73b
Mean	474.85	60.4	332.20	62.36
CV	5.38	8.45	6.02	21.34
Significant	***	***	***	***

Table 3: Analysis of ash, moisture, fat and crude protein content of avocado varieties

D ef	j b f d j j)&*			
	B i	N j f	f j	Gb
AL-1	5.43±0.21de	5.72±0.26gh	0.38±0.04bc	41.38±0.22f
Furite	8.24±0.21b	3.03±0.91j	0.53±5.774E-03ab	62.10±2.00a
Al-2	9.36±0.66a	5.67±0.19gh	0.50±0.13a-c	46.84±5.774E-03d
Hass	9.28±0.06a	5.45±0.32hi	0.48±0.17a-c	47.75±0.41d
Bacon	5.82±0.35d	6.31±0.17ef	0.32±0.21bc	51.20±0.20c
l-1	4.35±0.17g	9.85±0.21bc	0.35±0.18bc	38.71±0.13g
Choquette	3.84±0.02h	10.41±0.14b	0.54±0.28ab	18.45±0.02l
l-2	3.92±0.05h	11.69±0.09a	0.71±0.11a	30.94±0.42j
Dz1	6.35±0.08c	6.87±0.25e	0.41±0.21bc	37.34±0.15h
Nebal	5.46±0.36d	9.33±0.17c	0.54±0.25ab	38.43±1.60gh
DZ3	5.02±0.03ef	7.61±0.46d	0.40±0.02bc	28.94±0.22k
Pinkerton	9.06±0.14a	4.95±0.14i	0.53±0.16ab	57.09±0.13b
Dz4	8.26±0.31b	5.47±0.33g-i	0.38±5.774E-03bc	38.20±0.06gh
Simmonds	4.75±0.08fg	6.04±0.19fg	0.24±0.14c	32.78±0.15i
Ettinger	3.31±0.04i	8.05±0.48d	0.56±0.12ab	42.61±0.07e
Mean	6.16	7.10	0.4589	40.912
CV	4.05	4.90	34.28	1.68
Significant	**	***	*	***

Table 4; Mean value of sensorial result of avocado varieties at different ripening dates

Varities	Appearance	Aroma	Color	Mouth	Taste	Overall acceptability
Choquette	4.20±0.20A	3.21±0.52A	3.98±0.57A	3.03±0.47A	2.90±0.36B	3.72±0.48A
Pinkerton	3.84±0.73AB	3.60±0.53A	3.66±0.92AB	3.68±0.74A	3.43±0.40AB	3.79±0.44A
Furtie	3.68±0.24AB	3.72±0.40A	3.30±0.26AB	3.50±0.89A	3.38±0.83AB	3.84±0.42A
Hass	3.63±0.78AB	3.82±0.50A	3.64±0.67AB	3.70±0.43A	3.75±0.52A	3.93±0.68A
Nabal	3.60±0.37AB	3.29±0.34A	3.30±0.12AB	3.46±0.63A	3.33±0.44AB	3.52±0.27A
L-2	3.52±0.32AB	3.81±0.60A	3.52±0.32AB	3.43±0.40A	3.63±0.15AB	3.58±0.54A
Ettinger	3.51±0.25AB	3.68±0.61A	3.06±0.22B	3.62±0.40A	3.63±0.32AB	4.08±0.45A
Bacon	3.40±0.40B	3.57±0.4A	3.27±0.23AB	3.68±0.24A	3.50±0.30AB	3.91±0.54A
Grand mean	3.67	3.82	3.47	3.51	3.45	3.80
CV	12.57	3.82	14.10	15.98	13.23	12.93

rb g i f f fb

The samples will be collected from Jimma and Wondogenet agriculture research centers. The fatty acid composition will be done for selected avocado varieties. The proximate and mineral composition will be done for Jimma and Wondogenet agriculture research centers.

kfd j rfi 3; Development of NIRs Models and validation of analytical methods used to characterize complex agricultural

kfd f j e; July2017 - June 2021
Bd j j j rfi2; NIR calibration for sorghum quality parameters on NIRs (Infratec 9500) instrument
Bd j j f j e;July 2018- June 2020
P ckfd j f ;

1. To improve the result prediction ability and new calibration of NIRs (inframatics 9500 perten model) instrument
2. To minimize the standard error of prediction and to get high value of R-square data result

S f jc rfi f ; Mulate Z., Demirew A., Amare N., and Amare S.
S f fe c ; MulateZerihun
Zfb g i f f ; January - December 2019
T b g i f h f

S f m

A total of 108 sorghum samples were collected from the germplasm bank of the national sorghum research program (Melkassa Agricultural Research Center), active sorghum breeding programs and different sorghum productive areas for the development and validation of NIRS calibrations. These samples were included both wheat and red types sorghum and different environmental adaptation (highland, tropical, and subtropical) to increase the range of values for development the calibration curves. All samples were milled in to flour using a 1093 cyclotec mill (manufactured by pertain) with a 1 mm sieve. A sub-sample of the flour was obtained from each sample was used for wet chemical analysis, and the grain sample was used for NIRS analysis. The milled flour was stored in a dark area at room temperature in glass bottle for further analysis. Model development training was organized by national sorghum and millet improvement program collaboration with university of Quesseland for food science and sorghum breeder researchers. Based on the training model development was conducted through wet chemistry reference and other standards for moisture, ash, protein, amylase, tannin, starch, iron and zinc parameters. The model development and calibration have been conducted as follow. The Samples were scanned in the visible and NIR regions of the electromagnetic spectrum in reflectance (700-1100 nm) at 0.5 nm intervals using a scanning monochromator NIRS. The Spectral data was stored as a logarithm of the reciprocal of reflectance [log (1/*R*)]. The software for scanning, mathematical processing, and statistical analysis were supplied with the spectrophotometer by Infrasoft International (ISI). A principal component analysis (PCA) was run and the generalized Mahalanobis distances (*H*) were computed for each spectrum. Calibration equations were developed using CAMO unscrambler software from Infrasoft International (Infratec NIR Systems,). Calibration models were developed using modified partial least-squares (MPLS) regression and cross-validation techniques. Prior to the PLS regression, spectra had pretreated by applying a first derivative transformation defined by combination of four factors where the first is the degree of the derivative, the second is the gap between data points for subtraction, and the third and fourth are the data points used for smoothing. The results of the calibration calculation were monitored by checking the t outliers with $t > 2.5$, GH, and X outliers >10; samples with $t > 2.5$ was deleted from the sample file. The SD between NIRS and reference determinations for the calibration [standard error of calibration (SEC)] and validation sets [standard error of prediction (SEP)] have been calculated. The coefficient of determination of calibration (R^2 c) and the coefficient of determination of validation (R2 v) (the fraction of the variance of the reference values explained by the variance of NIRS determinations) were calculated. The RPD calculated as the ratio between the SD of the reference value and standard error of cross-validation (SECV). In addition, the ratio between the SD and the SEP were determined because the quality and robustness of a NIRS calibration can also be judged by the SEP and SD/ SEP; a SD/SEP less than 2 indicates an unsuitable calibration.

rnb g i f f fb

Full write-up will be finished and submitting for publication.

Bd j j j rnfi 3; Near-infrared spectroscopy calibration for finger millet and common beans quality parameters

Bd j j f j e; July 2019 - June 2021

P ckfd j f

- To develop NIRS models for the determination of proximate and minerals analysis of finger millet and common beans

S f jcrnfi f ; Mulate Z., Demirew A., Mulugeta T., Birhanu A., & Amare S.

T b g i f h f

S f m

A total of 102 finger millet & 86 common bean samples were collected and the wet chemistry analysis under going

rnb g i f f fb

The wet chemistry and blind NIRS scan will be performed. The model will be developed based on the wet chemistry data.

kfd j rnfi 4; Development of food processing technologies

kfd f j e; July 2018 - June 2021

Bd j j j rnfi 2; Effect of malting time on millet fortified flour for weaning food

Bd j j f j e; July 2018 - June 2020

P ckfd j f

1. To determine the effect of malting on millet fortified flour for weaning food making quality.
2. To formulate & evaluate ready to eat weaning food based on malted & un malted ingredients

S f jcrnfi f : Segedu B, Mulugeta T, Demerew A., BanchuA., &Mulate Z

S f fe c ; Segedu Belew

Zfb g i f f ; January - December 2019

T b g i f h f

S f m

The finger millet has been germinated at 24, 32, 40, 48 hrs and milled to flour and the chemical composition of Ash, moisture and crude fiber has been determined for germinated flour presented in Table 1.

Table 1: Proximate composition analysis of malted finger millet

Treatment	Ash	Fiber
Control	0.137	5.517
24hrs	0.043±0.0188a	4.031±0.6855b
32hrs	0.061±0.0707a	5.923±9.452a
40hrs	0.021±5.774a	2.850±0.5229c
48hrs	0.020±3.512a	4.108±0.7197b
Mean	0.036	4.228
Significant	Ns	***

rnb g i f f fb ; Product development and full write up will be done

Bd j j j rfi 3; The effect of particle size and milling type on sorghum flour injera making quality

Bd j j f j e; July 2019 - June 2022

P ckfd j f

1. To correlate the effect of particle size and mill type difference on sorghum injera quality
2. To identify the influence particle size and mill type on the physical and functional properties

S f jc rfi f 0 ; Mulate Z, Mulugtea T., Segedu and Banchu

S f fe c ; Mulate Zerihun

Zf b g i f f ; January - December 2019

T b g i f h f

Sorghum samples were collected and prepared for further analysis

rb g i f f fb

The collected samples will be subjected to different milling type and particle size. Injera making quality will be evaluated.

Bd j j j rfi 4; Effect of processing conditions on anti-nutritional factors in pulses

Bd j j f j e; July 2019 - June 2022

P ckfd j f

1. To comprehensively evaluate the presence of enzyme inhibitors in popular pulse varieties
2. To investigate the influence of processing methods on the retention of enzyme inhibitors

S f jc rfi f 0 ; Mulugtea T., Mulate Z, Segedu and Banchu

S f fe c ; Mulugtea Teamir

Zf b g i f f ; January - December 2019

T b g i f h f

Pulse samples were collected and prepared for further analysis

rb g i f f fb

The collected samples will be subjected to different processing methods and evaluated the anti-nutritional contents

Bd j j j rfi 5; Effect of canning on the arcelin retention, proximate composition and bioactive compounds of bean bruchid resistant lines

Bd j j f j e; July 2019 - June 2022

P ckfd j f

1. To investigate the influence of canning processing methods on arecelin retention
2. To study the changes produced by canning on the proximate composition and on the bioactive constituents

S f jc rfi f 0 ; Mulugeta T, Mulate Z, Demirew A, Tigist S and Banchu

S f fe c ; Mulugeta Teamir

Zf b g i f f ; January - December 2019

T b g i f h f

Beans samples were collected and prepared for further analysis

rb g i f f fb

The collected samples will be subjected to proximate composition and bioactive compounds analysis. The canning effect on the arcelin retention will be evaluated

kf d j rfi 5; Evaluation of food product making quality of improved crop varieties

kf d f j e: July 2018 - June 2021

Bd j j j rfi 2; Evaluation of nutritional and organoleptic properties of Snack foods (cookies and biscuits) incorporated with Common bean and Cow pea flour

Bd j j f j e; July 2018 - June 2020

f 0 f jc rfi: Banchu, Mulugeta, Segadu, Mulate and Demirew

S f fe c : Banchu Abedeta

Zfb g i f f ; January - December 2019
T b g i f h f

S f m
The functional properties, fiber, ash and moisture content of composite flour have been done. Wheat–cowpea biscuits have been prepared and sensory analysis data presented in Tables 1 and 2.

Table 1: Sensory analysis data of cowpea -wheat composite biscuits

Treatment	Appearance	color	texture	Taste	Mouth Feel	Overall Acceptance
T1	3.8±0.4000 bc	3.5333±0.5033c	3.6±0.2000a	3.8±0.4000ab	3.8667±0.3055ab	3.7333±0.3055b
T2	4.7333±0.3055a	4.4±0.2000a	3.8667±0.5774a	3.8667±0.4163ab	4.1333±0.5033ab	4.7333±0.2309a
T3	4.2667±0.2309ab	4.2667±0.1155ab	4±0.2000a	4.2±0.7211a	4.4667±0.3055a	4.6667±0.3055a
T4	3.5333±0.5774c	3.5333±0.5033c	3.7333±0.5033a	3.8667±0.4163ab	3.5333±0.9866ab	3.7333±0.5033b
T5	3.6±0.4000bc	3.6±0.6000bc	4±0.2000a	3.3333±0.4163b	3.0667±0.7024b	3.7333±0.6429b
T6	3.6±0.3464bc	3.4667±0.1155c	3.4667±0.2309a	3.6±0.4000ab	3.3333±0.5033b	3.5333±0.5033b
Grand mean	3.9222	3.8	3.7778	3.7778	3.7333	4.0222
C.V	9.98	10.38	9.42	12.6	16.07	10.93
Significant	**	**	ns	*	ns	**

T1(wheat control 100%), T2(90% wheat+ 10%cowpea), T3(80% wheat+20% cowpea), T4(70% wheat + 30% cowpea), T5(60% wheat + 40% cowpea) and T6(50% wheat +50% cowpea)

Table 2: Proximate composition of composite of Wheat- common bean flour

Treatment	Ash(%)	Moisture (%)	Fiber (%)
T1(wheat control 100%)	1.425±0.0000d	5.897±0.1500b	1.5135±0.0845b
T2(90%wheat +10%common bean)	1.399±0.0750d	6±0.1005ab	1.6995±0.2530b
T3(80%wheat +20%common bean)	1.2373±0.0375d	5.853±0.3500b	2.6235±0.3455b
T4(70%wheat +30%common bean)	2.0747±0.2005c	6.091±0.1500ab	6.6805±3.6795a
T5(60%wheat +40%common bean)	2.7617±0.2375b	6.378±0.2250a	3.084±0.1850b
T6(50%wheat +50%common bean)	3.2863±0.4625a	5.925±0.0250b	6.965±2.9330a
Grand Mean	2.0307	6.024	3.761
CV	11.33	3.6	51.27
Significant	**	*	**

rb g i f f fb
Product development & full write up and data analysis will be performed

Bd j j j rfi 3; Evaluation of selected varieties of sorghum for malting purpose
Bd j j f j e: July 2019 – June 2020
P ckfd j f ;

- To identify the best varieties of sorghum for malting quality.
- To increase the utilization of sorghum for malting quality

S f jc rfi f 0 ; Mulate Z., Mulugeta T., Segedu B. and Banchu A.
S f fe c : Mulate Zerihun
Zfb g i f f ; January - December 2019
T b g i f h f

S f m
The improved sorghum crop varieties were collected, from Melkassa Agricultural research center and the experiment was laid out under laboratory condition. Then, the collected improved sorghum varieties were washed and germinated for 72hrs under the ambient or room temperature. The malted or germinated sorghum varieties of sample was dried in oven at 550c and the sample of some of the parameters such as Amylose, Amylose pectin, starch Ash, Moisture, protein in dry, and iron were performed. The prepared samples were stored under or in refrigerator for further analysis for the remaining parameters. The remaining hybrid of sorghum varieties such as malting, steeping, Germination mashing fermentation [yeastrt+wort] will be performed. The obtained resuts presented in Tables 1,2 &3.

Table 1: The wet chemistry analysis data of sorghum grain

Code	Amylose	Ash	Tannin	Iron	Moisture	Protein	Starch	Zinc
Argiti	19.20± 0.37a	1.37± 0.10a	-4918± 1.61b	29.92± 6.28ab	18.07± 1.27a	11.98± 0.67ab	64.64± 1.66ab	30.28± 5.34bC
Debar	18.91± 0.38a	1.4433±0.74a	15573± 4.10a	34.07± 1.05a	17.33± 3.74a	11.27± 0.90b	61.34± 4.50b	38.86± 6.95a
Dekeba	19.13± 0.33a	1.28± 0.10a	685± 1016.3b	12.997± 3.23d	18.48± 0.18a	11.60± 0.48ab	64.99± 0.44ab	20.45± 1.21d
ESH-1	19.20± 0.14a	1.42± 0.73a	-1344±0.96b	19.83±1.08Cd	16.69±1.97a	13.09±1.06a	64.42±2.07ab	26.03±3.87b-d
ESH-4	19.15±0.10a	1.43±0.33a	1813±0.93ab	38.66±7.46a	17.72±0.98a	12.02±1.70ab	63.54±1.79ab	33.22±6.24ab
ESH-5	19.02± 0.14a	1.08±0.06a	1888±0.42ab	23.63±8.16bc	18.77±0.09a	11.57±1.09ab	64.67±0.96ab	25.47±5.23b-d
Melkam	19.12± 0.02a	0.87±0.03a	5975±2.13ab	12.34±1.61d	18.60± 0.05a	11.45±0.45ab	65.39±0.13a	22.13±1.43Cd
Mean	19.11	1.27	2810.3	24.53	17.95	11.86	64.14	28.07
CV	1.31	2.76	18.14	20.53	9.53	8.36	3.32	17.13
Significant	Ns	Ns	***	***	ns	*	*	***

Table 2: Evaluation of germination energy

Sample code	24h	48h	72h
P#1	17.50	67.50	77.50
P#2	35.00	75.00	95.00
P#3	35.00	65.00	85.00
P#4	65.00	67.50	97.50
P#5	50.00	67.50	90.00
P#6	32.50	67.50	80.00
P#7	42.50	92.50	92.50
P#8	52.50	85.00	92.50
P#9	17.50	32.50	32.50.
P#10	32.50	67.50	70.00
Melkam	55.00	100.00	100.00
Argiti	57.50	92.50	97.50
Dekeba	25.00	97.50	97.50
Debere	100.00	100.00	100.00

Table 3: Wort characterization

Code	Friability (%)	Plato (ºP) reading	PH of wort	Colorof wort	Volume(ml) of wort
Argity (11)	47.38	7	5.49	2	650
Argity(p#1)	50.3	7	5.5	2	650
Melkam(P#8)	72.86	8.5	5.41	3	680
ESH-4(melthaat)	68.00	7.5	5.67	3	580
ESH-5(P#3)	56.6	7	5.67	2.5	640
ESH-4(melthaat)	42.262	7	5.69	2.5	630
ESH-5(p#14)	54.16	7.5	5.95	2.5	580
Dekeba (10)	51.32	7	5.71	2.5	585
Melkam(p#6)	69.1	8.25	5.74	3	645
Debar(p#9)	73	9.00	5.61	3	165
Debar(p#5)	77.54	8.82	5.8	2	150

rh g i f f fb

The remaining wort characterization parameters will be done.

Bd j j j rfi 4; Evaluating of the nutritional and anti-nutritional composition of finger millets varieties and its food recipes

Bd j j f j e; July 2019 - June 2020

P ckfd j f

- To identify the best varieties of finger millet based on nutritional profiling
- To increase the utilization of finger millet by preparing d/t food recipes

S f jc rnfi f 0 ; Mulate Z., Segedu and Banchu
S f fe c ; Mulate Zerihun
Zfb g i f f ; January - December 2019
T b g i f h f
Physico-chemical, functional properties and sensory analysis were conducted and presented in Tabeles 1&2.

S f m

Table 1: The physiochemical analysis result of released finger varieties

Wb jf jf	Proximate composition (%)			
	Ash	Moisture	Protein	Iron
Addis-01	2.79+0.1b	12.92+1.08c-e	6.23+1.75a	28.82+0.19e-g
Axum	2.37+0.03c-f	13.62+0.3a-c	6.70+2.61a	31.73+21.56d-g
Bako09	2.19+0.04ef	13.13+0.58c-e	7.68+4a	24.13+0.56fg
Bareda	2.45+0.05b-e	12.84+0.3+c-f	5.69+1.86a	30.85+16.99d-g
Baruda	2.62+0.56b-d	14.15+0.29a	4.84+1.75a	31.83+0.68d-g
BKFM0	2.04+0.09f	13.70+0.1abc	7.54+4.69a	33.43+4.96d-f
Boneya	2.29+0.02d-f	11.96+0.13f-h	6.79+3.89a	32.67+3.87d-g
Degu	3.42+0.04a	14.02+0.16ab	7.65+4.96a	58.3+1.18a
Dibatsi	2.037+0.04f	14.02+0.33ab	5.32+1.8a	24.01+0.21fg
Diga-1	2.71+0.8bc	12.7+0.26d-f	5.66+1.92a	50.73+2.28ab
Gudetu	2.5+0.21b-e	12.92+0.14c-e	3.17+0.0a	36.29+8.41c-e
Gute	2.5+0.21b-e	11.4+1.03hi	6.69+3.02a	39.83+0.87b-e
Meba	2.81+0.01b	13.72+0.29a-c	5.99+1.98a	54.52+0.20a
Mecha	3.22+0.15a	14.27+1.1a	5.79+2.37a	54.4+0.59a
Merebe	2.32+0.07d-f	11.51+0.69g-i	4.63+2.3a	41.94+7.62b-d
Necho	2.59+0.02b-d	12.42+0.11d-f	3.72+0.00a	33.75+0.83d-f
Padet	2.25+0.09d-f	12.27+0.72e-h	5.22+1.49a	20.9+9.04gh
Tadesse	2.35+0.03c-f	12.37+0.21e-g	7.32+4.27a	10.24+3.68hi
Tekeze	2.76+0.09b	10.87+0.06i	3.82+0.94a	58.39+6.69a
Tessema	2.26+0.11d-f	12.64+0.76d-f	4.69+2.74a	10.35+0.44hi
Uriji	2.16+0.017ef	13.257+0.305b-d	6.75+4.32a	47.78+2.04a-c
Mean	2.51	12.89	5.80	33.62
CV	9.19	4.18	49.36	21.29
Significant	***	***	Ns	***

Table 2a: The physiochemical analysis result of released finger varieties

Varieties	Zinc	Starch	Amylose	Amylopectin
Addis-01	61.64+1.43e-h	64.19+10.37a-d	20.83+0.68ef	43.37+11.05a-e
Axum	67.71+4.47cd	55.39+12.09def	20.91+1.25d-f	34.48+10.84e-g
Bako09	61.63+2.7e-h	62.65+0.68a-e	21.16+0.17c-e	41.49+0.51a-f
Bareda	63.23+5.89d-g	56.93+3.85c-f	20.77+0.39ef	36.16+3.46d-g
Baruda	64.84+0.24d-f	65.73+10.3abc	20.31+0.36fg	45.42+9.94a-d
BKFM0	71.01+0.3bc	69.46+1.56a	21.62+0.19bc	47.84+137ab
Boneya	67.34+0.97cd	54.65+0.47def	20.29+0.07fg	34.35+0.53e-g
Degu	76.66+0.97a	37.21+7.83g	19.44+0.37h-j	17.77+7.46h
Dibatsi	56.95+0.06hi	66.19+10.66abc	20.04+0.06g-i	46.15+10.6a-c
Diga-1	73.57+1.29ab	50.85+5.58f	20.12+0.15g	30.73+5.73g
Gudetu	67.31cd	58.060b-f	20.305fg	37.757c-g
Gute	58.58+8.62gh	59.41+10.04a-f	20.07+0.15gh	39.34+10.18b-g
Meba	52.92+1.34i	67.5+0.69ab	20.39+0.14fg	47.11+0.55a-c
Mecha	58.48+1.84gh	60.59+0.69a-f	21.52+1.02cd	39.07+0.68b-g
Merebe	66.97+1.67cd	55.46+3.44def	19.99+0.13g-i	35.47+3.31efg
Necho	36.11+5.99j	68.84+0.13a	19.42+0.03ij	49.42+0.16a
Padet	60.52+2.85f-h	63.82+3.04a-e	22.28+0.57a	41.53+3.1a-f
Tadesse	62.65+1.5d-g	64.76+1.47a-d	22.25+0.02ab	42.51+1.49a-f
Tekeze	75.45+0.47ab	53.79+5.54ef	19.9+0.24g-i	33.89+5.3e-g
Tessema	62.7+0.49d-g	63.99+1.24a-d	21.61+0.03c	42.38+1.27a-f
Uriji	65.98+1.47c-e	52.27+1.17f	19.14+0.053j	33.130+1.13fg
Mean	63.44	59.61	20.59	39.02
CV	4.96	10.36	1.88	15.46
Significant	***	***	***	***

Table 2b: The functional property result of released finger millet varieties

Sample	dispersibility (%)	oil absorption (%)	solubility (%)	swelling power (%)	WAC (%)
Addis-01	76±00h-j	175±5b-e	2.49±0.70c-e	9.28±0.06d-g	215±15cd
Axum	77.1±0.10f-h	175±5b-e	3.79±0.2bc	9.79±0.39ab	230±120bc
Bako 09	76.45±0.55g-i	190±10a-c	2.95±0.16c-e	9.56±0.05b-d	85±5g
Bareda	77±0.50f-i	100±10hi	2.45±0.35c-e	9.28±0.03d-g	200±10cd
Baruda	76±0.00h-j	170±10c-e	3.14±0.05c-e	9.21±0.03e-g	195±15cd
BKFM010	77.25±0.75fg	125±15gh	2.3±0.10c-e	9.32±0.41d-g	215±5cd
Boneya	80.05±0.05c	170±10c-e	2.45±0.06c-e	9.7±0.10a-c	125±5fg
Degu	78.5±0.50de	150±40e-g	1.45±0.15e	9.19±0.12e-g	180±0.00de
Dibatsi	75.25±0.25jk	105±5hi	2.94±0.36c-e	9.4±0.12c-f	205±35cd
Gudetu	76.1±0.1h-j	185±5a-d	2.55±0.05c-e	9.33±0.10g	105±5fg
Gute	77.5±0.25ef	140±10fg	2.55±0.05c-e	9.51±0.12b-e	300±20a
Meba	77.75±0.25ef	110±0.00hi	2.84±±0.05c-e	9.11±0.04fg	175±15de
Mecha	74.25±0.25k	205±15a	2.4±0.20c-e	9.2±0.05e-g	195±15cd
Merebe	77±0.00f-i	161.67±44.81d-f	6.05±2.95a	9.5±5.774E-03b-e	175±15de
Necho	75±0.00jk	180±0.00a-d	2.84±0.35c-e	9.44±0.10c-e	140±40ef
Padet	76±0.00h-j	175±5b-e	2.85±0.16c-e	10.02±0.46a	285±5a
Tadesse	75.9±0.10a	105±5hi	3.49±0.10b-d	9.7±0.21a-c	120±20fg
Tekeze	83.5±0.5a	95±5i	5.43±4.63ab	9.68±0.44bc	195±5cd
Tessema	79.75±2.75c	140±20fg	3.95±0.05bc	9.69±0.04a-c	195±5cd
Uriji	76.5±0.50g-i	165±5c-f	2.65±0.05c-e	9.44±0.08c-e	140±10ef
Wama	79.25±0.25cd	140±10fg	1.7±0.10de	9.21±0.15e-g	115±5fg
Diga-1	82.25±0.75b	200±10ab	2.1±0.10c-e	9.03±0.02g	265±15ab
Mean	77.48	152.8	2.97	9.44	184.32
CV	0.88	10.21	40.09	2.11	16.27
Significant	***	***	***	***	***

Table 3: Average sensory score of Injera

Varieties	Texture	Appearance	Taste	Colour	Aroma	Overall acceptability (%)
Addis-01	7.43+0.21ab	7.8+0.35a	7.17+0.15ab	6.97+0.67a-d	6.9+0.78a-d	7.8+0.35ab
Axum	5.03+0.06c-e	5.33+0.15e-g	4.8+0.1h	5.5+0.2e-g	4.83+0.06e	6.03+0.06g-i
Bareda	6+1.59b-d	5.93+1.03c-f	5.6+1.59e-h	6.07+1.1d-e	5.93+1.81c-e	6.73+1.14c-h
Baruda	4.4+1.71e	4+1.06g	5+1.56gh	4.87+4.87g	5.53+1.45de	5.87+1.15hi
BKFM010	4.93+1.27c-e	4.47+0.76fg	6.3+1.82a-f	4.6+0.2g	5.8+1.25c-e	6+0.6g-i
Boneya	6.67+1.1ab	6.27+1.5b-e	6.2+0.8b-g	6.6+1.4a-d	6.07+1.86b-e	6.67+1.36d-i
Degu	5+0.53c-e	5.07+0.81e-g	5.17+0.38f-h	5.2+0.0fg	5.8+0.72c-e	5.67+0.23i
Diga-1	6.83+0.67ab	6.93+0.42a-d	6.3+0.3a-f	5.1+0.52g	6.47+0.61a-d	7+0.2b-g
Gudetu	7.37+0.91ab	7.83+0.49a	7.53+0.31a	7.17+0.15ab	7.47+0.5ab	7.87+0.31ab
Gute	6.53+0.5ab	7.53+0.46ab	6.63+0.35a-e	6.13+0.42c-f	6.13+1.01a-e	7.33+0.46a-f
Meba	7.33+0.64ab	7.8+0.72a	7.07+0.31a-c	7.0+0.767a-c	7.2+0.4a-c	7.73+0.31a-c
Mecha	6.97+0.72ab	6+0.53c-e	5.8+0.2c-h	6.17+0.15c-e	6.5+0.26a-d	6.33+0.46f-i
Merebe	7.27+0.99ab	7.6+1ab	6.93+0.58a-d	7.13+0.42ab	6.93+0.46a-d	7.67+0.7a-b
Necho	7.23+0.4ab	7.23+0.6a-c	7+0.72a-d	7.27+0.64a	7.2+0.6a-c	7.73+0.31a-c
Padet	4.73+0.45de	5.23+2.06e-g	5.83+0.35c-h	5.067+0.06g	6.3+0.3a-e	6.47+0.25e-i
Tadesse	7.37+0.15ab	7.03+0.35a-d	6.7+0.1a-e	7.4+0.3a	6.93+0.45a-d	7.47+0.25a-e
Tekeze	7.47+0.64ab	8.07+0.70a	7.5+0.26a	7.07+0.31a-c	7.63+0.29a	8.23+0.21a
Tessema	7+0.2ab	5.73+0.06d-f	5.73+0.06d-h	6.230.06b-e	6.5+0.1a-d	6.1+0.1g-i
Uriji	6.33+1.8a-c	5.27+1.55e-g	6.07+1.10b-h	6.53+1.01a-d	6.33+1.47a-e	6.33+1.33f-i
Control	7.53+0.06a	8+0.0a	7.2+0.0ab	6.87+0.15a-d	6.5+0.0a-d	8.33+0.31a
Mean	6.47	6.46	6.33	6.25	6.45	6.97
CV	13.87	13.80	12.15	9.24	14.10	9.25
significant	***	***	***	***	***	***

rıb g i f f fb

The crude fat, phytate, Mineral content (Ca and Mg) will be determined. Finger millet-based food products bread will be developed and sensory analysis will be conducted.

Bd j j j rıfi 5; Evaluation of sorghum proportion with wheat for biscuit making quality

Bd j j f j e; July 2019 - June 2021

Pckfd j f

- To determine the proportion of sorghum flour in biscuits making.
- To evaluate the quality of biscuits made from composite flours (wheat and sorghum)

Sf jcrıfi f 0; Mulate Z., Mulugta T., Segedu and Banchu A.

Sf fe c : Mulate Zerihun

Zfb g i f f ; January - December 2019

T b g i f h f

S f m

Biscuit product developed and sensory analysis were conducted and prepared for further analysis

rb g i f f fb

Developed biscuit product subjected to proximate and mineral analysis

Bd j j j rfi 6; Nutritional Composition and Product Making Quality Evaluation of Newly Introduced Tomato *(Lycopersicone sculentum Mill.*) Varieties

Bd j j f j e; July 2019 - June 2021

P ckfd j f0

- To evaluate the physico-chemical and nutritional Composition of newly introduced Tomato varieties
- To develop tomato based processed products

S f jc rfi f : Demirew A., Segedu B., Banch A., Mulugeta T. and Mulate Z.

S f fe c : Demirew A

Zfb g i f f ; January - December 2019

T b g f fb di h f ;

Differnt tomato varities were planted and waiting fruit harvesting.

rb g i f f fb

Nutrational and product processing quality will be evaluatied based on the standared methods.

kfd j rfi 6; Assessment of Multi- Residue Mycotoxins in Maize, Peanuts, Coffee, Milk, Feed and Red pepper and its

Bd j j j rfi 2; Determination of the level of Aflatoxin, Ochratoxin A, Zearalenone, Deoxynivalenol and Fumonisins in Red pepper

Bd j j f j e; July 2018 - June 2021

P ckfd j f

- To assess and quantify the extent of multi-residue mycotoxins problem in red pepper and analyze possible sources of the problem.
- To determine the status of mycotoxins contamination in red pepper and its system

S f jc rfi f 0 ; Mulate Z., Girum H., Demirew A., and Mulugeta

S f fe c : MulateZerihun

Zfb g i f f ; January - December 2019

T b g i f h f

Preliminary survey was conducted to evaluate postharvest effect and aflatoxin concentration level in pepper were performed and presented in Tables 1 & 2.

Table 1: Preliminary data to assess the storage system

Task/Activities	Rank			
	4-Most frequently	3-frequently	2-less frequently	1-less frequently very much
Farm land for production of targeted crop	0.5 ha	0.25 ha	0.33 ha	1 ha
Total grain harvested	30-40 kun	20-30 kun	10-20 kun	≤ 10 kun
Stored grain for sale	98-100%	95-98%	90-95%	≤ 90%
Stored grain used for home consumption	0-2%	2-5%	5-10%	≥ 10%
Any unfavorable condition during harvesting	Heavy rain	Overlapping ofanother crop	Wind	Labor shortage
Methods of facility to drying the crop	Spreading on flat land	Spreading on plastic sheet	Spreading on the floor of house	-
Place to drying the crop	Around home	-	-	In harvested field
Duration of drying the harvested crop	8 days	8-15 days	15-20 days	30 days
Crop parts for drying	Pods	-	Pods with head	Seed
Methods to use grain moisture content test at final to decide grain store	Biting between Finger	Sound grain	Color change	-
When the grain/seed for storage	November	October	December	September

S f m

Table 2: The result of aflatoxins concentration level of red pepper

b b f f j Vh0l h						
No	Code	Aflatoxin G2	Aflatoxin G1	Aflatoxin B2	Aflatoxin B1	Total Aflatoxin
1	sample14	ND	ND	ND	ND	ND
2	Gomer-2 sample-2	ND	1.55	ND	ND	1.55
3	Mankusa-5Sample-7	ND	1.23	ND	ND	1.23
4	Mankusa-4Sample6	ND	ND	ND	ND	ND
5	Kantefan-1Sample-27	1.48	27.47	1.2	7.07	37.22
6	Mankusa-6Sample-8	1.69	108.63	5.14	116.52	231.98
7	Mankusa-8Sample-10	1.79	26.75	2.8	20.87	52.21
8	Sample-22	ND	ND	ND	ND	ND
9	Mankusa-1Sample-3	ND	ND	ND	ND	ND
10	Smple-31	ND	20.83	2.55	66.18	89.56
11	Sample-19	ND	ND	ND	ND	ND
12	Sample-23	ND	ND	ND	ND	ND
13	Sampe-25	ND	1.73	ND	ND	1.73
14	Mankusa-2Sample-4	ND	0.51	ND	1.35	1.86
15	Sample 13	ND	ND	ND	ND	ND
16	Sample-32	ND	ND	ND	ND	ND
17	Sample -34	ND	ND	ND	ND	ND
18	Smple-18	ND	3.81	ND	0.9	4.71
19	Sample-24	ND	ND	ND	ND	ND
20	Sample-17	ND	58.89	0.91	22.1	81.9
21	Sample -9	ND	ND	ND	ND	ND
22	Sample -15	ND	ND	ND	ND	ND
23	Sample-21	ND	ND	ND	ND	ND
24	Sample-26	ND	ND	ND	ND	ND
25	Sample-29	ND	ND	ND	ND	ND
26	Mankusa-3Sample-5	ND	ND	ND	ND	ND
27	Goomer-1Sample-1	4.24	206.39	5.71	80.79	297.13
28	Sample-33	ND	ND	ND	ND	ND
29	Sample-30	ND	4.03	ND	3.65	7.68
30	Sample-28	ND	1.18	ND	ND	1.18

rb g i f f fb

Further-more sample analysis will be conducted. Correlation will be developed based on different storage system.

Bd j j j rfi 3; Determination of the level of Aflatoxin, Ochratoxin A, Zearalenone, Deoxynivalenol and Fumonisins in Maize

Bd j j f j e; July 2019 - June 2021

P ckfd j f

- To assess and quantify the extent of multi-residue mycotoxins problem in maize and analyze possible sources of the problem.
- To determine the status of mycotoxins contamination in maize and its system

S f jc rfi f 0 ; Mulate Z., DemirewA., andGirum H/

S f fe c ; Mulate Zerihun

Zfb g i f f ; January - December 2019

T b g i f h f

S f m

The survey was conducted by Ambo and Melkassa ARC teams. Based on the survey the sampling sites and size were determined.

rb g i f f fb

The samples will be collected based on preliminary survey. The collected samples will be prepared for further analysis

Bd j j j rfi 4; Comparative studies on the detoxification of aflatoxin levels in maize by different chemical methods and its nutritional effects

Bd j j f j e; July 2019 - June 2021

P ckfd j f

- To assess the detoxification of aflatoxin levels in maize by different chemical methods and its nutritional effects
- To determine the total aflatoxin level and nutritional value in maize before and after chemical detoxification treatments.

S f jc rfi f 0 ; Mulate Z., Demirew A., and Mulugeta T.

S f fe c ; Mulate Zerihun

Zfb g i f f ; January - December 2019

T b g i f h f

S f m

Sampling sites and size were determined.

rb g i f f fb

The samples will be collected based the preliminary survey. The collected samples will be subjected to chemical treatments. The physicochemical analysis of treated samples will be analysed.

kfd j rfi 7/ Microbial food safety investigation

kfd f j e: July 2018 - June 2021

Bd j j j rfi 2; Isolation, identification and collection of lactic acid bacteria from okara& evaluation of their antimicrobial activity against pathogenic bacteria

Bd j j f j e; July 2019 - June 2021

P ckfd j f

- To isolate, identify & collect lactic acid bacteria fromokara.
- To evaluate antimicrobial activity of lactic acid bacteria against pathogenic bacteria.

S f jc rfi f : Segedu B, MulugetaT, Demerew A, Banchu A &Mulate

S f fe c ; Segedu B

Zfb g i f f ; January - December 2019

T b g i f h f

S f m

The soya bean sample has been collected and sorted & cleaned. The okara was prepared from soybean. The lactic acid bacteria cultured and preserved for further laboratory analysis

Table 1: The morphological characteristics of cultured lactic acid bacteria

Tb rfi d ef	**O j rb f**	**N i mhjdbmb e d m bmdi b bd f j jd**		
		Colony size	Colony color	Colony shape	Consistency
T3	$4*10^{-3}$	Pin point	Whitish	Circular	Convex
		Small	Whitish	Circular	Convex
		Medium	Whitish	Circular	Convex
		Large	Whitish	Circular	Convex
T3	$4*10^{-4}$	Pin point	Whitish	Circular	Convex
		Small	Whitish	Circular	Convex
		Medium	Whitish	Circular	Convex
		Large	Whitish	Circular	Convex
T3	$4*10^{-5}$	Pin point	Whitish	Circular	Convex
		Small	Whitish	Circular	Convex
		Medium	Whitish	Circular	Convex
		Large	Whitish	Circular	Convex

T3	$4*10^{-6}$	Pin point	Whitish	Circular	Convex
		Small	Whitish	Circular	Convex
		Medium	Whitish	Circular	Convex
		Large	Whitish	Circular	Convex
T3	$4*10^{-6}$	Pin point	Whitish	Circular	Convex
		Small	Whitish	Circular	Convex
		Medium	Whitish	Circular	Convex
		Large	Whitish	Circular	Convex

rb g i f f fb

Lactic acid bacteria will be identified and collected. Antimicrobial activity of lactic acid bacteria against pathogenic bacteria will be evaluated.

kf d j rfi 8; AGP-2 support activities

kf d f j e; July 2018 - June 2021

Bd j j j rfi 2; Demonstration and popularization of semi and fully process sorghum food recipes in central rift valley of Ethiopia

Bd j j f j e; July 2019 - June 2021

P ckf d j f

- To demonstrate and popularize the sorghum grain food recipe as functional and staple food

S f jc rfi f 0 ; Mulate Z., Demirew A., mulugeta T., Banchu, Segedu and Fitsum.

S f fe c ; Mulate Zerihun

Zf b g i f f ; January - December 2019

T b g i f h f

The food recipes, preparation and manual developments under going well.

rb g i f f fb

The awareness about nutrition and demand for different crops will be created. The utilization of different in the traditional food system will be promoted.

Bd j j Uj rfi 3; Demonstration and Popularization ofProcessed Tomato food Products

Bd j j f j e; July 2019 - June 2021

P ckf d j f0

- To demonstrate and Popularize tomato based processed products

S f jc rfi f 0 ; Demirew A., Mulate Z., Mulugeta T., Banchu, Segedu and Fitsum.

S f fe c ; Demirew Abera

Zf b g i f f ; January - December 2019

T b g i f h f

S f m

The food recipes, preparation and manual developments under going well.

rb g i f f fb

The awareness about nutrition and demand for different crops will be created. The utilization of different in the traditional food system will be promoted.

Bd j j j rfi 4; Development and promotion of maize (normal and QPM)-based nutritious foods

Bd j j f j e: July 2019 - June 2021

P ckf d j f0

- To create awareness and demand for QPM
- To promote the utilization of QPM in the traditional food system

S f jc rfi f 0 ; Mulugeta T., Segedu- MulateZ. Demirew A.., Banchu and Fitsum.

S f fe c ; Mulugeta Teamir

Zfb g i f f ; January - December 2019

T b g i f h f

- The food recipes preparation and manual developments under going well

rb g i f f fb

The awareness on nutrition and demand for different crops will be created. The utilization of different in the traditional food system will be promoted.

Bd j j j rfi 5; Development and promotion of common beans-based nutritious foods

Bd j j f j e; July 2019 - June 2021

P ckfd j f0

- To create awareness on nutrition and demand for common beans
- To promote the utilization of beans in the traditional food system

S f jc rfi f 0 ; Mulugeta T., Segedu, Mulate Z., Demirew A., mulugeta T., Banchu, and Fitsum.

S f fe c ; Mulugeta Teamir

Zfb g i f f ; January - December 2019

T b g i f h f

The food recipes preparation and manual developments under going well.

rb g i f f fb

The awareness on nutrition and demand for different crops will be created. The utilization of different in the traditional food system will be promoted.

kfd j rfi 9; Climate-smart interventions for smallholder farmers

Bd j j j rfi 2; Protocol development for making best quality injera using sorghum mixed with tef

Bd j j f j e; Dec 2019 - June 2021

P ckfd j f; To develop cost-effective protocols for injera-making using mixtures of sorghum and tefflour

S f jc rfi f) *; Mulugeta T., Mulate Z and Segedu B

S f fe c ; Mulugeta Teamir

Zfb g i f f ; January - December 2019

T b g i f h f

S f m

Table Mixture design using design expert

Std	Run	Component 1 A: Tef %	Component 2 B: Sorghum %
4	1	37.5	62.5
8	2	25	75
6	3	50	50
1	4	50	50
5	5	12.5	87.5
3	6	25	75
2	7	0	100
7	8	0	100

rb g i f f fb

Best performing varieties in each region will be included. Fenugreek powder 1-4 % will be added to the mixture for further investigation.

Bd j j j rfi 3; Demonstration of best quality injera making business model and protocol
Bd j j f j e; June 2019 - Dec 2020
P ckfd j f:

- To demonstrate best quality injera making for selected women-run enterprises

S f jc rfi f) *; Mulugeta T, Mulate Z and Segedu B
S f fe c ; Mulugeta Teamir
Zfb g i f f ; January - December 2019
T b g i f h f
Preliminary survey was performed.
rb g i f f fb
Satisfaction of customers and skill acquired on injera making will be evaluation

Bd j j j rfi 4; Protocol development for making best quality bread and promotion to users
Bd j j f j e; June 2020 - Dec 2020
P ckfd j f: To develop and demonstrate high quality bread using mixtures of sorghum and wheat flour
S f jc rfi f) *; Mulugeta T, Mulat Z and Segedu B
S f fe c ; Mulate Zerihun
Zfb g i f f ; January - December 2019
T b g i f h f
Activity yet not started.
rb g i f f fb
Bread making quality protocol and characterization will be developed.

Natural Resources Management Process

Mesfin Hundessa
E-mail: hundessamesfin@gmail.com; Phone:+251911840484

kfd 2; Enhancing biological SWC to enhance water productivity, erosion control, and livelihood improvement under variable climatic conditions in Ethiopia
kfd f j e ; July 2015 to June 2020
Bd j j j rfi; Effect of Conservation tillage on run-off, soil, nutrient loss and yield of major crops under different agronomic practices in Ethiopia
P ckfd j f;

- To evaluate the effect of Conservation tillage on crop yield and yield components
- To investigate relationship between conservation agriculture and infiltration rate under different land use system
- To quantify runoff, soil and nutrient losses from major Conservation tillage land use practices
- To partial economic analysis between conventional tillage and Conservation tillage for recommendation ultimate users' of technologies

Bd j j f j e ; July 2015 to June 2020
S f jc rfi f) *; Abebe B., Melat E., Daniel B.
S f fe c ; Melat Eshetu
Zfb g f ; January - December 2019
T b g i f h f ;
The activity has been conducted for the past 5 years, accordingly all necessary data's have been collected except for the initial period(owed to the nationwide drought event we couldn't collect data). Due to the nature of the activity data collection could not completed (crop rotation is involved in the treatment).Therefore, we needed one year extension to complete the cycle (we presented it to the review forum and approved for one year extension).
Ef jh ; RCBD
U fb f ; Bare land, Conventional Sol Maize, Minimum tillage Sol Maize, Conventional Inter crop, Minimum tillage Inter crop, Conventional Crop rotation and Minimum tillage Crop rotation
M db j ; Bishola

S f m

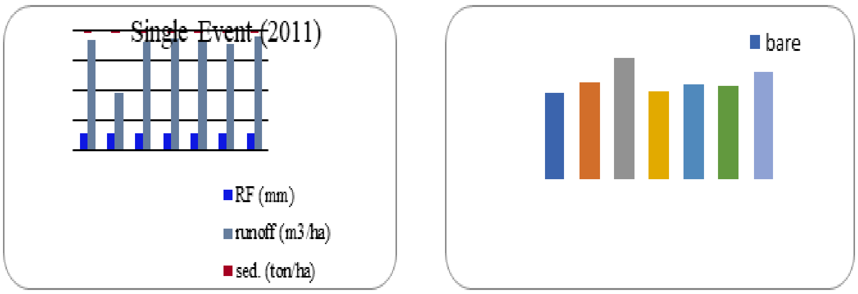


Figure 1. Rainfall, runoff and sediment relationship (a) available moisture (b) observed for a single event for the respective treatments at Bishola.

Figure 2. Field condition for the past three years (2017, 2018, 2019) at Bishola.

As indicated in the above resulteven after ten consecutive days of no rainfall the zero tillage treatments has conserved moisture better than that of the conventional practice. Which may imply that the low disturbance of soil has confined water in the soil from easily evaporation. The lowest soil loss has been recorded for the zero tillage treatments and the highest being recorded from the bare land;it is subjected to no cover crop on the ground, which protects the soil from erosion.

Table 1. Yield and yield component of maizeat Bishola

Treatments	Yield Qt/ha	Stand count	Plant height	inter nod height
Conventional Sol Maize	62.82ab	247.3	2.31	6.17
Min. tillage Sol Maize	65.50a	235.3	2.24	5.86
Conventional Inter crop	49.26c	218.6	2.36	7.73
Min. tillage Inter crop	56.03bc	249.3	2.34	6.13
Conventional Crop rotation	59.04ab	220	2.23	5.46
Min. tillage Crop rotation	64.71ab	216.3	2.21	5.6
P value (0.05)	0.015	NS	NS	NS
CV	8.08	13.3	3.83	25.39

Table 2. Yield and yield component of haricot at Bishola

Treatments	Yield qt/ha	Pod no./ (plant)	Plant height (cm)
Conventional inter crop	8.66	15.82	85
Min. tillage inter crop	6.72	14.72	91
P value (0.05)	NS	NS	NS

Regarding the yield advantage the highest yield has been countered from minimum tillage with sole maize treatment (65.5qt/ha) followed by minimum tillage with crop rotation (64.7 qt/ha) and the leastyield observed from intercropping with conventional practice treatment. However the intercropping treatments has haricot bean yield of (8.6qt/ha and 6.7qt/ha) for conventional and minimum tillage additional to maize yield, thus it requires an economic analysis to select the best treatment.

rb g i f f fb ; The experiment will be continued to be conducted for one additional year.

kfd 3; Enhancing the influences of physical SWC practices on ecosystem services under different Agro-ecologies of Ethiopia

kfd f j e ; July 2018 to June 2022

Bd j j 2; Effect of different spacing of level soil bund with biological SWC measures on ecosystem services at Bishola Ethiopia.

P ckfd j f

- To evaluate different level soil bund spacing with agronomic SWC measures on provisioning ecosystem services/ fuel-wood, fiber, Food/crop yield/
- To evaluate different level soil bund spacing with agronomic SWC measures on regulating services/runoff, soil loss, nutrients loss, carbon stock and water quality/filtration/
- To evaluate supporting services/nutrient cycling or soil fertility improvement
- To examine over year effects of the treatments on ecosystem services

Bd j j f j e ; July 2018 to June 2022

S f jc rfi f) *; Abebe B., Melat E., Daniel B.

S f fe c ; Melat Eshetu

Zfb g f ; January - December 2019

T b g i f h f ;

The experiment for this activity has been conducted according to the proposal. All necessary data's were collected (soil Sample for soil moisture assessment was collected every ten days during the growing season, soil loss and run-off data's are collected for every rainy days and all necessary agronomic data's were collected) data has been analyzed.

Ef jh ; RCBD

U fb f ;

- Bare land
- Traditional maresha with bund spacing (19m)
- Subsoiler + FYM with bund spacing (19m)
- Subsoiler + FYM with bund spacing (21m)
- Subsoiler + FYM with bund spacing (24m)

M db j ; Bishola

S f m

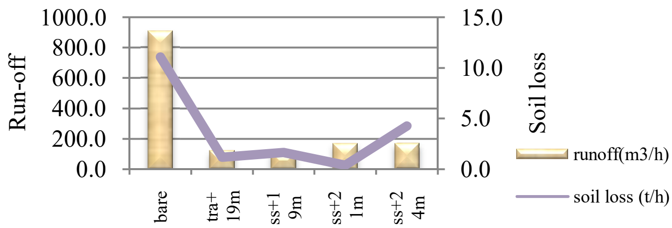


Figure 3. Annual soil loss and runoff at Bishola under different treatments Rainfall (722 mm)

Table 3. Annual soil loss and runoff at Bishola under different treatments Rainfall (722 mm)

Treatment	Yield(qt/ha)	Difference with best	Soil loss(t/ha)	Difference with bare	Runoff(m^3/ha)	Difference with bare
			Rainfall (20 mm)		Rainfall (20 mm)	
Bare	-	-	1.5942		103.91	
19m+local	27.3	-2.1	0.6768	-0.92	52.35	-51.56
19m+SS+FYM	28.3	-1.1	0.8482	-0.75	66.93	-36.98
21M+SS+FYM	29.4	0	0.403	-1.19	32.9	-71.01
24M+SS+FYM	28.1	-1.3	0.7521	-0.84	80.3	-23.61

As indicated in the above table even though no significant difference (p>0.05) has been observed between treatments the highest yield advantage has been recorded bytreatment 4 (Subsoiler + FYM with bund spacing 21m) (29.4 qt/ha). Similarly treatment 4 (Subsoiler + FYM with bund spacing 21m) has reduced the soil loss as well as the runoff. The analysis from a single observation showed that treatment 4 has reduce the soil loss and runoff by (1.19 t/ha and 71 m^3/ha.

rb g i f f fb ; The activity will be conducted for the next two years

Bd j j 3/ Effect of different graded soil bund spacing with biological soil and water conservation measures on ecosystem services in Kulumsa

P ckfd j f;

- To evaluate different level soil bund spacing with agronomic SWC measures on provisioning ecosystem services/ fuel-wood, fiber, Food/crop yield/
- To evaluate different level soil bund spacing with agronomic SWC measures on regulating services/runoff, soil loss, nutrients loss, carbon stock and water quality/filtration/
- To evaluate supporting services/nutrient cycling or soil fertility improvement
- To examine over year effects of the treatments on ecosystem services

Bd j j f j e ; July 2018 to June 2022

S f jc rfi f) *; Abebe B., Melat E., Daniel B.

S f fe c ; Melat Eshetu

Zfb g f ; January - December 2019

T b g i f h f ; The experiment for this activity has been conducted according to the proposal. All necessary data's were collected (soil sample for soil moisture assessment was collected every ten days during the growing season, soil loss and run-off data's are collected for every rainy days and all necessary agronomic data's were collected) data has been analyzed.

Ef jh ; RCBD

U fb f ;

- Bare land
- Traditional maresha with bund spacing (20m)
- Winged-subsoiler and FYM with bund spacing (20m)
- Winged-subsoiler and FYM with bund spacing (22m)
- Winged-subsoiler and FYM with bund spacing (25m)

M db j ; Kulumsa

S f m

The yield of wheat from the experiment showed that the highest grain yield recorded under 25 m bund spacing with subsoiler and farm yard manure followed by 20 m bund spacing with subsoiler and farm yard manure with average value of (38.76aqt/ha/yr) and (35.04qt/ha/yr)respectively. Whereas the lower grain yield was recorded under 20m bund spacing with local maresha.

Table 4. Response of yield and yield component of wheat to different treatments at Kulumsa

Treatments	Grain yield (qt/ha)	Seed no/cob	Plant height
20m+local	33.06b	40.53a	2.06a
20m+SS+FYM	35.04ab	39.73a	2.46a
22M+SS+FYM	33.08b	44.26a	2.40a
25M+SS+FYM	38.76a	42.66a	2.40a
LSD % (0.05)	0.23	0.76	0.55
CV	8.79	13.69	15.12

rb g i f f fb ; The activity will be conducted for the next two years

kfd 4; Enhancing physical SWC to enhance water productivity, erosion control, and livelihood improvement under variable climatic conditions in Ethiopia

kfd f j e ; July 2019 to June 2022

Bd j j 2; Assessment of gully erosion for its controlling mechanism in Dodota, ArsiZone, Ethiopia

P ckfd j f;

- To asses and characterize gully erosion in the study area
- To determine the causes and its effect on the watershed
- To determine the conservation and rehabilitation mechanism

Bd j j f j e ; July 2019 to June 2021

S f jc rfi f) *; Daniel B., Abebe B., Melat E.

S f fe c ; Melat Eshetu

Zf b g f ; January - December 2019

T b g i f h f ; The activity has been started according to the plan.Initial data collection and analysis is under progress(GPS points has been recorded at tail, head and along the gully (lat, long and elevation), DEM (30m*30m) has been downloaded, catchment areas which contributes to the gully and the natural drainage has been identified and watershed has been delineated slope class has been classified according to minster of agriculture for SWC intervention.

Ef jh ; Modeling

U f b f ;No

M db j ; Dodota

S f m

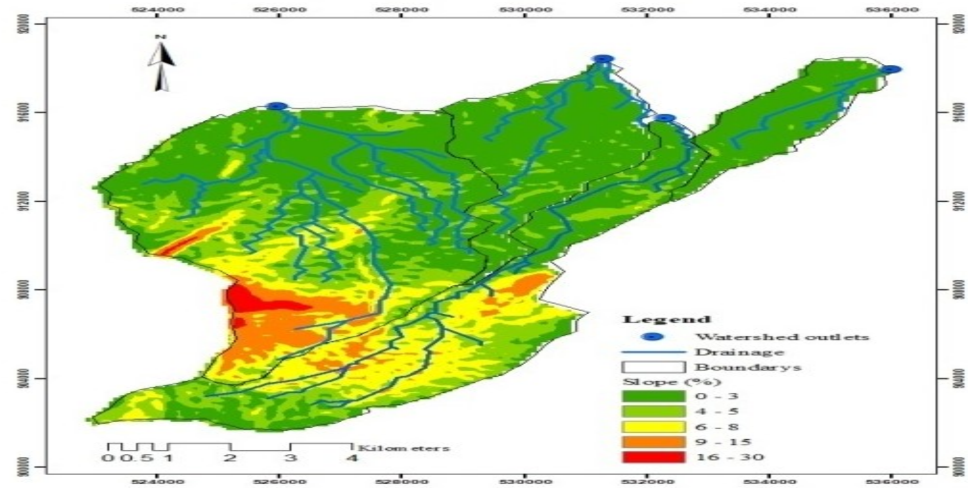


Figure 4. Map of the study area

As the result shows (figure) the gully is not formed only by water from a single catchment.Water from four micro watersheds contribute to the gully formation. Two of the micro catchments are classified as a gentle slope. While the other two catchments classified under the slope of moderate to high slope.

rb g i f f f b ; The activity will continue in the next year

Bd j j 3; Gully erosion hazard mapping for its control mechanism in Dodota, Arsi Zone, Ethiopia

P ckf d j f ;

- To map gully erosion hot spot area,
- To determine the conservation and protection mechanism

Bd j j f j e ; July 2019 to June 2021

S f jc rfi f) *; Daniel B., Melat E., Abebe B.

S f fe c ; Melat Eshetu

Zf b g f ; January - December 2019

T b g i f h f ; The activity has been started according to the plan. Initial data collection has been started (GPS points has been taken, DEM has been downloaded, watershed has been re-delineated.Land use data preparation is under way

Ef jh ; Modeling
U fb f ; No
M db j ; Adulala

S f m

As its shown in the map (figure) slop classification has been made according to minster of Agriculture for SWC intervention. More than 50% of the catchment is classified under slop class of 0 to 3 (gentle slope). There are also mountainousareas which has classified as high sloppy area (which are susceptible to erosion.

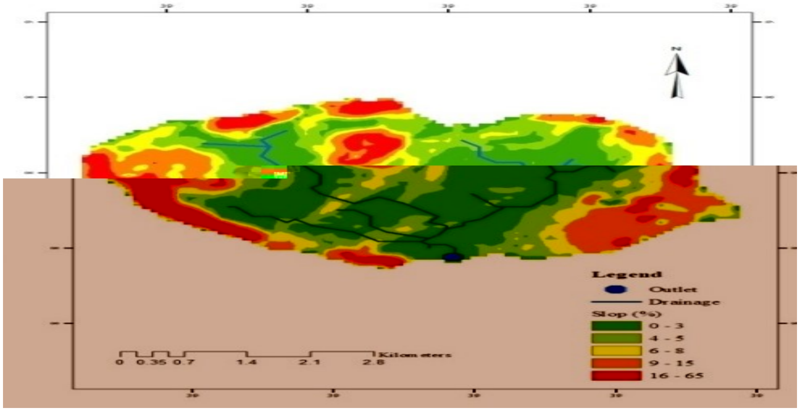


Figure 5. Map of the study area

rb g i f f fb ; The activity will continue in the next year

Bd j j 4; Monitor and examine the discharge, sediment yield and nutrient flow in the model watershed

P ckfd j f ;

- To use the data in selecting suitable hydrological model and for study purpose of short and long term impact of SWC practices on soil loss, stream flow and crop yield
- To monitor/examine the discharge, sediment yield and nutrient flow in the model watershed throughout the project life.

Bd j j f j e ; July 2019 to June 2024
S f jc rfi f) *; Abebe B., Melat E., Daniel B
S f fe c ; Melat Eshetu
Zfb g f ; January - December 2019
T b g i f h f ; This activity was undertaken since 2015 (using manual gauging station). But its modified and reinitiated since July 2019 (by changing the gauging station from manual to Automated gauge) which may help to provide a better prices data.
Ef jh ; Modeling
U fb f ; No
M db j ; Jogo Gudedo watershed

S f m

Runoff has been measured and sample has been collected to measure the sediment loss (data analysis is under way).

rb g i f f fb ; The activity will continue in the next year

kfd 5; Watershed based climate SMART agriculture for sustainable land resource improvement& livelihood improvement in model watersheds

kfd f j e ; July 2019 to June 2022

Bd j j 2; Impact Of Land Use Land Cover Change on Soil Erosion Risk: The Case of Adulala Watershed, Central Rift Valley of Ethiopia

P ckfd j f;

- To identify the long term trend of land use land cover changes of the study area
- To map and quantify land use land cover dynamics over the last three decades
- To quantify the rate of soil erosion and investigate the impacts of land use land cover change on soil erosion risk for the study watershed
- To examine the implications of observed land use changes on sustainable land management

Bd j j f j e ; July 2019 to June 2021

S f jc rfi f) *; Melat E., Daniel B., Abebe B

S f fe c ; Melat Eshetu

Z f b g f ; January - December 2019

T b g i f h f ; The activity has been started to be implemented according to the proposal. Initial data collection has been started, GPS point at the outlet has been taken, DEM has been downloaded (30m*30m), Watershed has been re-delineated, Slope classification has been made and Land use image analysis is under way

Ef jh ; Modeling

U fb f ; No

M db j ; Adulala watershed

S f m

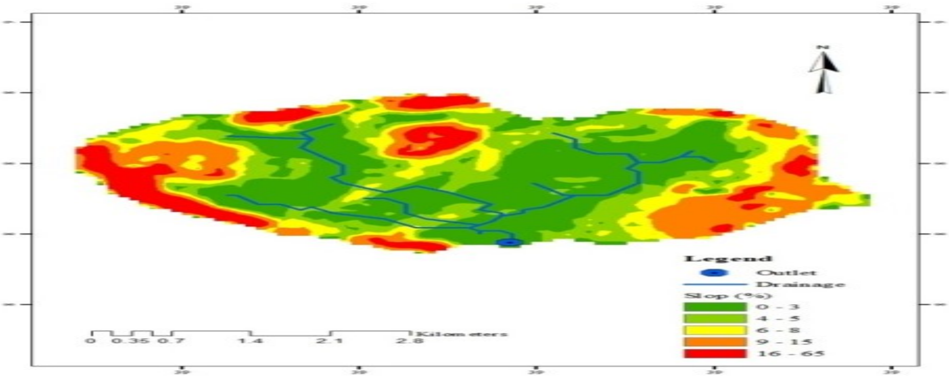


Figure 6. Map of the study area

rb g i f f fb ; The activity will continue in the next year

Bd j j 3; Impact of Soil and Water Conservation Practices on The Livelihood of Smallholder Farmers at Jogo-gudedo and Adulala watersheds Ethiopia.

P ckfd j f ;

- To assess the effect of soil and water conservation practices on crop yield and farm income.
- To investigate the socio-economic factors that influence farmers' soil and water conservation practice adoption decisions.
- To explore and describe farmers' perceived priority agricultural problems, preferred areas for development intervention, and which factors affect the preference for alternative types of intervention
- To assess major constraints faced by soil and water conservation practices implementers.

Bd j j f j e ; July 2019 to June 2021

S f jc rfi f) *; Abebe B., Yared, Melat E., Daniel B

S f fe c ; Melat Eshetu

Z f b g f ; January - December 2019

T b g i f h f ; Baseline survey was conducted in two kebeles' of the watershed in two focus group discussion.Basic data was collected from Adama and lume district Office of Agriculture and Natural Resources

Ef jh ; Survey

U fb f ; No

M db j ; Jogo Gudedo andAdulala watersheds

Sf m

As the participant of the discussion confirmed that SWC was started 1976 by food for work program.About 335 HH head was participated during the campaign and majority of the land is covered with SWC measures (farmlands and hillsides). Soil bund, fanyaa juu and micro basins were the major SWC structures constructed in the area. Structures were stabilized with biological measures (planting of trees such as acacia, cassia, eucalyptus, lucinea species).The SWC measures completely changed the landscape in to wood land as stated by the farmer who have been living in the watershed since then. The reason for its effectiveness was the government enforcement and the benefit from food for work. Farmers were benefited by harvesting wood and non wood tree products, grasses and tree planted serves as land ownership assurance.

However, after the program discontinued the conservation work was immediately stopped due to lack of support and miss understanding

rb g i f f fb ; The activity will continue in the next year

kfd 6; Pre-extension Demonstration of Integrated Watershed Management technologies (AGP II)

kfd f j e ; 2017 to 2019

Bd j j 2; Demonstration of gully rehabilitation techniques with locally available materials

Pckfd j f ;

- Enhance pre-extension demonstration and participatory on-farm SWC technology piloting
- Enhance capacity of farmers to use and adapt soil and water conservation technologies
- Develop module on SWC packages for scaling up technologies and sharing information on improved watershed management

Bd j j f j e; July 2017 to Dec 2019

Sf jc rfi f) *; Melat E., Abebe B., Daniel B

Sf fe c ; Melat Eshetu

Zfb g f ; January - December 2019

T b g i f h f ; The activity was conducted according to the plan/ The gully has been treated with wooden check dam and biological SWC measures has been supplemented.12 GPS points has been marked at the initial year (2017).Gully width and depth has been measured on those GPS points for the consecutive three years (2017 to 2019).Check dam maintenance has been made, tree seedlings and grass cuttings were raised in the centre nursery site and planted to stabilize the gully with biological materials/

Ef jh ; Demonstration

U fb f ; No

M db j ; Jogo gudedo watersheds

Sf m

As the result shows even though statically a non significant trend has been observed, gully bottom width showed an increasing trend, while gully depth has showed a decreasing trend. The gully depth showed a decreasing trend ranging from 37cm to 1.12 m. While gully bottom width has showed an increasing trend ranging from 50 cm to 1.2 m (which implies that the gully is filling or rehabilitating). P8 and P12 has showed a decreasing trend for gully bottom width (which might mean that a new gully has been formed on those points).

Similarly the above graph showed and increasing trend in gully bottom width and decreasing trend of gully depth has been observed for the past three years after treating the gully with locally available materials.

Table 5. Mann-Kendall (Z) and Sen's Slope (Q) trend result of gully width (a) and gully depth (b) at Jogo-gudedo watershed during 2010 to 2012

GPS points	Z	Q	P
P1	1	1.1	0.33
P2	1	0.55	0.33
P3	1	1.75	0.33
P4	1	0.5	0.33
P5	1	0.5	0.33
P6	1	1.05	0.33
P7	1	0.37	0.33
P8	-0.33	-0.4	1
P9	1	0.65	0.33
P10	1	0.67	0.33
P11	1	1.2	0.33
P12	-0.82	-0.77	0.5

GPS points	Z	Q	P
P1	-1	-0.54	0.33
P2	-1	-0.82	0.33
P3	-1	-1.12	0.33
P4	-1	-1.22	0.33
P5	-1	-1.07	0.33
P6	-1	-1.06	0.33
P7	-1	-0.97	0.33
P8	-1	-0.72	0.33
P9	-1	-0.72	0.33
P10	-1	-0.72	0.33
P11	-1	-0.87	0.33
P12	-1	-1.1	0.33

Figure 7. Gully bottom width and gully depth observation for the duration of (2017 to 2019) at Jogo gudedo watershed

rb g i f f fb ; The activity has been completed the full document will be provided as the completion of analysis and write-up and then based on the result we are going to expand the finding to the majority of the watershed.

Bd j j 3; Demonstration of Conservation agriculture practices in the watershed

P ckfd j f ;

- Enhance pre-extension demonstration and participatory on-farm SWC technology piloting
- Enhance capacity of farmers to use and adapt soil and water conservation technologies
- Develop module on SWC packages for scaling up technologies and sharing information on improved watershed management

Bd j j f j e ; July 2017 to Dec 2019

S f jc rfi f) *; Abebe B., Melat E., Daniel B

S f fe c ; Melat Eshetu

Zfb g f ; January - December 2019

T b g i f h f ; Five volunteer farmers were selected from the watershed to execute the experiment, hence by collecting the base line data the experiment was conducted on two crops (maize and faba bean) as per the schedule indicated on the proposal. There after the necessary data (crop yield and yield component, soil data) was collected and analysed.

Ef jh ; Ef b j

U fb f ;

- Convention tillage
- Conservation tillage

M db j ; Jogo gudedo watersheds

S f m

Table 15. Yield and yield component

Treatments	Yield Q/ha	Population	P height	Cob number
Convention	63.523b	49588	2.41	52475
CA	73.310a	55363	2.40	58113
LSD (0.05)	0.015*	0.17	0.43	0.28
CV	22.33	27.10	3.88	21.61

The result of analysis showed that conservation tillage is significantly higher than conventional tillage with an average value of 73.3 quintal per hectare for conservation tillage and 63.5 quintal per hectare for conventional tillage with highly significant at $p<0.05$. This might be due to reduced tillage which has great role in reducing soil and nutrient loss, maintenance of crop residue and rotation of legume with cereal crops.

rb g i f f fb ; The activity has been completed the full document will be provided as the completion of analysis and write-up and then based on the final result we are going to expand the finding to the whole watershed.

Table 2. Partial budget analysis for the influence of NPS Blend fertilizer on Melkassa 2 maize grain yield *

Treatments	GY (kg/ha)	AGY (kg/ha)	GB (Br.)	CIF	TVC (Br.)	MC	NB (Br.)	MB	MRR (%)
0 + 0	2208	1987	15895	0	0	0	15895	-	-
100 NPS + 150Urea	3493	3144	25152	3669	3669	3669	21484	5589	152.35
150 NPS + 150Urea	3695	3326	26605	4396	4396	727.4	22209	724.8	99.65
200 NPS + 150Urea	4203	3783	30263	5123	5123	727.4	25140	2931	402.93

* GY= grain yield; AGY= adjusted grain yield; Gross benefit, CIF= Cost of inorganic fertilizers; TVC= Total variable costs; MC=Marginal Cost; NB= Net benefit; MB=Marginal benefit; MRR= Marginal rate of return

Table 3. Partial budget analysis for the influence of NPS Blend fertilizer on MH-140 maize grain yield

Treatments	GY (kg/ha)	AGY (kg/ha)	GB (Br.)	CIF	TVC (Br.)	MC	NB (Br.)	MB	MRR (%)
0 + 0	1220	1097	8781	0	0	0	8781		
100 DAP + 50 Urea	2495	2245	17966	2193	2192	2192	15774	6992	318.88
100 NPS + 150Urea	4045	3640	29120	3668	3668	1475	25451	9678	655.71
150 NPS + 150Urea	4675	4207	33657	4396	4396	727	29261	3810	523.79
100 NPS + 200Urea	5135	4621	36969	4406	4406	10	32562	3301	31286.54

* GY= grain yield; AGY= adjusted grain yield; Gross benefit, CIF= Cost of inorganic fertilizers; TVC= Total variable costs; MC=Marginal Cost; NB= Net benefit; MB=Marginal benefit; MRR= Marginal rate of return

Bd j j 3; Response of Maize to Blended (NPSB) Fertilizers at Central Rift Valley of Ethiopia

The activity was executed at Dugda and AdemituluJidokombolchadistrict on farmer field during 2017-2019 cropping season. The experiment was laid down in split plot design with three replications. Melkassa 2 and MH-140 maize varieties were used as a test crop. NPSB was used as basal application and Urea as a source of N which is applied in spilt.

Analysis of variance of the data revealed that maize yield was significantly influenced by NPSB + Urea fertilizers (Table 4). The highest mean grain yield of MH-140 was obtained from fertilizers applied at the rates of 100 kg NPSB + 150 kg Urea/ha with an increment of 48.6 % yield advantage over the previous recommended NP fertilizer. Similarly, the grain yield of Melkassa 2 at 100 NPSB + 150Urea /ha exceeded the yield obtained at previous recommendation of NP fertilizers by about 38.7%. At all other combined levels which are full filled the minimum acceptable marginal rate of return for both blends could be recommended as alternative rate for users.

Table 4. Grain yield (kg/ha) response of Melkassa2 and MH-140 maize varieties to NPSB blend fertilizer

U fb f	**N fmhb b.3**	**N I .251**
0 NPSB + 0 Urea	2694.1	4692.6
100 NPSB + 150 Urea	**5736/6**	6272.1
150 NPSB + 150 Urea	4013.5	6520.5
200 NPSB + 150 Urea	4885.0	6346.1
250 NPSB + 150 Urea	4939.2	6607.8
100 NPSB + 200 Urea	4581.2	6080.0
150 NPSB + 200 Urea	4859.9	6570.0
200 NPSB + 200 Urea	4969.9	6687.0
250 NPSB + 200 Urea	5114.0	6702.0
100 NPSB + 250 Urea	4376.4	6382.9
150 NPSB + 250 Urea	5020.9	6915.6
200 NPSB + 250 Urea	**6534/2**	6705.7
250 NPSB + 250 Urea	4494.8	6768.8
100 DAP + 50 Urea	3334.6	4220.4
LSD	1096.9	1045.7
CV%	21.04	14.51

Table 5. Partial budget analysis for the influence of NPSB Blend fertilizer on MH-140 maize grain yield

Treatments	PY (kg/ha)	APY (kg/ha)	GB (Br.)	CIF	TC (Br.)	MC	NB (Br.)	MB	MRR (%)
0 + 0	4693	4223	33787	0	0	0	33787		
100 NPSB +150 Urea	6272	5645	45159	3669	3669	3669	41490	7704	209.99
150 NPSB + 150 Urea	6521	5868	46948	4396	4396	727.4	42552	1061	145.87
150 NPSB + 250 Urea	6916	6224	49792	5872	5872	1476	43920	1369	92.74

* GY= grain yield; AGY= adjusted grain yield; Gross benefit, CIF= Cost of inorganic fertilizers; TVC= Total variable costs; MC=Marginal Cost; NB= Net benefit; MB=Marginal benefit; MRR= Marginal rate of return

Table 6. Partial budget analysis for the influence of NPSB Blend fertilizer on Melkassa 2 maize grain yield

Treatments	PY (kg/ha)	APY (kg/ha)	GB (Br.)	CIF	TVC (Br.)	MC	NB (Br.)	MB	MRR (%)
0	2694	2425	19398	0	0	0	19398		
100 DAP + 50 Urea	3335	3001	24009	2193	2193	2193	21816	2419	110.31
100 NPSB + 150 Urea	4626	4163	33304	3669	3669	1476	29635	7819	529.75
200 NPSB +150Urea	4885	4397	35172	5123	5123	1455	30049	413.6	28.43
150NPSB + 250Urea	5021	4519	36150	5872	5872	748.5	30279	230	30.73
200NPSB + 250Urea	5423	4881	39046	6599	6599	727.4	32447	2168	298.11

* GY= grain yield; AGY= adjusted grain yield; Gross benefit, CIF= Cost of inorganic fertilizers; TVC= Total variable costs; MC=Marginal Cost; NB= Net benefit; MB=Marginal benefit; MRR= Marginal rate of return

Bd j j 4; Effect of Phosphorus fertilizer on yield and yield component of Haricot bean varieties across soil and agro-ecologies

P ckfd j f ;

- To determine optimum rates of phosphorous fertilizers for different varieties of Pulses (Faba bean, lentil, haricot bean and soybean)
- To assess economic feasibility of P fertilizer for pulses (Faba bean, lentil, haricot bean and soybean)

Bd j j f j e; July 2017 – June 2019
S f jcrfi f ; Getinet A, Isreal B, Dejene A, Mesfin Hand Kiya A.,
S f fe c ; Getinet A
Zfb g f ; January - December 2019.
T b gS f fb di h f : Completed
Ef jh ; RCBD in factorial combination of three common bean varieties and p fertilizer rates
U fb f ; 15 Fertilizer combinations
M db j ; Bofa, ShallaandAdamitulugidokomibolch

S f m

The activity was executed at Bofa,Shalla and Ademigiddukobolch district on farmer field during 2017-2019 main cropping season. The experiment was laid down out in RCBD design and factorial combination. The three verity is used (SER119, Awash-2,andDume) as test crops. The source of P is TSP fertilizer.

Over years pooled mean data analysis revealed that application of different levels of P fertilizer significantly influenced bean grain yield ($p<0.05$) only at Shala (Table 6), while no significant effect was observed for the case of A/Tulu and Bofa sites. At Shala, maximum bean yield was recorded from P application at the rate of 40 kg P /ha that was not found to be significantly different from all other P levels except control. Generally, the study on

Table 7. Main effects of P on common bean grain yield across location and over years Shala during 2017-2019

Treatments	Sites			
Adamitulu	A/Tulu	Bofa	Shalla	Mean
Var	Bean Yield)kg/ha)			
Dume	3012.70	2695.90	1696.50	2465.40
SER-119	2974.10	3049.50	2087.10	2703.60
Awash-2	2477.30	2545.40	1747.70	2256.80
LSD (005)	224.59	275.16	198.12	178.80
P rate (kg/ha)				
0	2767.10	2507.70	1552.10	2275.60
10	2899.70	2806.40	1928.10	2544.80
20	2622.80	2844.90	1756.50	2408.00
30	2878.80	2810.60	1976.70	2555.40
40	2938.06	2848.50	2065.40	2597.50
CV (%)	19.0.6	23.84	25.78	30.12
LSD (005)	NS	NS	255.80	230.80
Var * P	NS			

Table 8. Economics analysis

P rate (kg/ha)	Total cost (ETB)	Marginal cost	Net benefit (ETB)	Marginal benefit	MRR (%)
0	0	0	24576.50	-	
10	789.25	789.25	26694.60	2118.11	268.37
20	1578.5	789.25	24427.90**E**	-2266.70	-
30	2367.75	789.25	25230.60**E**	802.67	-
40	3157.00	789.25	24896.00**E**	-334.57	-

Bd j j 5; Determination of different level of NP fertilizers rate for Green pepper across soil and agro-ecologies

P ckfd j f ;

- To determine optimum rates of Nitrogen and Phosphorous fertilizers for green pepper under balanced fertilizer
- To assess economic feasibility of N and P fertilizer rate for green pepper vegetable crop

Bd j j f j e; July 2017 - June 2019

S f jcmfi f ; Israel Bekele, Getinet Adugna, Agere Lupi, Dejene Abera, Kiya Aboye, Mesfin Hundessa and Jibril Mohammed

S f fe c ; Israel Bekele

Zfb g f ; January - December 2019

T b g i f h f ; The activity will be conducted for one more cropping season.

Ef jh ; RCBD

U fb f ; 16 treatments with two varieties of green pepper

M db j ; MARC and Dugda

S f mb e Ej d j

Pod yield of green pepper were significantly influenced by main plot factors (varieties) in both locations, However, no significant yield differences were observed between sub plot factors (different NP rates) in the production of green peppers as compared to the control at p<0.05 level in both locations M. Shotte gave significantly highest yield at Dugda as compared to others varieties. At Melkassa M. Awaze gave the higher pod yield as compared to M. Shotte.

rb g i f f fb ; Validation trials will be conducted with rewarding treatments.

Bd j j 6/ Response of wheat to different levels of NPS Fertilizer in the Central Rift Valley of Ethiopia

P ckfd j f ;

- To determine optimum blended fertilizer rate for wheat in different soil type and agro ecologies

- To assess economic feasibility of NPS blend fertilizer rate for wheat production

Bd j j f j e; May 2019 - Dec 2021

S f jc rfi f ;MesfinHundessa, GetinetAdugna, Israel Bekele, DejeneAbera, KiyaAboye and Genet Mulugeta

S f fe c : Mesfin Hundessa

Zf b g f ; January - December 2019

T b g i f h f

The activity was implemented on three farmersfields but one of them harvested the crop before agronomic data collected.

Ef jh ; RCBD

U f b f ; 14 varities and NPS level

M db j ; Dugda on three farmer's field

S f m

The activity was implemented on three farmers but one of them harvested the crop before agronomic data collected.

rb g i f f f b ; the activity will be conducted for one more season.

kfd 3; BH JJG e f e

Bd j j 7/ Validation and demonstration of mineral fertilizer and organic fertilizer for maize (AGP)

P ckfd j f ;

- To validate and demonstrate use of mineral and organic fertilizers for maize crop production and soil physicochemical properties

Bd j j f j e; July 2018 – June 2019

S f jc rfi f ; Israel B., Agere L., Getinet A., Dejene A., Mesfin H. and Genet

S f fe c ;Israel Bekele

Zf b g f ; January - December 2019

Ef jh ; RCBD

U f b f ;3 mineral and organic fertilizer

M db j ; Negelle Arsi

S f m b e ej d j

The analysis of variance across farmers' field revealed that, a significant yield advantage between the Farmers practice and the recommended NPS fertilizer at $p < 0.05$ level. There was no statistical yield difference between the integrated fertilized plot (4.6Mt of compost with 23kg Nha-1) and the recommended NPS fertilizer at N. Arsi. However, the recommended NPS plots have about 4.5% yield advantage over the farmers practice.

Table 9. Effects of compost and inorganic fertilizers on grain yields of maize

Treatment (n=8)	AGY
Comp(4.6Mt)+N (23kgha^{-1})+20kg P ha^{-1}	4532.4^{ab}
121 kg NPS ha^{-1}	4737.7^{a}
FP (32.5N8.3P3.5S)	4094.7^{b}
LSD$_{(<0.05)}$	506
C CV(%)	9 .75

rb g i f f f b ; the activity will be conducted for one more season.

Bd j j 8/ Response of Tomato to phosphorus fertilizer under balanced condition in different soil types and Agro ecologies of Ethiopia

Pckfdj f ;

- To determine the response of tomato to different levels of phosphorus fertilizer rate under balanced fertilizer
- To determine optimum P response curve under balanced fertilizer

Bdj j f j e: Jan 2019 - June. 2020
S f jcjmjjf ; Mesfin H., Dejene A., Israel B., Kiya A., Getinet A., Zeyede A.
S f fe c ; Mesfin Hundessa
Zfb g f ; January - December 2019
T b gSf fb di h f :
The study sites were selected and land preparation was done.Nursery preparation is underway; seedling will be raised in the 3rd week of January 2020 and then will be transplanted to the selected sites in February 2020.
Ef jh ; RCBD
U fb f ; 9 level of nitrogen
M db j ; MARC (Wonji and Dugda)

S f m ; The activity is to be planted in 2020 (off season)
rb g if f fb ; Land preparation is donefor planting

Bdj j 9/ Response of Tomato to nitrogen fertilizer under balanced condition in different soil types and Agro ecologies of Ethiopia
Pckfdj f ;

- To determine the response of tomato to different levels of nitrogen fertilizer rate under balanced fertilizer
- To determine optimum N response curve under balanced fertilizer

Bdj j f j e: January 2019 - June 2020
S f jcjmjjf ; DejeneA,Mesfin H, Israel B, Kiya A, Getinet A, Zeyede A.
S f fe c ; MesfinHundessa
Zfb g f ; January - December 2019
T b gSf fb di h f :
The study sites were selected and land preparation was done. Nursery preparation is underway; seedling will be raised in the 3rd week of January 2020 and then will be transplanted to the selected sites in February 2020.
Ef jh ; RCBD
U fb f ; 9 nitrogen fertilizer
M db j ; MARC (Wonji and Dugda)

S f m ; The activity is to be planted in 2020 (offseason)
rb g if f fb ; Land preparation is donefor planting

Bdj j :/ Response of Onion to nitrogen fertilizer under balanced condition in different soil types and Agro ecologies of Ethiopia
Pckfdj f ;

- To determine the response of onion to different levels of nitrogen fertilizer rate under balanced fertilizer
- To determine optimum N response curve under balanced fertilizer

Bdj j f j e: Jan 2019 - June 2020
S f jcjmjjf ; Dejene A., Israel B., Mesfin H., Getinet A., Kiya A. and Zeyede A.
S f fe c ; Dejene Abera (PhD)
Zfb g f ; January - December 2019
T b gSf fb di h f :
Onion (Nasik red variety) seedling was raised in Sept/ 2011 E.C; transplanted on first week of December 2012 at Wonji, and Dugda.

Ef jh ; RCBD
U fb f ; 9 nitrogen fertilizer
M db j ; MARC (Wonji, Dugda),
S f m ; The activity is yet underway in the field/
rb g i f f fb ; After harvesting, data will be analyzed to show the response curve that will guide us to decide important rates N for further interaction evaluation with selected P rates.

Bd j j 21/ Response of Onion to phosphorus fertilizer under balanced condition in different soil types and Agro ecologies of Ethiopia
P ckfd j f ;

- To determine the response of onion to different levels of phosphorus fertilizer rate under balanced fertilizer
- To determine optimum P response curve under balanced fertilizer

Bd j j f j e: July 2019 - June 2020
S f jc jrjn jf ; Dejene A., Israel B., Mesfin H., Getinet A., Kiya A. and Zeyede A.
S f fe c ; Dejene Abera (PhD)
Zfb g f ; January - December 2019
T b gS f fb di h f :
Onion (Nasik red variety) seedling was raised in SEPT/ 2019; transplanted on first week of December 2020 at Merti, Wonji, and Dugda.
Ef jh ; RCBD
U fb f ; 9 level of nitrogen
M db j ; Merti, Wonji, Dugda

S f m ; the activity is yet underway in the field.
rb g i f f fb ; After harvesting, data will be analyzed to show the response curve that will guide us to decide important rates P for further interaction evaluation with selected N rates.

Bd j j 22/ Phosphorus sorption and desorption dynamics under different P levels in alkaline, saline and sodic soils of the Central Rift Valley, Ethiopia
P ckfd j f

- To study the influence of P fertilizer levels on P sorption, desorption capacity and P availability in alkaline soils of central raft vale area
- To determine the relationship between the physic-chemical properties of saline and sodic soils and P sorption and desorption capacity in the study area

Bd j j f j e; July 2019 - June 2020
S f jc rfi f ; Israel B., Dejene A., Getinet A.,Kiya A., Genet M. and Zeyede
S f fe c ; Israel Bekele
Zfb g f ; January - December 2019
T b g h f ; Soil samples collection from salt affected areas is underway. Pot experiments will be started just after the soil analysis for pH, ECe and AP will be completed.
Ef jh ; CRD
U fb f ; 5 levels of Pfertilizer
M db j ; Dugda and Adamitulu Jidokombolcha

S f m ; chemical analysis of collected samples is underway.
rb g i f f fb ; pot experiment will be conducted after the soil analysis

kfd 3/ Development of Organic Fertilizer Technologies
Bd j j 23/ Adaptation and evaluation of vermin worms with locally available

feedstock for quality composting and rapid decomposition of organic wastes

Pckfd j f; To evaluate the adaptability of available vermicultures for rapid decomposition and quality vermin composting using the local available feed sources

Bd j j f j e; July 2019 - June 2020

S f jc rfi f ; Dejene A., Mefine H., Kiya A., Israel B., Getinet A. and Genet

S f fe c ; Dejene Abera

Zf b g f ; January - December 2019

T b g h f ; Earthworms obtained from W. Genet ARC, Haramaya University & Dz ARC are under multiplication. The multiplication of one of the local earth worm obtained from Dz ARC started with limited number and took us more tim to get the required number. Now we have enough earthworms to start the actual experiment.

Ef jh ; CRD

U fb f ; Six (Two earthworms factorial combined with three feed compositions).

M db j ; MARC

S f m ;Vermiculture/ vermicomposting production facilities is improved.

rb g i f f fb ; The performance of vermin worms on different feeding materials will be evaluated this off season.

Bd j j 24/ Evaluation of integrated use of organic and inorganic fertilizers for maize and soil physicochemical properties improvement in CRV of Ethiopia

Pckfd j f

- To evaluate the combined use of bio-slurry compost or vermicompost as organic fertilizer with inorganic fertilizers on yield of maize crop and selected soil physicochemical properties in the CRV of Ethiopia

Bd j j f j e: July 2019 - June 2022

S f jc jmjn jf ; Dejene A., Getinet A., Kiya A., Mesfin H., Isreal B.

S f fe c : Dejene Abera (PhD)

Zf b g f ; January - December 2019

T b gS f fb di h f ; The experiment was conducted at the three sites; and data collection is completed. Data entry to computer is underway

Ef jh ; RCBD

U fb f ; 10 treatments

M db j ; MARC (On station, 2 onfarm at Dugda)

S f m ; the activity is conducted in 2019/2020 cropping season and data analysis is under way.

rb g i f f fb ; the activity will be conducted for two more seasons.

kfd 4/ New Fertilizer product testing

Bd j j 4/2; Evaluation of Tradecorp Zn Fertilizer Products on Tomato under Irrigation in East Zone of Oromia

Pckfd j f ;

- to evaluate the efficacy of Tradecorp AZ Bentley plus as a supplementary fertilizer to improve yield of tomato under irrigation in different areas in east Shoa Zone of Oromia, Ethiopia.

Bd j j f j e; 2017 - 2019

S f jc rfi f ; Getinet A., Dejene A., Mesfin H., Isreal B. and Kiya A., Gelmesa G.

S f fe c ; Getinet A

Zf b g f ; January - December 2019

T b g f fb di h f ; Completed

Ef jh ; RCBD

U fb f ; 5 treatments

M db j ; Dugda, Melkassa and Koka

S f m

The data given in Table 1 indicated that new product and its doses in combination with NPS fertilizer had significant effect on marketable and total yield of tomato in the three locations when analyzed separately over years. Among various treatments, application of the new product at 3kg/ha in combination with recommended NPS (T3) produced maximum marketable (52.42 ton/ha) and total yield (66.25 ton/ha) while the control (T1) no use of input produced 42.95 marketable yield and total yield 54.61 ton/ha for Melkassa site (Table 7). Similarly, maximum marketable yield (59.19, 74.12 ton/ha) and total yield (75.02, 82.36 ton/ha) was recorded when recommended NPS nutrient combined with 1.8 kg/ha of the new product and the minimum marketable (42.11, 40.18 ton/ha) and total yield (54.96, 45.27 ton/ ha) were recorded from Koka and Dugda sites in control treatment, respectively. The yield improvement can attributable to application of Tradecorp AZ Bentley plus fertilizer. Gitte et al. (2005) observed that the combined application of Zn and B exhibited yield increases over unfertilized controls.

On average higher marketable tomato yield was recorded from Dugda site (63.43 ton/ha) followed by Koka site (53.52 ton/ha) and the minimum from Melkassa site (47.59 ton/ha) when analyzed for two years. The most probable reason why the two sites gave low response to the applied fertilizer is due to high fertilizer application for a long time for research and intensive vegetable production for Melkassa and Koka, respectively. When compared the marketable yield from control the increment of marketable yield were 13.52% (10.39-22.05%), 34.76% (30.09-40.56%) and 72.34% (57.82-82.03 %) for Melkassa, Koka and Dugda, respectively, over control and NPS + new product applied treatments (Table 7). Generally, ihe result obtained from the three locations over two years indicated that application of Tradecorp AZ Bentley plus fertilizer as supplemented to recommended mineral fertilizers improved tomato yields by 15.9 % (11.3 ton) and 4.8 % (3.0 ton) compared to recommended NPS fertilizers applied alone at Melakassa and Dugda sites, respectively. The partial budget analysis result also showed higher net benefit and MRR due to application of Tradecorp AZ Bentley plus as supplementary fertilizer in combination with the recommended NPS from mineral fertilizer at Melkassa and Dugda. Hence, the product can be suggested for tomato producing farmers in Melkassa and Dugda area

Table 1. Means of Marketable yield, unmarketable and total yield of Tomato as affected by treatment application over years at each location separately

Melkassa site	Mark yield (t/ha)	Unmarketable yield (t/ha)	Total yield (t/ha)
Factors			
Year			
2017/18	46.68a	19.45a	66.12a
2018/19	48.52a	8.93b	57.45b
LSD	NS	2.05	4.42
Treatments			
Control (no input)	42.95b	11.66b	54.61b
Recommended fertilizer (128kg N, 40 kg P, 17 kg S/ha)	47.41ab	15.82a	63.23a
Recommended fertilizer + 1.8 kg of the product	47.23ab	15.24a	62.47a
Recommended fertilizer + 3 kg of the product	52.42a	13.82ab	66.25a
Recommended fertilizer + 4.2 kg of the product	47.97ab	14.39ab	62.37a
LSD	5.93	3.24	6.98
Mean	47.59	14.19	61.79
CV	12.5	22.26	11.02
Koka site			
Year			
2017/18	83.53a	16.4a	40.54b
2018/19	24.11b	15.56a	99.08a
LSD	2.39	NS	3.48
Treatments			

Control (no input)	42.11^{c}	12.85^{b}	54.96^{b}
Recommended fertilizer (128kg N, 40 kg P, 17 kg S/ha)	57.86^{ab}	16.87^{ab}	74.73^{a}
Recommended fertilizer + 1.8 kg of the product	59.19^{a}	15.83^{ab}	75.02^{a}
Recommended fertilizer + 3 kg of the product	54.78^{b}	16.87^{ab}	71.65^{a}
Recommended fertilizer + 4.2 kg of the product	55.16^{b}	17.56^{a}	72.72^{a}
LSD	3.77	4.52	5.51
Mean	53.52	15.99	69.81
CV	6.84	27.52	7.68
Dugda			
Year			
2017/18	68.84^{a}	10.53^{a}	79.37^{a}
2018/19	58.02^{b}	3.92^{b}	61.94^{b}
LSD	4.56	1.35	5.02
Treatments			
Control (no input)	40.18^{d}	5.09b	45.27^{d}
Recommended fertilizer (128kg N, 40 kg P, 17 kg S/ha)	63.41^{c}	7.63a	71.05^{c}
Recommended fertilizer + 1.8 kg of the product	74.12^{a}	8.25a	82.36^{a}
Recommended fertilizer + 3 kg of the product	66.31^{bc}	7.79a	73.66^{bc}
Recommended fertilizer + 4.2 kg of the product	73.14^{ab}	7.35a	80.94^{ab}
LSD	7.21	2.14	7.93
Mean	63.43	28.86	70.65
CV	11.07	7.22	10.95

Bd j j 4/3/ Evaluation of Bio Gold, a microbial product, on French Bean yield improvements under Irrigation in East Shoa Zones of Oromia, Ethiopia.

P ckfd j f;

- to determine the effect of Bio-Gold RTU on growth and yield of French bean, determine effects of Bio-Gold RTU on shelf life of French beans (post-harvest), determine residual effects of Bio-Gold RTU on yield of subsequent French beans.

Bd j j f j e; 2018 - 2019

S f jc rfi f ; Getinet A., Dejene A., Mesfin H., Isreal B. and Kiya A., Gelmesa G.

S f fe c ; Getinet A

Zfb g f ; January - December 2019

T b g f fb di h f ; Completed

Ef jh ; RCBD

U fb f ; 7 fertilizer treatments

M db j ; Dugda, Melkassa, Fentale and Koka

S f m

As shown on table 1, pod yield was significantly affected by application of different treatments. The highest pod yield of French bean (14.6 t/ha) was obtained with the application of recommended inorganic fertilizer (142 kg^{-1} NPS at planting + 79 kg^{-1} urea 30 days after planting), followed by the supplementation of recommended fertilizer rate with full rate of the recommended BioGold (14.4 t/ha) and full recommended BioGold + half of the recommended inorganic fertilizer (14.1 t/ha). However, all these treatments were statistically at par with the unfertilized control plants, implying that the improvement on pod yield of French bean due to different treatments was marginal. On the other hand, the least pod yield (11.4 t/ha) was obtained from plants that received double of the recommended BioGold microbial product. The improvement in pod yield of French bean due to the application of recommended inorganic fertilizer was 13.8% compared to the unfertilized control and that of the combined use of full rate of Biogold and half of the inorganic fertilizer was 10.3%.

Generally, the study on French bean showed only marginal differences in pod yield among different bio-gold treatments during the first season of its application. However, the residual effect was able to depict pod yield differences. Besides, sole biogold application or its combined application with the recommended inorganic fertilizer improved the shelf life of French bean pods under cold storage conditions. The profitability of using biogold to produce French bean production was ranked second to full recommended inorganic fertilizer application. In addition, application of full rate of biogold in combination with half of the recommended inorganic fertilizer increased in yield advantage of about 1.3 ton over control. Based on agronomic response and partial budget analysis, application of full rate of biogold in combination with half of the recommended inorganic fertilizer can be suggested as a supplemental fertilizer for production of French bean in the study areas.

Table 1. Effect of different treatments on pod yield of French bean (pooled over locations)

U fb f	**e jfm)l h0i b***
Recommended inorganic fertilizer	14551A
Recommended inorganic fertilizer + recommended rate of Biogold	14388A
Rec. Biogold + ½ recommended chemical fertilizer	14103A
Unfertilized control	12790AB
Recommended rate of Biogold	11705B
½ Recommended rate of Biogold	11500B
Double Rec. Biogold	11352B

Bd j j 4/4/ Evaluation of potassium humate fertilizer on onion in East Shoa Zone of Oromia, Ethiopia

P ckfd j f:

- To evaluate the effect of Potassium Humate application on onion yield and yield component

Bd j j f j e : 2019 to 2020

S f jc rfi f ; Getinet A., Dejene A., Mesfin H., Isreal B. and Kiya A., Gelmesa G.

S f fe c ; Getinet A

Zfb g f ; January - December 2019

T b g f fb di h f ; Completed

Ef jh ; RCBD

U fb f ; 5 potassium fertilizer

M db j ; Dugda, Melkassa, Koka and Wonji

S f m

The experiment has carried out in 2019 and 2020 off- cropping season on onion at four locations. Currently, the field trials were completed and data filling in to the computer and compiling are underway.

rb g i f f fb ; Write full result and submit the result and the advice for future use as required

Bd j j 4/5/ Evaluation of `Fertiplus 4-3-3` Organic Fertilizer on Yield of Tomato under Irrigation in Ethiopia

P ckfd j f;

- To evaluate the effect of Fertiplus 4-3-3` as a supplementary fertilizer on the yield of tomato crops under irrigated conditions in CRV of Ethiopia.

Bd j j f j e : June, 2018 to May 2020

S f jc rfi f ;Getinet A, Dejene A, Israel B, Mesfin H, Kiya A and Gelmessa G

S f fe C : Getinet A

Zfb g f ; January - December 2019

T b g f fb di h f ; Completed

Ef jh ; RCBD
U fb f ; 10 organic fertilizer
M db j ;Melkassa, Dugda and Fentale

S f m

The experiment has carried out in 2019 and 2019 off- cropping season on tomato at three locations. Currently, the trials were completed and data filling in to the computer and compiling are underway.

rb g i f f fb ;Write full result and submit the result and the advice for future use as required

kfd 2; Ef f j b j gJ jhb j S fhj f g N bk D

S f fe c ; Ketema Tezera
Zfb g f ; January - December 2019
T b g i f h f ;

- The trial for Banana and Papaya is being conducted at Melkassa under drip irrigation.
- first year trial damaged by the extreme cold during 2017
- Second year trial conducted with problem including pump failure and irregular irrigation treatment application: Emitter clogging, instruction not followed properly followed for purification
- On the third year papaya population reduced due to dieback andterminated.
- The data for banana presented in Table below.

M db j : Melkassa
Ef jh ; The experimental design is RCBD with three replications.
U fb f ; The experiment has 5 treatments

Table 2: Treatments and treatment combinations

Treatment	Description
MAD1	60% ASMDL
MAD2	80% ASMDL
MAD3	ASMDL*
MAD4	120% ASMDL
MAD5	140% ASMDL

Table 3: Marketable and total yield of banana under optimal irrigation treatments

Treatments	Marketable		Unmarketable		Total		Mark yield in t/ha	Total yield in t/ha
	Fruit No.	wt. (Kg)	Fruit No.	wt. (Kg)	Fruit No.	wt.(Kg)		
60% ASMD	144	27.65a	114	9.89	257	37.54a	44.23a	60.07a
80% ASMD	170	29.12a	102	10.63	272	39.75a	46.60a	63.59a
100% ASMD	141	22.31b	149	13.26	290	35.57ab	35.70b	56.90ab
120% ASMD	132	20.61b	114	9.94	246	30.54bc	32.93b	48.87bc
140% ASMD	125	17.75c	101	7.71	226	25.47c	28.40c	40.75c
CV	27.99	10.15	27.91	23.40	21.26	10.98	10.15	10.98
LSD 0.05	NS	4.49	NS	NS	NS	6.98	7.18	11.18

The statistical analysis shows that shorter irrigation intervals perform marketable yields than wider intervals as summarized and presented in Table 3.

Figure 2. Banana and Papaya ASMD trial at field condition during the cool season, 2017

rb g i f f fb ; Hence, these trials started with problem and continued with imperfection considered for re- initiation with better arrangement for irrigation water distribution.

kfd 3; Improving water productivities of major crops

kfd E b j ; July 2017 to June 2020

Bd j j 2; Maize response to soil moisture stress condition at different crop growth Stages

P ckfd j f;

to identify crop growth stages sensitive to soil moisture stress

to determine productivity of water

E b j ; 2017 - 2020

f S f jc rfi; Tilahun H., Gobena D., Tatek W., Ketema T., Aynalem G. & Tigist

S f fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b g i f h f ;

The first year activity has been commenced and it is at field condition. Data collection and all other management practices are underway.

Ef jh ; The experimental design is RCBD with three replications.

U fb f ; The experiment has 15 treatments

M db j ; Melkassa

S f m

Table 4: Treatment combination of soil moisture stress at different growth stages

Treatments	Growth stages			
	Initial	Development	Midseason	Maturity
T1 (control)	1	1	1	1
T2	0	1	1	1
T3	1	0	1	1
T4	1	1	0	1
T5	1	1	1	0
T6	0	0	1	1
T7	0	1	0	1
T8	0	1	1	0
T9	1	0	0	1
T10	1	0	1	0
T11	1	1	0	0
T12	0	0	0	1
T13	0	0	1	0
T14	0	1	0	0
T15	1	0	0	0

Remark: 1 means irrigated and 0 means not irrigated during the crop growth stages

Table 5: Maize yield and water productivity undersoil moisture stress at different growth stages.

Treatments	2019-trial			
	GY(t/ha)	WP (Kg/m)	Irrigation applied (mm)	Eff. rain(mm)
IDMdMt	6.60a	1.01ef	483	169
DMdMt	5.76abcd	0.94c	445	169
IMdMt	6.23ab	1.16abcde	367	169
IDMt	5.63abcd	1.46abc	219	169
IDMd	6.33ab	1.08bcde	418	169
MdMt	3.63fgh	0.72e	330	169
DMt	5.07bcde	1.45abcd	182	169
DMd	5.93abc	1.08bcde	381	169
IMt	3.4h	1.25abcd	103	169
IMd	4.77cdef	1.01bcde	302	169
ID	4.77cdef	1.47ab	154	169
Mt	2.53hi	1.08bcde	66	169
Md	4.00efg	0.93de	265	169
D	4.6defg	1.62a	117	169
I	2.30i	1.11abcde	38	169
Cv	16.53	27.20	-	-
LSD(0.05)	1.32	0.53		

The maximum yield of 6.6 t/ha and water productivity of 1.62 obtained from T1 that fully irrigated and T14 that irrigated only at development stage, respectively.

rb g i f f fb ; The activity will be conducted for the next one year.

Bd j j 3; Response of major crops to deficit irrigation (Banana and Papaya)

P ckfd j f;

- to identify the level optimal deficit irrigation level
- to identify WUE under deficit irrigation

E b j ; 2016 - 2020

f S f jc rfi; Tilahun H., Gobena D., Tatek W., Ketema T., Aynalem G., Tigist W. & Girma K.

S f fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b gS f fb di h f ;

The same as optimal irrigation trial

Hence, these trials started with problem and continued with imperfection and considered for re- initiation. Thus there was no complete result obtained.

Ef jh ; The experimental design is RCBD with three replications.

U fb f ; The experiment has 6 treatments

M db j ; MARC

S f m

Table 6: Treatments and treatment combinations

Treatments	Treatment combinations
T1	Irrigation at 100% Etc
T2	Irrigation at 90% Etc
T3	Irrigation at 80% Etc
T4	Irrigation at 70% Etc
T5	Irrigation at 60% Etc
T6	Irrigation at 50% Etc

rb g i f f fb ; Hence, these trials started with problem and continued with imperfection considered for re- initiation with better arrangement for irrigation water distribution.

Bd j j 4; Effect of deficit irrigation levels at different growth stages on Onion yield and water productivity

P ckfd j f;

- to investigate the effect of water stress on yield and water productivity
- to identify the most sensitive growth stage to deficit irrigation

E b j ; 2017 - 2020

f S f jc rfi; Tilahun H., Gobena D., Ketema T., Tatek W., Tigist W. and Aynalem G.

S f fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b g i f h f ; This year the second year trial was conducted successfully; necessary data collection was made and presented in Table 8.

Ef jh ; The experimental design is RCBD – split block design with three replications.

U fb f ; The experiment has 16 treatments

M db j ; MARC

S f bm

Table 7: Treatments and treatment combinations

U fb f	D cj bj
Initial stage	Irrigated at 100% Etc
	Irrigated at 85% Etc
	Irrigated at 70% Etc
	Irrigated at 55% Etc
Development stage	Irrigated at 100% Etc
	Irrigated at 85% Etc
	Irrigated at 70% Etc
	Irrigated at 55% Etc
Mid stage	Irrigated at 100% Etc
	Irrigated at 85% Etc
	Irrigated at 70% Etc
	Irrigated at 55% Etc
Late stage	Irrigated at 100% Etc
	Irrigated at 85% Etc
	Irrigated at 70% Etc
	Irrigated at 55% Etc

Table 8: Onion yield and water productivity

Treatments	2018/19 trial	
	Yield (t/ha)	WP(Kg/m3)
Initial stage	38.70a	6.34
Dev’t stage	34.65b	6.20
Mid stage	33.89b	6.24
Late stage	38.89a	6.65
Cv	9.50	9.41
LSD 0.05	3.47	NS
55% Etc	34.17c	6.40
70% Etc	35.97b	6.46
85% Etc	37.11a	6.41
100% Etc	38.87a	6.46
Cv	4.14	4.00
LSD 0.05	1.27	NS

Result showed that holding irrigation water at initial and late stage is not significantly affect onion yield and it also implies holding 15% ETc not significantly affect onion yield Table 8.

rb g i f f fb ; The activity will be conducted for the next one year.

Bd j j 5: Effect of supplemental irrigation at different irrigation levels for rain fed agriculture (Maize)

P ckfd j f ;

- to evaluate the improvement on crop yield and water productivity (WP)
- to maximize crop productivity of rain-fed agriculture

E b j ; 2017 - 2020

f S f jc rfi; Tilahun H., KetemaT., Aynalem G., Tigist W. and Abera T.

S f fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b g i f h f ; This activity was being conducted in the main season at Melkassa.Due to enough rainfall no supplementary irrigation applied during the season.

Ef jh ; The experimental design is RCBD with three replications.

U fb f ; The experiment has 6 treatments

M db j ; MARC

S f m

Table 9: Treatments and treatment combinations

Treatments	Supplemental irrigation levels
T1	No SI
T2	SI of 100 % Etc
T3	SI of % 80 Etc
T4	SI of 60 % Etc
T5	SI of 40 % Etc
T6	SI of 20 % Etc

Remark: *SI is supplementary irrigation

rb g i f f f b ; The activity needs extension to be conducted for the next one year.

Bd j j 6; Response of crops to Supplementary Irrigation (Haricot bean)

P ckfd j f; to evaluate the influence of supplemental irrigation applied at different growth stages on the yield and water productivity of the crop

E b j ; 2015 - 2020

f S f jc rfi; Tilahun H., Gobena D. and Tatek W.

S f fe c ; Ketema Tezera

Zf b g f ; January - December 2019

T b g i f h f ; This activity was being conducted in the main season at Melkassa.Due to enough rainfall no supplementary irrigation applied during the season.

Ef jh ; The experimental design is RCBD consisting of seven levels of irrigation treatment and a control treatment (Rainfed agriculture) with three replications.

U fb f ; Treatments include:

Rain fed / No SI

Full SI/ 100 % ETc

3/4 SI/ 75% ETc

½ SI/ 50% ETc

1/4 SI/ 25% ETc

One SI at flowering stage

One SI at fruit setting stage

Two SI at flowering and fruit setting stage

M db j ; MARC

S f m;

rb g i f f f b ; The activity needs extension to be conducted for the next one year.

Bd j j 7: Integrated effect of Mulching and furrow methods on major crops yield and water productivity (Onion)

P ckfd j f; to evaluate the effect of different Mulching and Furrow methods on yield and water productivity

E b j ; 2017 - 2020

f S f jc rfi; Tilahun H., Gobena D. and Tatek W.

S f fe c ; Ketema Tezera

Zf b g f ; January - December 2019

T b g i f h f ;This year the second year trial was conducted successfully; necessary data collection was made and analyzed data were summarized and presented in Table 11.

Ef jh ; The experimental design is RCBD – split block design with three replications.

U fb f ; The treatments include three irrigation water application methods as main plot: Fixed, Alternate and Conventional, and two mulch types (straw and plastic) and control as no mulch.

M db j ; MARC

S f m

Table 10: The treatment combinations of Mulch and Furrow trial

U fb f	
N bj m	**T c m**
Alternate Furrow Irrigation	No mulch
	Straw mulch
	Plastic mulch
Fixed Furrow Irrigation	No mulch
	Straw mulch
	Plastic mulch
Conventional Furrow Irrigation	Sub plot
	Straw mulch
	Plastic mulch

Table 11: Yield and water productivity of Onion under mulch type and furrow techniques

	312902:	
Mulch type	Bulb Yield (t/ha)	WP (kg/m3)
PM	30.78a	8.01a
SM	30.06a	7.84a
NM	27.57b	7.19c
LSD (0.05)	1.26	0.38
CV (%)	4.17	4.90
Furrow techniques	Yield(t/ha)	Water Productivity (kg/m3)
CFI	38.17a	6.34b
AFI	25.24b	8.39a
FFI	24.99b	8.3a
LSD (0.05)	2.81	0.53
CV (%)	7.28	7.58

The result obtained implies that plastic and straw mulch significantly increase yield and water productivity of onion over no mulch. Even though conventional furrow irrigation resulted in significant yield difference in yield than alternate and fixed furrow irrigation, the water productivity obtained was significantly less than the two furrow techniques Table 11.

rb g i f f fb ; The activity will be conducted for the next one year.

Bd j j 8; Water productivity and yield response of crops as influenced by drip and alternate furrow Irrigation (Maize)

P ckfd j f; to investigate the effect of alternate furrow and drip irrigation systems on crop yield & water productivity

E b j ; 2017 - 2020

f S f jc rfi; Tilahun H., Gobena D. and Tatek W.

S f fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b g i f h f ; This year the second-year trial was conducted successfully; necessary data collection was made and analyzed data were presented in Table.

Ef jh ; The experimental design is RCBD – split block design with three replications.

U fb f ; The treatments include two irrigation water application methods: Alternate Furrow and Drip, and four irrigation levels (55%, 70%Etc, 85%Etc, 100%Etc). The irrigation methods are the main plot while irrigation levels are assigned to the sub plots.

M db j ; MARC

S f m

Table 12: The treatment combinations of drip and alternate furrow comparison

U fb f	
N bj m ;J jhb j f i e	**T c m ;efgjdj rfi fm**
Alternate Furrow Irrigation	100% Etc
	85% Etc
	70% Etc
	55% Etc
Fixed Furrow Irrigation	100% Etc
	85% Etc
	70% Etc
	55% Etc

Table 13: Maize grain yield for irrigation methods and irrigation levels

2019 trial	
Irrigation Method	Grain Yield (Qt/ha)
Drip	49.00a
Alternate F.	41.13b
CV (%)	4.73
LSD (0.05)	3.74
Irrigation Level	Grain Yield (Qt/ha)
100 % ETc	54.75a
85 % ETc	47.88b
70 % ETc	42.40c
55 % ETc	35.22d
CV (%)	7.42
LSD (0.05)	4.20

The maximum yield of 49 qt/ha obtained from Drip irrigation method and 54.75 qt/h from 100% ETc

rb g i f f fb ; The activity will be conducted for the next one year.

.

kfd 4; Determination of optimum fertilizer rate for crops under irrigated agriculture

kfd E b j ; July 2017 to June 2020

Bd j j 2: Determination of optimal balanced fertilizer rate and irrigation scheduling for major crops (Onion)

P ckfd j f; to determine the optimum rate of balanced fertilizers and irrigation intervals for Onion

E b j ; 2017 - 2020

f S f jc rfi; Tilahun H., Gobena D. and Tatek W.

S f fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b g i f h f ;

This year the second year trial was conducted successfully; necessary data collection was made and analyzed data were presented in Table 15.

Ef jh ; The experimental design is RCBD – split block design with three replications.

U fb f ; The irrigation intervalsare assigned to the main plot while balanced fertilizer and the recommended NP rate treatments are assigned to the sub plots.

M db j ; MARC and Fentale

S f m

Table 14: Optimal balanced fertilizer rate and irrigation scheduling trial treatments

Treatment	Fertilizer rates for Onion			
Irrigation Intervals	RNP	100 Kg Map Recommended Formula	150 Kg Map Recommended Formula	200 Kg Map Recommended Formula
80% MAD	T1	T2	T3	T4
MAD (Recommended)	T5	T6	T7	T8
120% MAD	T9	T10	T11	T12

Table 15: Onion yield under balanced fertilizer and depletion level at Melkassa and Fentale

2018/2019 trial		
	Melkassa	Fentale
SMDL	Bulb Yield (t/ha)	Bulb Yield (t/ha)
80 % ASMDL	34.35 a	25.03a
ASMDL	26.40b	24.83a
120 % ASMDL	25.40b	20.42c
LSD (0.05)	6.25	1.88
CV (%)	19.20	7.07
Balance Fertilizer-rate (Kg/ha) NPSZn	Bulb Yield (t/ha)	Bulb Yield (t/ha)
200	31.77a	27.78a
150	29.90a	24.18b
100	27.41b	21.71c
RNP	25.78b	20.04c
LSD (0.05)	2.04	2.22
CV (%)	7.17	9.56

The maximum yield of 34.35 t/ha and 31.77 obtained from 80 % ASMDL and 200 Kg/ha NPSZn respectively at melkassa. The maximum yield of 25.03 t/ha and 27.78 obtained from 80 % ASMDL and 200 Kg/ha NPSZn respectively at Fentale.

rb g i f f fb ; The activity will be conducted for the next one year.

Bd j j 3; Determination of optimal Phosphorus fertilizer rate and soil moisture level for major crops (Haricot bean)

P ckfd j f; to determine the optimum rate of P and deficit irrigation level for Haricot bean

E b j ; 2017 - 2020

f S f jcrfi; Tilahun H., Gobena D., Tatek W., Ketema T., Aynalem G. and Tigist W.

S f fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b g i f h f ;

This year the second year trial was conducted successfully; necessary data collection was made and analyzed data were presented in Table 17.

Ef jh ; The experimental design is RCBD – split block design with three replications.

U fb f ; The deficit irrigation levels are the main plot while phosphorus fertilizer rate treatments are assigned to the sub plots.100%ETc with 0 level of P is a control treatment for this experiment.

M db j ; MARC and Fentale

S f m

Table 16: Optimal Phosphorus fertilizer rate and soil moisture level trial treatments

Treatment	P rate (kg/ha) for Haricot Bean				
Irrigation Intervals	0	10	20	30	40
100% ETc	T1	T2	T3	T4	T5
75% Etc	T6	T7	T8	T9	T10
50% ETc	T11	T12	T13	T14	T15

Table 17: Haricot bean grain yield under Optimal Phosphorus fertilizer rate and soil moisture level at Melkassa and Fentale

Irrigation Levels	Melkassa	Fentale
	Grain Yield (Qt/ha)	Grain Yield (Qt/ha)
100 %	25.22	23.19
75 %	24.64	20.92
50 %	20.93	20.21
LSD (0.05)	NS	NS
CV (%)	18.83	15.84
P- rateKg/ha	Grain Yield (Qt/ha)	Grain Yield (Qt/ha)
40	27.35a	24.19a
30	25.37b	23.25a
20	23.44c	21.85b
10	22.2d	20.26c
0	19.61e	17.66d
LSD (0.05)	1.02	1.20
CV (%)	15.47	15.77

The maximum yield of 25.22 and 27.35qt/ha obtained from 100 % ETc and 40 Kg/ha P-rate, respectively at melkassa.
The maximum yield of 23.19 and 24.19 qt/haobtained from 100 % ETc and 40 Kg/ha P-rate, respectively at Fentale.
rb g i f f fb ; The activity will be conducted for the next one year.

Bd j j 4: Determination of Optimal Nitrogen fertilizer rate and soil moisture level for major crops (Onion)
P ckfd j f; to determine the optimum rate of N and irrigation level
E b j ; 2017 - 2020
f S f jc rfi; Tilahun H., Gobena D. and Tatek W.
S f fe c ; Ketema Tezera
Zf b g f ; January - December 2019
T b g i f h f ;
This year the second-year trial was conducted successfully; necessary data collection was made and analyzed data were presented in Table 19.
Ef jh ; The experimental design is RCBD – split block design with three replications.
U f b f ; The irrigation intervals will be in the main plot while Nitrogen fertilizer rate is assigned to the sub plots.
M db j ; MARC

S f m
Table 18: Optimal Nitrogen fertilizer rate and soil moisture level trial treatments

Treatment	N rate (kg/ha) for Onion				
Irrigation Intervals	0	23	46	69	92
100% ETc	T1	T2	T3	T4	T5
75% Etc	T6	T7	T8	T9	T10
50% ETc	T11	T12	T13	T14	T15

Table 19: Onion yield and water productivity of optimal Nitrogen fertilizer rate and soil moisture levels

2018/19 TRIAL		
IRRIGATION LEVELS (M-PLOT)	BULB YIELD (T/HA)	WP (KG/M3)
100 % ETC	29.2A	4.86C
75 % ETC	27.21A	6.03B
50 % ETC	24.13B	8.02A
LSD (0.05)	2.88	1.15
CV (%)	10.57	18.02
N- RATE (KG/HA) S-PLOT	YIELD(T/HA)	WP (KG/M3)
92	28.64A	6.67A
69	27.48AB	6.51A
46	26.98ABC	6.41A
23	26.21BC	6.11AB
0	24.92E	5.81B
LSD (0.05)	2.31	0.58
CV (%)	8.86	9.51

rb g i f f fb ; The activity will be conducted for the next one year.

kfd g : Performance evaluation of irrigation schemes and design of furrow irrigation
kfd E b j ; July 2017 to June 2020
Bd j j 2; Indigenous knowledge assessment on irrigation water management practices
P ckfd j f;

- To identify the current irrigation water management practice under small scale farmers' condition
- To assess the farmers perception and subjective assessment towards irrigation water management practice in their area
- To identify the best indigenous irrigation water management of different area

E b j ; 2017 - 2020

f Sf jcmfi; Tilahun H., Gobena D. Ketema T. and Tatek W.
Sf fe c ; Ketema Tezera
Zfb g f ; January - December 2019
T b g if h f
This activity includes reconnaissance survey and observation survey. Thus, all the necessary data collection formats and questionnaire were developed.
Ef jh ; No design
U fb f ; Technical study using survey
M db j ; Melkassa mandate areas
Sf m;
rib g if f fb ; Field survey will be collected in the next one year.

Bd j j 3; Performance evaluation of furrow irrigation at medium and large scale irrigation scheme
P ckfd j f ;

- to determine the field application efficiency of surface irrigation system
- to evaluate the current water management of irrigation schemes

E b j ; 2017 - 2020
f Sf jcmfi; Tilahun H., Gobena D. and Tatek W.
Sf fe c ; Ketema Tezera
Zfb g f ; January - December 2019
T b g if h f ; This year trial is being conducted at field level. Necessary materials were collected and site selection was done but due to early rainfall start not yet started
Ef jh ; No design
U fb f ; Technical study by taking different measurements of different parameters.
M db j ; Wonji Sugar Factory
rib g if f fb ; The activity will be conducted for the next one year.

Bd j j 4; Performance Evaluation of Small-Scale Irrigation Schemes
P ckfd j f ;

- to determine the field application efficiency of surface irrigation system
- to evaluate the current water management of irrigation schemes

E b j ; 2017 - 2020
f Sf jcmfi; Tilahun H., Gobena D. and Tatek W.
Sf fe c ; Ketema Tezera
Zfb g f ; January - December 2019
T b g if h f ; This year trial is being conducted at field level. Necessary materials were collected and site selection was done. Field data collection was partially done the reason was farmers were not interested.
Ef jh ; No design
U fb f ; Technical study by taking different measurements of different parameters
M db j ; Dugda District
rib g if f fb ; The activity will be conducted for the next one year.

Bd j j 5; Determination and verification of Optimum Flow Rate and Furrow Length Using Furdev Model Under large scale irrigation Scheme
P ckfd j f; to determine optimum combination of flow rate, furrow length, and estimate the maximum attainable efficiency of furrow irrigation under large irrigation scheme
E b j ; 2017 - 2020
f Sf jcmfi; Tilahun H., Gobena D. and Tatek W.
Sf fe c ; Ketema Tezera
Zfb g f ; January - December 2019

T b g i f h f ; This activity needs deskwork. Data collection for the model input was done and the result of output values were generated

P i f G ef cf f jgjfe;

Runoff ratio

Storage efficiency

Distribution Uniformity

Advanced time

Recession time

Ef jh ; No design

U fb f ; Technical study by taking different measurements of different parameters

M db j ; Melkassa

rb g i f f fb ; The activity will be conducted for the next one year to verify the model results at field condition.

Bd j j 6; Determination of appropriate furrow length and flow rate for furrow irrigation practice

P ckfd j f ;

- to determine optimum combination of furrow length and flow rate
- to improve on farm water management under smallholder farmers condition

E b j ; 2017 - 2020

f Sf jc rfi; Tilahun H., Gobena D. Tatek W., Ketema T., Aynalem G. and Tigist W.

Sf fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b g i f h f ; This activity was conducted last year but due to delayed planting and early beginning of rain necessary data was not collected.

Ef jh ; Randomized Complete Block Design (RCBD)

U fb f ; Nine experimental treatments. Three furrow length as main plots and three flow rates as subplots.

M db j ; MARC

Sf m

Figure 3: Furrow testing at field condition

rb g i f f fb ; The activity will be conducted for the next one year according to the plan.

kf d 6; Evaluation, validation and adaptation of on-farm irrigation technologies for major crops

kf d E b j ; July 2017 to June 2020

Bd j j 2; Verification and Demonstration of Low-cost Family Drip Irrigation for Small Holder

P ckf d j f;

- to promote and establish a family drip irrigation as a house hold irrigation systems
- to create awareness for smallholder farmers on water management

E b j ; 2017 - 2019

f S f jc rfi; Tilahun H., Gobena D. Ketema T. Tigist W. Aynalem G. and Tatek

S f fe c ; Ketema Tezera

Zf b g f ; January - December 2019

T b g i f h f ; This year activity is being conducted as planned on Onion. Demonstration to the local community will be conducted at Dugda District soon.

Ef jh ; 10x10 m

U f b f ; Single factor

M db j ; Dugda District

rb g i f f fb ; The activity will be conducted for the next one year according to the plan.

Bd j j 3; Verification and Demonstration of Promising and Improved Water Management Technologies on Farmer's Field

P ckf d j f ;

- to compare and validate improved optimal irrigation scheduling, when and how much to apply
- to verify crop water use and irrigation water need in the cropping season

E b j ; 2017 - 2019

f S f jc rfi; Tilahun H., Gobena D., Tatek W. and Ketema T.

S f fe c ; Ketema Tezera

Zf b g f ; January - December 2019

T b g i f h f ; This activity is conducted to verify the trial results of promising completed activities. Verification study on Maize optimal irrigation scheduling, during dry season was conducted and data analysis underway

Ef jh ; 10x10 m

U f b f ; Three treatments non replicated

M db j ; MARC

rb g i f f fb ; The activity will be conducted for the next one year according to the plan.

kf d 7; Development, testing, evaluation and adaptation of improved water harvesting techniques for small holder farmers

kf d E b j ; July 2017 to June 2020

Activity 2: Evaluation of different lining materials for water harvesting structures

P ckf d j f ;

- to select and most effective lowcost lining material for water harvesting pond
- to analyze cost-benefits of using lining material for water harvesting pond

E b j ; 2017 - 2019

f S f jc rfi; Tilahun H., Gobena D. Tatek W. and Ketema T.

S f fe c ; Ketema Tezera

Zf b g f ; January - December 2019

T b g i f h f ; all the trial pits are dug and ready to be covered with geo-membrane and bottom lining materials, after which the experiment will be started, but not started due to purchase problem.

Ef jh ; The experimental design is RCBD design with four replications. The treatments include the following.

U fb f ; The experiment has 4 treatments

T1 = Excavation only (Control)

T2 = Mortar

T3 = Bentonite

T4 = Geo-membrane

M db j ; MARC

rb g i f f fb ; The activity will be conducted for the next one year to test lining materials

Bd j j 4: Water Resource Management for Effective Irrigation Water allocation at different watershed

P ckfd j f;

- To evaluate the capability of the watersheds water resource to fulfill the current water demands among multiple water user
- To identify strategies and mechanisms for efficient utilization of available water resources of catchments

E b j ; 2017 - 2020

f S f jc rfi; Tilahun H., Gobena D. Ketema T and Tatek W.

S f fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b g i f h f ; This is a deskwork activity. It is conducted for selected catchment areas under Melkassa mandate areas. Currently all the necessary data is collected.

Ef jh ; No design

U fb f ; Technical study using model

M db j ; Adulala Watershed

rb g i f f fb ; The activity will be conducted for the next one year to allocate effective irrigation water at different watershed.

Bd j j 5; Planning Integrated Water Harvesting and Storage Systems for smallholder Irrigated Agriculture

P ckfd j f ;

- To determine the rainfall and runoff amount of the watershed
- To identify potential water harvesting sites in the watershed
- To select the most appropriate water harvesting techniques
- To design appropriate water harvesting structure and delivery system

E b j ; 2017 - 2020

f S f jc rfi; Tilahun H., Gobena D. Ketema T and Tatek W.

S f fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b g i f h f ; This is a deskwork activity. It is conducted for selected catchment areas under Melkassa mandate areas. Currently all the necessary data is collected and using data entry at targeted area focus points were mapped.

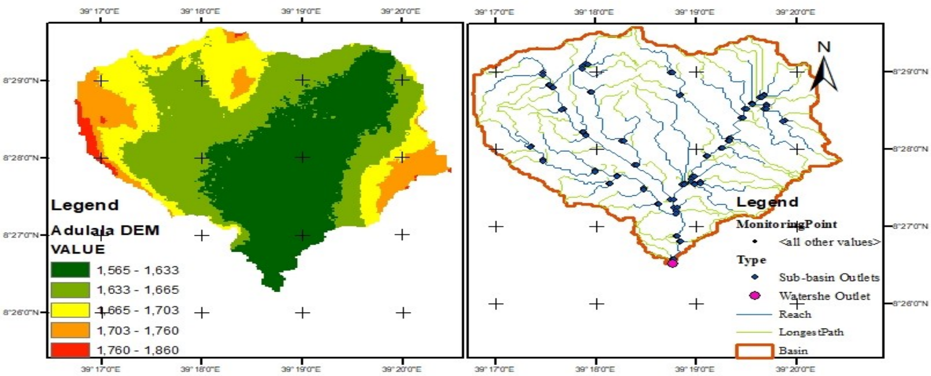


Figure 5: Map delineated watershed

Ef jh ; No design

U fb f ; Technical study using model

M db j ; Adulala Watershed

rb g i f f fb ; The activity will be conducted for the next one year.

kfd 8; Improving the productivity of salt affected soils

Bd j j 2: Impact of Irrigation water management practices on Ground water Level Fluctuation in Irrigated Agriculture

P ckfd j f; to monitor and investigate effect of irrigation water management practices on ground water level fluctuation and water quality

E b j ; 2017 - 2020

f S f jc rfi; Tilahun H., Gobena D., Tatek W. and Ketema T.

S f fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b g i f h f ; For monitoring the ground water fluctuation, 21 piezometer locations were identified using isosceles triangular grid form. Installation of piezometer using PVC material will be not yet conducted. For two reason: Budgetary and purchase problem

Ef jh ; No design

U fb f ; Technical study

M db j ; MARC

rb g i f f fb ; The activity will be conducted for the next year by purchasing the required items with strict follow-up purchase request

Bd j j 3; Developing Optimal Irrigation Scenario in Irrigated Agriculture

P ckfd j f;

- to develop optimal irrigation scenario
- to improve existing irrigation water application efficiency

E b j ; 2017 - 2020

f S f jc rfi; Tilahun H., Gobena D., Tatek W., Ketema T., Tigist W. and Aynalem

S f fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b gS f fb di h f ; This activity was done accordingly the plan successfully and collected yield data presented in Table 22.

Ef jh ; The experimental design is RCBD with three replications.

U fb f ; The experiment has 6 treatments

T1 = Optimal irrigation application efficiency + leaching requirement (Control – as obtained from phase one)

T2 = Optimal irrigation application efficiency and no leaching

T3 = Optimal irrigation application efficiency + 0.10 and leaching requirement
T4 = Optimal irrigation application efficiency + 0.10 and no leaching
T5 = Optimal irrigation application efficiency - 0.10 and leaching requirement
T6 = Optimal irrigation application efficiency - 0.10 and no leaching
M db j ; MARC

S f m

Table 20: Maize yield under optimal irrigation scenario in irrigated agriculture

	2019 trial
Treatments	Yield (t/ha)
OAE+LR	4.82abc
OAE	4.85abc
OAE+0.1+LR	5.67a
OAE+0.1	5.38ab
OAE-0.1+LR	4.56bc
OAE-0.1	4.08c
CV	11.14
LSD0.05	0.96

The maximum and minimum yield obtained from treatment T3 and T6, respectively Table 21.
nb g i f f f b ; The activity will be conducted for the next one year.

kf d 9; Accelerating the release of agricultural technologies (AGP II)
kf d E b j ; July 2018 to June 2020
Activity 1: Validation of Optimal Irrigation Scheduling Technologies on Farmer's Field (Tomato)
P ckf d j f ;

- To compare and validate improved optimal irrigation scheduling, when and how much to apply
- To verify and validate irrigation application on crop yield and WUE
- To verify crop water use and irrigation water need in the cropping season

E b j ; 2018 - 2020
f S f jc nfi; Tilahun H., Gobena D., Ketema T., Tatek W., Aynalem G. & Tigist W.
S f fe c ; Ketema Tezera
Zfb g f ; January - December 2019
T b g i f h f ; The validation was conducted on farmer's field at Dugda/ This activity is conducted to verify the trial results of promising completed activities. The field trial was demonstrated to farmers and agricultural experts
Ef jh ; 10x10 m
U fb f ; The experiment has three treatments: 60% ASMD, 100% ASMD and 140% ASMD application
M db j ; Dugda
S f m

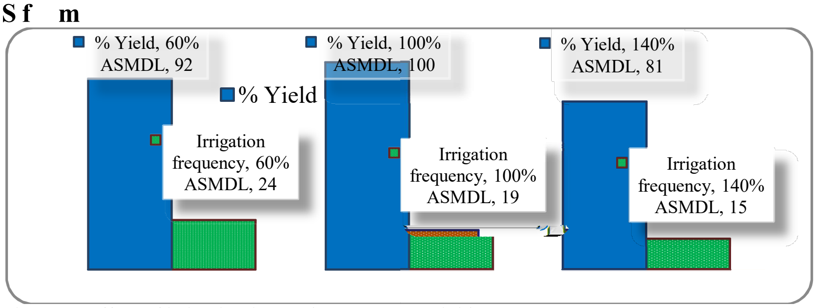


Figure 6: Effect of irrigation interval on tomatoes yield

The result implies that there was no significant differenceamong those treatments (different intervals) on Tomatoes yield. Thus, farmers can irrigate with those intervals based on competition at the area.

rb g if f fb ; The activity will be conducted for the next one year according to the plan.

Bd j j 3; Validation of Deficit Irrigation Application Technologies on Farmer's Field (Tomato)

P ckfd j f ;

- to compare and validate optimal deficit irrigation level.
- to verify and validate irrigation application on crop yield and WUE
- to verify CWU and IW need in the cropping season

E b j ; 2018 - 2020

f S f jc rfi; Tilahun H., Gobena D., Ketema T., Tatek W., Aynalem G. & Tigist W.

S f fe c ; Ketema Tezera

Zfb g f ; January - December 2019

T b g if h f ; The validation was conducted on farmer's field at Dugda

This activity is conducted to verify the trial results of promising completed activities. The field trial was demonstrated to farmers and agricultural experts

Ef jh ; 10x10 m

U fb f ; The experiment has two treatments

Treatments: 100% ETc & 70% ETc application

M db j ; Dugda

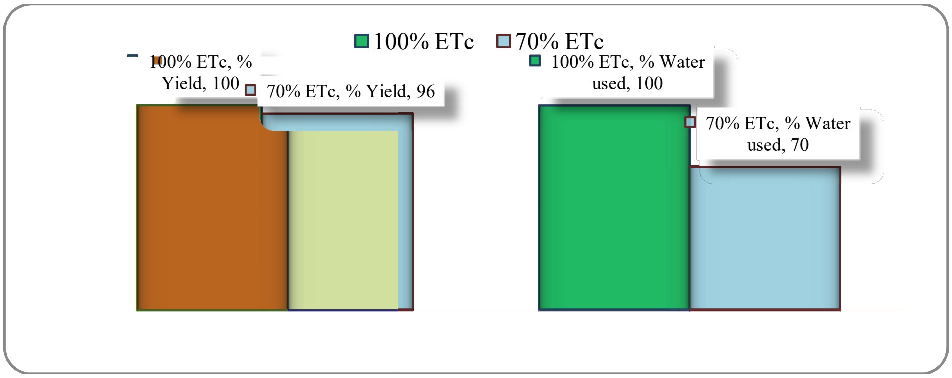


Figure 7: Effect of deficit irrigation on tomatoes yield

The result implies that there were no significant differencebetween treatments. Holding 30% of applied water the yield penalty was very low about 4%. Thus by reducing crop water requirement of tomato farmers can produce it in water scarce area.

rb g if f fb ; The activity will be conducted for the next one year according to the plan.

Bd j j 4; Validation of Alternate furrow irrigation application Technologies on Farmer's Field (Tomato)

P ckfd j f ;

- to validate alternate furrow irrigation application on crop yield and WUE
- to verify crop water use and irrigation water need in the cropping season

E b j ; 2018 - 2020

f Sf jcmfi; Tilahun H., Gobena D., Ketema T., Tatek W., Aynalem G. & Tigist W.
Sf fe c ; Ketema Tezera
Zfb g f ; January - December 2019
T b g if h f ; The validation was conducted on farmer's field at Dugda/ This activity is conducted to verify the trial results of promising completed activities. The field trial was demonstrated to farmers and agricultural experts
Ef jh ; 10x10 m replicated on three farmer's field
U fb f ; The experiment has two treatments

1. Conventional furrow irrigation application
2. Alternate furrow irrigation application

M db j ; Dugda

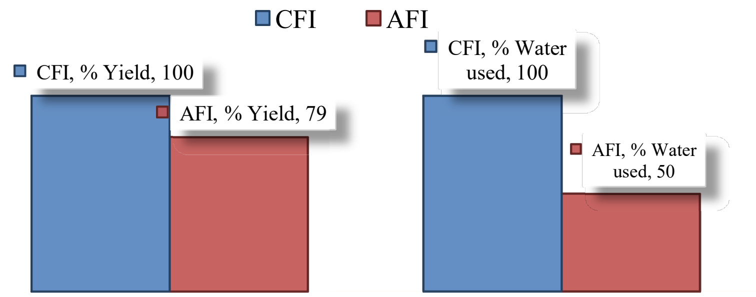


Figure 8: Effect of alternate furrow irrigation technique on tomatoes yield

The result implies that there was no significant differencebetween treatments. Alternating our furrow and applying the crop demand enables the farmers to holding 50% of applied water, the yield penalty was about 20%. Thus by using alternate furrow technique farmers can produce tomato in water scarce area.
rb g if f fb ; The activity will be conducted for the next one year according to the plan.
Bdj j 5; Validation of Supplementary Irrigation Application Technologies on Farmer's Field(Maize)
Pckfd j f ;

- to compare and validate supplemental irrigation application on crop yield and WUE
- to verify and compare crop water use and irrigation requirement

E bj ; 2018 - 2020
f Sf jcmfi; Tigist W., Abera T., Ketema T., Aynalem G. and Dr. Tilahun H.
Sf fe c ; Ketema Tezera
Zfb g f ; January - December 2019
T b g if h f ; The validation was conducted on farmer's field at Dugda/ This activity is conducted to verify the trial results of promising completed activities. The field trial was not demonstrated to farmers and agricultural experts because of enough rainfall at rainy season the experiment was not supplemented with irrigation water.
Ef jh ; 10x10 m replicated on three farmer's field
U fb f ; The experiment has three treatments
Rainfed / No SI
Full SI/ 100 % ETc
Two supplemental Irrigation at flowering and fruiting stage
M db j ; Dugda
rb g if f fb ; The activity full writeup and reported with the result obtained for the next one year according to the plan.

Plant Biotechnology Research Process

Gemechu Olani
Email: gamachuolani@gmail.com; Tel: +251967718425

S f fb di df : Agricultural Biotechnology

h b ; Plant Biotechnology

kfd j rfi; Application of Molecular techniques for crop improvement

kfd f j e; 2018 - 2020

Bd j j j rfi 2; Identification of QTLs for Fusarium wilt (*Fusarium oxysporum*) and Phytophthora blight (*Phytophthora capsici*) Resistance in Capsicum

P ckfd j f; to study the availability of resistant gene for Fusarium wilt and *P. capsici*in pepper of Ethiopia accession lines using molecular marker.

Bd j j f j e: July 2017 - June 2019

S f jcrfi f ; Abel D., Shimelis A., Dawit T. and Gamachu O.

S f fe c ; Gamachu Olani

Zfb g f ; January - December 2019

T b g h f

Survey was conducted on Mareko, Butajira, Halaba, Hawassazuriya and Wonji area to assess the extent of the pathogen and to collect plant and soil samples. Plant samples were culture on PDA (wide range pathogen) and CMA (*Phytophthora*). From the pathological analysis four types of pathogen were identified namely *Fusarium, Anthracnose,* Nematodes and *Phytophthora.* Study interest pathogens fusarium and phytophthora was purified and isolated. Inoculum to study the reaction of available capsicum varieties for fusarium and phytophthora wilt was prepared using Armstrong Fusarium media (Fusarium) and Mineral Salts Solution (Phytophthora). Isolates were grown on the mentioned media on shakers for seven days, and inoculation of 54 capsicum isolates were done and their reaction to the pathogen is collected weekly.

Ef jh : No

U fb f ; Markers used

M db j ; MARC & NABRC, Holetta

S f m ; Nothing done this year

rb g i f f fb ;

We planned to plant the 54 acceessions in the green house again and look at their response to inoculations of phytophtora blight & fusarium wilt isolates. Inline with this start to study their reaction using molecular tools (since the primers needed were already purchased from abroad).

Bd j j j rfi 3; Genetic diversity study in pepper (Capsicum annum L.) germplasm using SSR markers

P ckfd f ;To identify and to characterize accessions of the *Capsicum*spp collection from different geographical regions of Ethiopia

-To estimate the genetic divergence among accessions for future hybridization and selection programs

Bd j j f j e: July 2017 - June 2019

S f jcrfi f ; Gamachu O., Shimelis A., Abel D. and Dawit T.

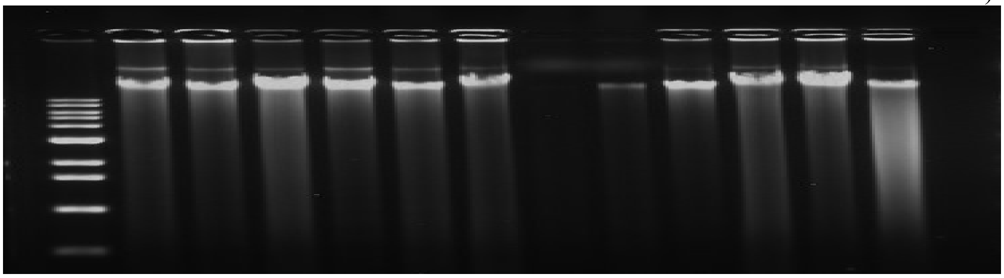
S f fe c ; Gamachu Olani

Zfb g f ; January - December 2019

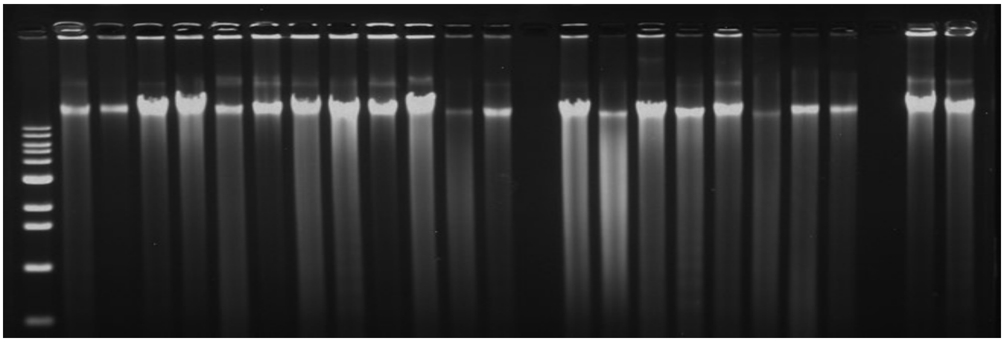
T b g h f

Although the activity was proposed along time ago, due to unavailability of the required primers and reagents, it wasn't started on time. Recently this budget year all required materials were bought and therefore the activitity resumed. So far, a total of 49 pepper accessions collected at MARC were planted within greenhouse facilities at NABRC Holetta and their leaves harvested a month latter for their DNA extraction using CTAB protocols. The quality and quantities of the extracted DNA's were also tested using Gel documentation camera and Nanorops respectively. The observed images along their measurements indicated a good extraction and to use them for PCR, they will undego normalization. The Gel documentation image and the figures indicating the quantities extracted were shown as described below under Results (Fig & Table).
Ef jh : No
U fb f ; Markers used
M db j ; MARC & NABRC, Holetta

S f m A).



S f m C-



Gjh f 2; Pepper genotypes genomic DNA 0.8% agarsoe gel in TBE buffer. First lane is 1kb DNA ladder in both gels; the rest of the lanes are sample DNA's A -1-22, and B; 23-34.
rb g i f f fb ;
In the coming budget year, the markers were optimized for their polymorphic nature and a selected primers will be used for PCR amplification, amplified fragments will be identified by running PAGE and their images data scored using specified ladder DNA. Finally, the diversity among collections were analyzed by software.

Bd j j j rfi 4; Morphological and Molecular Characterization of Banana genotypes
P ckfd j f ;

- To characterize and create a fingerprint of elite banana varieties
- To study the genetic polymorphism among the elite banana cultivars

Bd j j f j e: July 2017 - June 2019
S f jcrfi f ; Dawit T.,Wegayehu A., Abel D.and Gamachu O.
S f fe c ; Gamachu Olani
Zfb g f ; January - December 2019

T b g h f

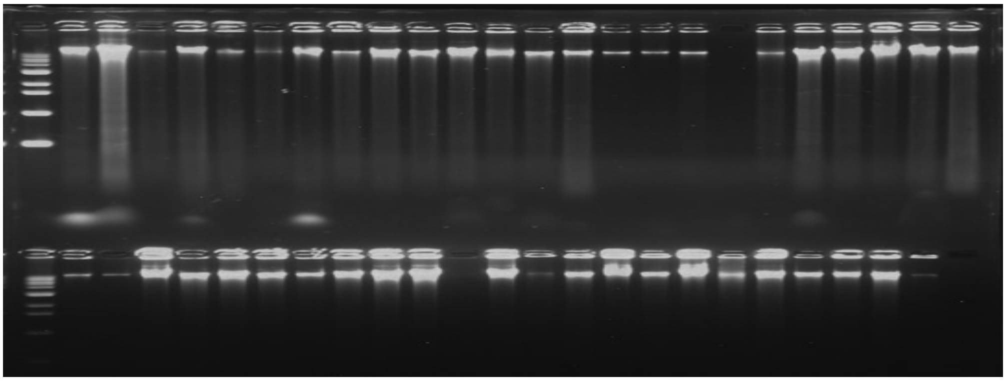
Along with Tropical fruit at MARC, leaf samples of 100 Banana germplasms from Banana Nurseries within the center were collected, taken to Holetta molecular lab were their DNA extraction were also accomplished. The quality and quantities of the extracts were also measured by nanodrops, and kept for normalization to use them further for PCR.

Ef jh : No

U fb f ; Markers used

M db j ; MARC & NABRC, Holetta

Sf m



Gjh f2; Banana genotyes genomic DNA 0.8% agarsoe in TBE buffer. Firts lane is 1kb DNA ladder in all gels, the rest of the lanes are sample DNA's of A, 1-31, B:32-50

rb g if f fb ;

DNA extraction will be done for those whose DNA quality are very poor. Inline to this, the markers were optimized for their polymorphic nature and a selected primer will be used for PCR amplification, amplified fragments will be identified by running PAGE and their images data scored using specified ladder DNA. Finally, the diversity among collections were analyzed by software.

kfd 3; Development and Application of *In Vitro* Techniques for Mass Propagation, Haploid Induction and Conservation of Selected Plants

kfd f j e: 2017 - 2020

Bdj j jrfi 5; In Vitro Conservation of Banana Germplasm through a Slow Growth Technique

Pckfdj f) *;

- To optimize a proper conservation protocol for major dessert banana cultivars.
- To evaluate the efficiency the technique after conservation trial.

Bdj j f j e: July 2017-June 2019

Sf jcrfi f ; Dawit T., Gamachu O. and Abel D.

Sf fe c ; GamachuOlani

Zfb g f ; January - December 2019

T b g h f

Six Selected varieties of banana (Dwarf, Grande naine, Williams-I, Butuza, Poyo and Giant) a total of 1014 plantlets (6 explant per jar) were cultured for short term conservation on MS media along treatment factors such as Sucrose level (1, 2, 3%) and growth regarding agents (Mannitol and Sorbitol). After 8 months, the different banana cultivars indicate different survival rate as indicated in table below for three varieties. We are looking now the response due to the additive growth retardants.

Ef jh : CRD

U fb f ; Sucrose level (1, 2, 3%) and growth regarding agents (Mannitol and Sorbitol)

M db j ; MARC

S f m

Started lately, hence they are on initial period on the media. No data regenerated so far.

rb g i f f fb ;

Taking the morphological data's of plantlets every three months and observe their regeneration capacity after their lengthy conservation by culturing on fresh media.

Bd j j 6; *In Vitro* Protocol Development/Optimization, Mass Propagsation of Disease Free Materials and Short Term Conservation of Elite Garlic Varieties

P ckfd j f; To optimize *in vitro* protocols for mass propagation and disease cleaning of elite garlic varieties.

Bd j j f j e; July 2017 - June 2020

S f jc rfi f ; Abel D., Gamachu O. and Dawit T.

S f fe c ; Gamachu Olani

Zf b g f ; January - December 2019

Ef jh : CRD

U fb f ; 12 hormone combinations of 2ip & NAA

M db j ; MARC

T b g i f S f m;

Hb njd j gf d j h j je f jgjdb j b e j dnfib j h j h N f j f d m f b e i f i f b j F i j jb

Garlic is one of the most crucial Allium vegetables used as seasoning of foods in different parts of the country around the globe. It has tremendous benefits from the medicinal and nutritional point of view. Albeit garlic has a lot of benefits beyond what is stated here, its production is highly constrained by both biotic and abiotic challenges. Among which, viral infection are the most prevalent factors affecting the crop around the globe. Appropriate identification and characterization of viral diseases is very important from the management perspectives. This experiment was conducted at Bioscience eastern and central Africa-International livestock Research Institute (BecA-ILRI) Hub and Melkassa Agricultural Research Center (MARC) on eleven selected garlic accessions and three improved varieties which were collected from different garlic agro-climatic regions of Ethiopia. Aimed to deep sequence and identify garlic infecting viruses, to design effective RT-PCR based diagnostic assay using sequence information and to optimize in vitro protocol for elite cultivars of garlic. The identification was carried out based on RNA- Sequencing (RNA-Seq) with the expectation of new viruses using Illumina MiSeq next generation sequencing platforms. The bioinformatics data analysis results depicted that complete genomes of six garlic viruses were identified viz. Onion yellow dwarf virus (OYDV), Leek yellow stripe virus (LYSV), Garlic virus C, Garlic virus D, Garlic virus E and Garlic virus X. OYDV (100%) and LYSV (78%) are the most prevalent across agro-climatic region of garlic production. Findings from the study indicated that the three improved garlic varieties were completely infected by Potyvirus and Allexivirus which implies that virus has been disseminated throughout the countries. Then, after realizing the three released cultivars are totally infected by viruses. Thus, to recover the cultivars two techniques viz. meristem culture alone and meristem culture associated with thermotherapy (cloves treated with 380c for 60 days) were compared. Then, indexing by RT-PCR indicated that 77% and 82% in vitro plantlets were found to be virus free from meristem culture alone and thermotherapy associated with meristem culture, respectively. Ultimately in vitro protocol to multiply clean cultivars has been tried and result indicated that lower rates of multiplication were observed.

S f m

Table 1: In vitro regenerated garlic plants

Treatment	Hormone (mg/l)		Explant	Regenerated shoots		Number	Number of shoots per		
	3j	**OBB**		**O cf**	**)&***		**8**	**23**	**29**
1	0	0	15	4	26	1	0	1	
2	0.5	0.25	16	8	50	3.5	5	2.3	1.4
3	0.25	0.05	15	15	100	1.5	5	2.1	1.2
4	1.5	0.05	15	11	73	1.7	5	2.3	1.6
5	1	0.05	15	13	86	1.5	6	1.9	1.2
6	2	0.25	15	5	33	5.4	5	7	2.3
7	0.22	0.19	16	8	50	8.9	8	4.9	1.6
8	1	0.2	16	6	37	1	0	1	1
9	5	0.2	15	5	33	1	0	1	1
10	3	0.25	16	8	50	1.5	3	1.3	1.2
11	0.5	0.05	15	8	53	1.4	3	1.2	1.2
12	3	0.1	16	10	63	3.9	8	1.8	1.6

Plan for the next year:

Bd j j 7; *In Vitro* Protocol Development/Optimization for Production and Mass Propagation of Disease Free Materials of Elite Citrus Varieties

P ckfd j f; To optimize *in vitro* disease cleaning protocol using somatic embryogenesis of style for selected released varieties

E b j ; July2017 - June 2020

f S f jcrnfi; Gamachu O., Abel D. and Dawit T.

S f fe c ; Gamachu Olani

Zfb g f ; January - December 2019

Design: CRD

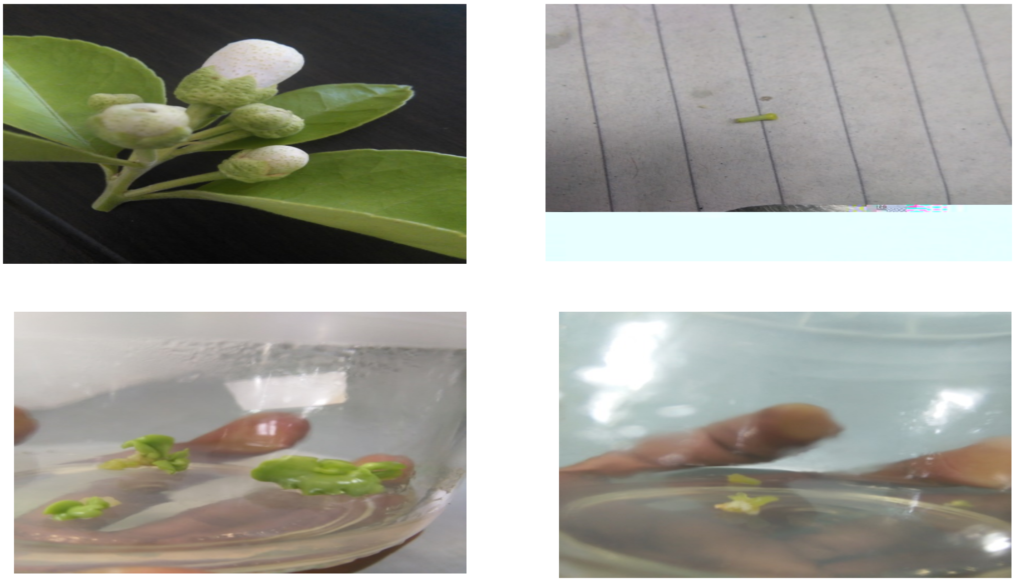
Treatments: 4 hormonal treatments (1, 2, 3 & 4mg/L BAP) with 5 replication

M db j ; MARC

T b g h f ;

The aim of this experiment was to produce disease free citrus materials from the introduced certified materials from abroad. But due to lack of appropriate insect proof net house, the imported certified planting materials are suffered to insect infestation and other available graft transmitted diseases in the area. With is objective, the Melkassa Plant Biotechnology program had been undergoing a micro grafting practices before and after individuals gain a short training abroad. However, because of its technical difficulties and lack of well-trained manpower on the area, there is no promising plantlet regeneration observed through the techniques.As an optional solution to the observed scenarios, along discussion with Fruit Research Programs, citrus style and stigma culture which had been a practice in many countries to clean an already infected plant materials started lately using unopened citrus flowers. Since then we tried to initiate styles and stigmas from flowers of Washingten Navel and Valencia varieties which were located in MARC fruit nursery and observed their response all the way to leaf formation and rooting. Four selected treatments were used to initiate their calli (1,2,3 and 4 mg/L BAP) each replicated five times. The flowers were sterilized with a minute soak in 70% Ethanol and 1% NaOCl solution under laminar hood using sterilized distilled water. Once embryogenic calli regenerated they were transferred to MS hormone free media to enable them continue their growth. Two Valencia rooted plantlets were finally also tried to be acclimatized in green house, though both died through time and other some remaining cultures were contaminated while they have been refreshed to other medias (Fig 1.).This year we reinitiated them again in the laboratory, but we could not obtained a calli for embryo developments.

S f m



Gjh f 4; Invitro stages of Citrus stigma cultures (A: Unopened citrus flower used,B: Stigma excised along with minute style for inoculation after their sterilization, C: Ebryogenic callus being formed on hormone free media (after initially formed calli transformed to HF media)and D: when the cultures form leaves and roots on the same media)

rb g i f f fb ;
We planned to reinitiate them again and same practice followed. Finally, the regenerated plantlets will be checked for their infection with ELISA and those freed from virus disease maintainedwithininsect proof greenhouse.

Bd j j 8; In vitro protocol development/optimization, mass propagation of disease free materials and short term conservation of elite Date palm varieties
P ckfd j f; To optimize *in vitro protocol for mass propagation of* three elite date palm cultivars (Medjoul, Barhee & Khalas).
Bd j j f j e; July 2017 - June 2020
S f jc rfi f ; Dawit T., Abel D. and Gamachu O.
S f fe c ; GamachuOlani
Zfb g f ; January - December 2019
T b g h f ;
Young suckers of two Date palm cultivars (Medjool and Kalasse) have been brought from Melkawere Research Center and Afambodate palm site. On their arrival, they were trimmed down to remove their external superficies' sheath to size 10*4cm.Washed with brush and detergent in tap water and soaked in 1gm/L fungicide (Redomil/Benomyl) for 15 minutes before sterilized in lab with a solution of 2% barekina/NaOCl and 0.3gm/L KHMn (Potassium permanganate) for 20 minutes. During both steps in between washed thoroughly three times with sterilized distilled water and kept within antioxidant. Final sterilization was done under laminar hood in 2% NaOCl for additional 20 minutes and rinsed three times with sterilized water and kept in antioxidants to further trim & culture on already made MS media. The culture was then incubated in dark growth room. The regenerated embryogenic calliregenerates somatic embryos and gradually develops shoots and roots. We also tried twice to acclimatize a numbers of rooted plantlets in green house, but during both cases they dried. This final stage of Date palm tissue culture had been the most difficult stage as lots of studies indicated and needs special treatments to be followed. So far a preliminary protocol up to rooting was optimized though the procedure needs additional rounds of work starting

from culture establishment from their suckers. This is due to data collected doesn't managed well and to observe repeatability of the progress made until now.

Ef jh : CRD

U fb f ; 3 plant hormone combinations for both calli induction (T1: 50mg/L 2,4-D+1.5mg/L 2-ip+1.56g/L Activated charcoal; T2: 25mg/L 2,4-D+0.75mg/L 2-ip+1.56 AC and T3: 20mg/L 2,4-D+0.75mg/L 2-ip+0.94g/L AC) & rooting (Half MS along with 0.2mg/L NAA, MS + 0.1mg/L NAA and GA3, and MS+0.1mg/L NAA and GA3 with Activated charcoal).

M db j ; MARC

S f m

30 rooted regenerated seedlings were tried to acclimatize though doesn't survive long in screen house and additional 40 datepalm plantlets were under acclimatization.

rb g i f f fb ;

We planned to bring both cultivars again and establish them in the laboratory. Each stages' data will be registered to enable their reproducibility. To manage the temperature fluctuation effect on embryo development and rooting, we are now going to buy a growth chambers in near future.

Bd j j 9; *In vitro* protocol development/optimization for elite cooking banana varieties

P ckfd j f ;

- To optimize rapid propagation protocol for two varieties (Matoke&Nijiru)
- To supply clean stock mother plant seedlings.

Bd j j f j e;July 2017 - June 2020

S f jc rfi f ; Abel D., Gamachu O., and Dawit T.

S f fe c ; Gamachu Olani

Zfb g f ; January - December 2019

T b g h f ;

Two Cooking Banana varieties, Njiru and Matooke, were used as plant materials for this activity from MARC Banana nursery. Emerging lateral sword suckers were taken and their corms treated with 50°C boiled water and fungicides (Ridomil) for 10 minute each, after which planted in green house as a source of mother plant on a pot filled with 1:1 top soil and red ash. Once the shoots emerged reach 20 to 30 cm long, seedlings were collected along with their basal corms to be used for establishment within laboratory. Washed in tap water for a while with brushing, disinfected with 2% chlorox for 20 min and washed thoroughly with distilled water. They were then trimmed down to 5 to 10 cm length and then disinfected again by immersion in 1% chlorox for 15 min with sterilized distilled water under Laminar flow hood / cabinet. Finally, rinsed three times with distilled water and cultured on artificial media after trimmed down again.The culture medium used wasMurashige and Skoog media (Murashige and Skoog, 1962) basal medium with Sucrose 30g/L and solidified by agar at 7g/L before being autoclaved at 121°C for 15min. Both cultivars were initiated on hormone free MS media and multiplied on a common media with low cytokinin until sufficient number of plantlets obtained to start multiplication treatment optimization. The cultures were refreshed on the same medium monthly for five consecutive times.

Now, multiplication treatments for Njiru done for the second time and variety Matooke lately start its multiplication treatment. We have been taking data's like numbers of shoots and their multiplication factors whenever the cultures refreshed monthly. The cultures will be transferred five times on multiplication media and below table showing a single culture (first subculture) data analysis. The adventitious shoot formation observed until now is far lower than the way the plantain banana cultivars respond (in most of the treatments even no adventitious shoot development observed).

Ef jh : CRD

U fb f ; combination of BAP and IAA (3mg/L BAP alone, 3mg/L BAP + 0.2 mg/L IAA, 3mg/L BAP + 0.4mg/L IAA, 3mg/L BAP + 0.6mg/L IAA, 4mg/L BAP alone, 4mg/L BAP + 0.2mg/L IAA, 4mg/L BAP+0.4mg/L IAA and 4mg/LBAP+0.6mg/L IAA) for multiplication and
M db j ; MARC

S f m
Table 2. Mean numbers for Njiru(Number of shoots and Multiplication Factor).

Treat.	Mean_NofShoots	Mul.Fact.
1	0.73	1.30
2	0.67	0.97
3	0.67	1.07
4	0.90	1.13
5	0.37	0.63
6	0.60	1.17
7	0.63	1.03
8	0.67	1.07

rb g i f f fb ;
To complete the remaining rooting and acclimatization optimization, this activity was delivered to our staff MSc student as part of his thesis research. He will soon come with a full protocols .

Bd j j : ; *In vitro* multiplication/scaling upof tissue culture banana using the already developed protocol for three Cavendish cultivars Dwarf, Giant and Poyo.
P ckfd j f;Mass propagation of six released varieties of banana using already developed protocols
Bd j j f j e; July 2017 - June 2020
S f jc rfi f ; Abel D., Gamachu O., and Dawit T.
S f fe c ; Gamachu Olani
Zfb g f ; January - December 2019
T b g h f ; *So* far the i*n vitro* multiplication protocol for six released banana cultivars, namelyPoyo, Giant, Dwarf, Butuza, Williams and Grande naine, were developed at MARC tissue culture laboratory. Hence using those protocols, we have been propagating banana seedling for these cultivars and distributed enough numbers of seedlings in addition to a completion of a commitment we made with the Amhara Agricultural Bureau to deliver 200,000 banana seedlings. Currently,we had a numbers of plantlets (9,291) being propagated in the laboratory and around 16,000 seedlings were ready in our green house to be given for our stakeholders.The details of the numbers in both laboratory and screen house were indicated below.
Ef jh : No
U fb f ; No
M db j ; MARC

S f m
Table 3. Total number of banana in vitro plantlet in Laboratory and Greenhouse (As of July 22, 2019)

Variety	Stage	Available numbers of plantlets
Poyo	Mul. & Rooting	23,556
Giant Cavendish	Mult. & Rooting	7,128
Williams	Mult. & Rooting	80
Grande naine	Mult. & Rooting	8,096
Butuza	Mult.	80
Aloe vera (Linn.)	Mult.	376
Total		39,316
Dwarf	Acclimatization	10
Grande Naine	Acclimatization	72
Njiru (Cooking Banana)	Acclimatization	160
Total		242

Table 4. The amount of tissue culture banana distributed to stakeholder in 2018/19

Sites of Distributions	Gaint	Grande Naine	Dwarf	Poyo	Williams	Total
Arsi Surrounding	250	250				500
Sire Wereda (Invester)	330	650				980
Fentalle	312	600	10	928		2000
Fentalle		60		140		200
Melkassa/Bishola		24	20	96	14	154
Arbaminch	250					250
Chiro		500	500	500		1500
Adama				150		150
Sinana ARC	250	250	250	250		1000
Total	1392	2334	780	2064	14	6734

rb g i f f fb ;

Since there is increasingdemandsforatissue cultured Banana, in the following budget year also we planned to duplicate the numbers we had in the laboratory by establishing additional numbers of cultivars in our labs

Plant Protection Research Process

Endriyas Gabrekiristos
E-mail: endriasgabre@gmail.com; Tel: +2519000330

Plant pathology Research Program

kfd j rfi 2; Introduction of the high productivity variety in solanaceae crop and development of customized cultivation technology Project

kfd f j e; January 2018 - December 2020

Bd j j 2;Severity assessment of wilt diseases and possible integrated management approaches on pepper

Bd j j f j e; July 2018 – December 2020

P ckfd j f0 0<

- To assess the degree of severity of wilt disease and major wilt causing agent on major pepper growing areas of Ethiopia.
- To evaluate genetic resistance of pepper germplasm to *Fusarium* wilt.
- To device integrated wilt management practice for pepper production.

S f jc rfi f ; Endriyas G. and Horticulture staff

S f fe c ; Endriyas Gabrekiristos

Zfb g f ; January - December 2019

T b g i f h f

Ef jh ; RCBD (field condition)

U fb f ;

Table 1. List of treatments

No	Treatments	Rate per 3 plot($8.4m^2$)
1	Animal manure	10.0Kg
2	Biochar	5Kg
3	Agro Laxyl	7.56gm
4	$CaCo_3$ + Animal Manure	7.5kg + 5Kg
5	$CaCo_3$	15kg
6	Animal manure + Biochar	5Kg + 2.5Kg
7	Control	None

M db j ; Bora, Dugda and Adami Tullu Jiddo Kombolcha is the survey locations

S f m

Severity assessment was conducted in Adami Tullu Jiddo Kombolcha and Bora districts in August 2019 main hot pepper growing season per schedule. In objective three of the activity selected integrated management approach were conducted in 2019/20. The percentage wilt incidence varies among treatments as shown in figure1. The highest wilt incidence of fusarium wilt was recorded on the plot treated by animal manure, control and Agro Laxyl with the percentage of 72, 70 and 68% respectively. Relatively the wilt incidence was slighter in the plot treated with CaCo3 + Animal manure (40%) and Animal Manu re + Biochar (40%).

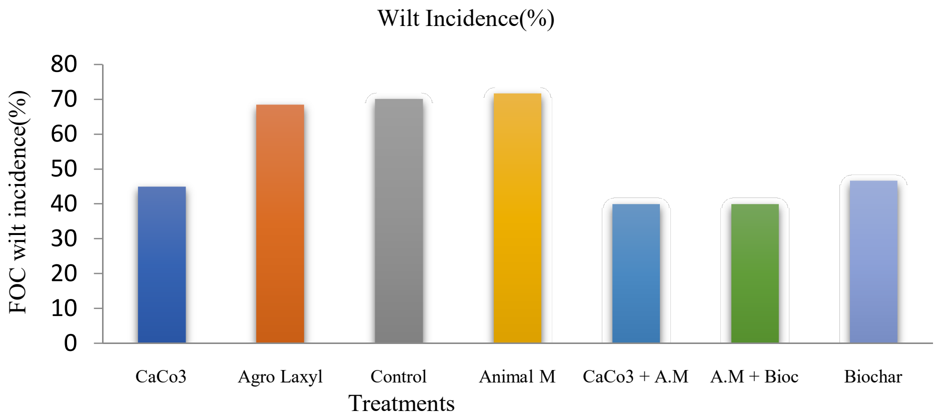


Figure 1. Incidence of Hot pepper fusarium wilt among treatments (2019)

The hot pepper fusarium hot spot were selected by isolating the wilt causing agents in Melkassa plant pathology laboratory. The sequential steps were followed upon confirmation of the causal agents and other than identifying the causal pathogen after treating the plots further confirmation were done. Unfortunately, none of the treatments were effective but relatively there is variation. This experiment will be repeated within the same sick plot in the coming main season, 2020. The significance of fusarium wilt increases with increasing the age of hot pepper. This show that when the plant is busy by physiological growth the activity of the pathogen increases logically.

Table 2. Management of hot pepper fusarium wilts through soil amendment approach

Treatments	Wilt Incidence (%)	Healthy Plant (%)
CaCo3	45	55
Agro Laxyl	68	32
Control	70	30
Animal M	72	28
CaCo3 + A.M	40	60
A.M + Biochar	40	60
Biochar	47	53

O f;A.M (Animal manure); $CaCo_3$ (Calcium carbonate)

Figure 2. Picture showing the difference among treated and untreated plots at vegetative stage

rb g i f f fb ; Severity assessment will beconducted in site of the Central Rift Valley in the coming main season in 2020. Hot pepper germplasm evaluation for the reaction to fusarium wilt and integrated management will be done in the coming season of 2020.

kfd j rfi 3; Development of Pest Management Technologies for Warm Season Vegetable Crops
kfd f j e; January 2017 - June 2020
Bd j j j rfi 2; A ssessment of postharvest diseases of tomato, snap bean and onion crops in Central Rift valley of Ethiopia
Bd j j f j e; July 2017 - June 2020
P ckfd j f <

- To study prevalence and incidence of post harvest diseases
- To prioritize further research on postharvest disease management

S f jc rfi f ; Endriyas G. and Abebe G.
S f fe c ; Endriyas Gabrekiristos
Zfb g f ; January - December 2019
T b g i f h f
Ef jh ;
U fb f ; Survey
M db j ; AdamituluJidokombolcha area, Adama, NegelleArsi, Hawasa area, Aleta wondo, and Aleta Chuko

S f m
On onion, besides bulb rot and purple blotch diseases observed during survey (Table 3), *Colletotrichum*, *Aspergillus* and *Pencillium* spp. were also recovered from onion samples brought to the laboratory. On tomato, however, it was mainly early blight, followed by anthracnose (Table 3); and *Fusarium* sp. in the lab. Snap bean was not encountered on market places surveyed.

Table 3. Severity and incidence of onion and tomato postharvest diseases

D	Ej fb f	M db j	Tf f j)1.6*	J djef df	Zfb
Onion	Purple blotch	Wolaita Sodo	1.5 (± 0.0)	15.0 (± 0.0)	
		Arba Minch	2.0 (± 0.5)	30.0 (± 0.0)	
	Bulb rot	Wolaita Sodo	1.8 (± 0.8)	30.0 (± 21.2)	
		Areka	1.9 (± 1.0)	17.5 (± 10.6)	
		Arba Minch	0.5 (± 0.0)	15.0 (± 0.0)	2018 EC
Tomato	Early blight	Wolaita Sodo	1.0 (± 0.5)	10.0 (± 7.1)	
		Areka	1.0 (± 0.8)	18.3 (± 2.9)	
		Arba Minch	2.5 (± 0.4)	22.5 (± 3.5)	
	Anthracnose	Wolaita Sodo	1.4 (± 0.6)	15.0 (± 5.0)	

rb g i f f fb ; The last assessment will be done in the nearby, 2020 and will be completed.

Bd j j j rfi 3; Studies towards an Integrated Management of wilt complex of hot pepper with special focus on Fusarium Wilt (*Fusarium oxysporium*) in Central Rift valley of Ethiopia
Bd j j f j e; July 2017 - June 2020
P ckfd j f0 0<

1. To evaluate genetic resistances of pepper against fusarium wilt isolate with highly pathogenic fungi in glass house
2. To evaluate antagonists against fusarium wilt
3. To evaluate fungicide against fusarium wilt of pepper.
4. To evaluate soil amendment with activate silicon and compost to manage fusarium wilt of pepper

S f jc rfi f ; Endriyas G. and Horticulture staff
S f fe c ; Endriyas Gabrekiristos
Zfb g f ; January - December 2019
T b g i f h f
Ef jh ; CRD
U fb f ; 6(Table 5)
M db j ; Melkassa

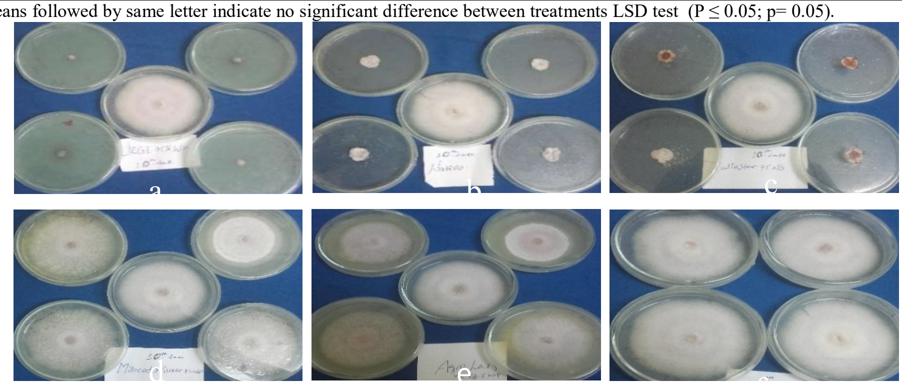
S f m

The inhibitory effect of selected fungicides on the growth of *Fusarium oxysporum* was evaluated under *in vitro* studies. The obtained results are presented as following/ The *in vitro* mycelial growth inhibition of five fungicides at recommended dose was added to un molten PDA just before pouring it into plates and the virulent FOC isolate 4DGK, isolated from infected hot pepper fields in Dugda district and identified as the most aggressive isolates was evaluated in a dual culture assay. Statistical analysis revealed that, URGI 75% WP, Twinstar 75 WG and Nativo SC 300 was best performing in inhibiting mycelial growth of test organism among *in vitro* evaluated fungicides. Three fungicides having the nature of both systemic and contact action strongly inhibited the growth of the test fungi (Table 5, Figure 3). URGI 75% WP (Carbendazim + Mancozeb; 120 + 640 g/Kg), Nativo SC 300 (Trifloxystrobin + Tebuconazole; 100:200g/l), Twinstar75 WG (Trifloxystrobin + Tebuconazole; 50:25 % w/w) led to 98.8, 94.0 and 92.3% inhibition of mycelia*,* respectively. However, the minimum inhibition in mycelial growth was recorded in Mancodex Super 72 WP (Metalaxyl + Mancozeb 80:640g/kg), 2.9% and Agro Laxyl MZ 63.5 WP (Mancozeb + Metalaxyl 56:7.5 %), 6.5% that was significantly lower than rest of the treatments (Table 5; Figure 3). Interestingly, URGI 75% WP (Carbendazim + Mancozeb; 120 + 640 g/Kg) is best performing fungicide in this study. Carbendazim recorded complete inhibition of mycelial growth at 2000 and 3000 ppm at all depths, followed by benomyl at 1000, 2000 and 3000 ppm only at 5 cm depth as soil drench (Jaywant Kumar Singh, 2016).

Table 4. Effect of fungicides on mycelial growth of *Fusarium oxysporum* f.sp*capsici after ten days*

Treatments	Means of Radial growth	%Inhibition
URGI 75% WP	0.05^{a}	98.8^{a}
Nativo 75WG	0.25^{b}	94.0^{b}
Twinstar75 WG	0.3^{b}	92.3^{b}
Agro Laxyl MZ 63.5 WP	3.9^{c}	6.5^{c}
Mancodex Super 72 WP	4.1^{d}	2.9^{d}
Mock	4.2^{e}	0.0^{e}
CV (%)	2.64	2.88
LSD(0.5)	0.08	2.13

Means followed by same letter indicate no significant difference between treatments LSD test ($P \leq 0.05$; p= 0.05).



Gjh f 4/ Mycelial growth inhibition of 4DGK with different (a. URGI 75% WP, b. Nativo SC 300, c. Twinstar75 WG, d. Mancodex Super 72 WP, e. Agro Laxyl MZ 63.5 WP, f. Mock) after 10 day post incubation

rb g if f fb ; Effective fungicide obtained from *in vitro* evaluation will be evaluated in the field condition through root Deeping in the coming main season of 2020.

kfd 4; Integrated pre- and post-harvest pest management of tropical and sub tropical fruit crops

kfd f j e; July 2016 – June 2020

Bd j j 2/ Screening of papaya germplasms for tolerance/ resistance to black spot disease

Bd j j f j e; July 2016 – June 2019

P ckfd j f

- To identify resistant/tolerant line(s) against papaya black spot disease

S f jc rfi f ; Endriyas G. and Wegayehu A.

S f fe c ; Endriyas Gabrekiristos

Zfb g f ; January - December 2019

T b g if h f

Ef jh ; CRD (single line)

U fb f ; 110 papaya lines (31 germplasm in this shift)

M db j ; Melkassa

S f m

Thirty-one more dioecious lines were screened. Only MK-120 L#94 exhibited moderate resistance (Table 5).This is the last phase of this activity. The overall incidence among lines was 100% which shows none of the 31 lines were free of the pathogen. Now days this pathogen is emerging significantly in the central Rift valley of Ethiopia.

Table 5. Reaction of papaya germplasm to black spot (*Asperisporium caricae*)

Trt	Plot	MDS	DI (%)	Trt	Plot	MDS	DI (%)
MK-120 L#94	1	2.0(0.5)	100	WL-140 L#487	17	3.6(0.2)	100
MK-124 L#324	2	2.4(0.4)	100	MK-120 L#82	18	3.6(0.2)	100
MK-110 L#80	3	2.8(0.3)	100	MK-116 L#324	19	3.6(0.2)	100
MK-110 L#80	4	3.0(0.3)	100	MK-120 L#92	20	3.6(0.1)	100
ZY-129 L#621	5	3.0(0.3)	100	KK-102 L#70	21	3.6(0.1)	100
ZY-125 L#121	6	3.2(0.2)	100	KK-101 L# 479	22	3.8(0.1)	100
KK-102 L#214	7	3.3(0.2)	100	MK-111 L#194	23	3.8(0.1)	100
MK-114 L#662	8	3.3(0.2)	100	MK-123 L#587	24	3.8(0.1)	100
MK-03 L#149	9	3.4(0.2)	100	CMF-061 L#101	25	3.8(0.1)	100
CMF-061 L#90	10	3.4(0.2)	100	WN-139 L#136	26	3.8(0.1)	100
MK-127 L#305	11	3.4).2)	100	MK-03 L#144	27	3.8(0.1)	100
ZY-124 L#266	12	3.5(0.2)	100	MK-116 L#310	28	3.9(0.1)	100
MK-114 L#295	13	3.5(0.2)	100	MK-105 L#45	29	4.0(0.1)	100
MK-118 L#15	14	3.6(0.2)	100	MK-116 L#	30	4.0(0.1)	100
ZY-132 L#103	15	3.6(0.2)	100	MK-118 L#16	31	4.1(0.0)	100
ZY-123 L#587	16	3.6	100				

Note: 0-1(Highly resistant); 1.1-2.0(Moderately resistant); 2.1-3.0(Susceptible); >3.1(Highly susceptible, the number in bracket designate standard deviation, Trt (treatment); MDS (mean disease severity); DI (disease incidence)

rb g if f fb ; all screened lines and disease data will be compiled. Basic information will be generated for further breeding program.

Agricultural Entomology Research Program

S f f b di df ; Plant protection research process

h b ; Agricultural Entomology **)Df fbm'**

kf d 2; Survey of Major crop insect pests

kf d f j e; October 2019 – June 2022

Bd j j j rfi2; Survey of parasitoids associated with fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) in the Eastern and Northern parts of Ethiopia

P ckf d j f; To dentify parasitoids associated with fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) in the Eastern and Northern parts of Ethiopia

Bd j j f j e; February 2020 – June 2022

S f jc rfi f) *; Ahmed Ibrahim, Abiy Fikadu and Gashawbeza Ayalew

S f fe c ; Ahmed Ibrahim

Zf b g f ; January - December 2019

T b g i f h f ; All the necessary requirements were prepared to start the survey starting from February-2020.

Ef jh ; Survey

U fb f ; Random sampling of the farmers' field and natural vegetation

M db j ; Eastern and Northern parts of Ethiopia

S f m; Not yet started and will be started on February-2020

rb g i f f fb ; Survey of the activity will be continued

kf d 3; Biological pest management

kf d f j e: June 2019 – June 2015

Bd j j j rfi 2; Screening of maize genotypes for resistance to fall armyworm, *Spodoptera frugiperda*

P ckf d j f: To identify maize genotypes for resistance to fall armyworm, *Spodoptera frugiperda*

Bd j j f j e; September 2019 – June 2023

S f jc rfi f) *; Ahmed Ibrahim, Abiy Fikadu and Gashawbeza Ayalew

S f fe c ; Ahmed Ibrahim

Zf b g f ; January - December 2019

T b g i f h f ; All the necessary materials were prepared to start the activity on April-2020.

Ef jh ; RCD

U fb f ; 300 Maize genotypes

M db j ; MARC

S f m; Not yet started and will be started on February-2020

rb g i f f fb ; screening of the activity will be continued

Bd j j j rfi 3; Screening of Sorghum genotypes for resistance to fall armyworm, *Spodoptera frugiperda*

P ckf d j f; To identify sorghum genotypes for resistance to fall armyworm, *Spodoptera frugiperda*

Bd j j f j e; September 2019 – June 2023

S f jc rfi f) *; Ahmed Ibrahim, Abiy Fikadu and Gashawbeza Ayalew

S f fe c ; Ahmed Ibrahim

Zfb g f ; January - December 2019
T b g i f h f ; All the necessary materials were prepared to start the activity on February-2020.
Ef jh ; RCD
U fb f ; Maize genotypes
M db j ; MARC

S f m; The activity will be started on February-2020
rb g i f f fb ; screening of the activity will be continued

Bd j j j rfi4; Evaluations of push-pull system for the managements fall armyworm, *Spodoptera frugiperda* (J E Smith) on maize
P ckfd j f; To evaluate push-pull system for the managements fall armyworm, *Spodoptera frugiperda* (J E Smith) on maize
Bd j j f j e; October 2019 - June 2022
S f jcrfi f) *; Ahmed Ibrahim, Abiy Fikadu and Gashawbeza Ayalew
S f fe c ; Ahmed Ibrahim
Zfb g f ; January - December 2019
T b g i f h f ; the activity was started and data collections are underway
Ef jh ; RCBD
U fb f ; *Desmodium uncinatum, Desmodium intortum*Brachiaria cv Mulato II, chemical (Belt/tracer) and check
M db j ; MARC (responsible by MARC Researcher), Werer (responsible by Werer group), Jima (responsible Jimma group)

S f m; Data collections are underway
rb g i f f fb ; The activity will be continued

Bd j j j rfi 5; Preliminary observation of sugar cane bi-product (molasses) trapping efficacy of fall armyworm moth on Sorghum and Maize crops
P ckfd j f; To evaluate sugar cane bi-product (molasses) trapping efficacy of fall armyworm moth on Sorghum and Maize crops
Bd j j f j e; June 2019 - December 2019
S f jcrfi f) *; Ahmed Ibrahim, Abiy Fikadu and Gashawbeza Ayalew
S f fe c ; Ahmed Ibrahim
Zfb g f ; January - December 2019
T b g i f h f ; the activity was implemented for one year and all the necessary data collections were completed
Ef jh ; RCBD
U fb f ; *Mollasse, phermon lure and check without lure*
M db j ; MARC and Miesso

S f m

Molasses trap, pheromone trap and check without lure were evaluated for FAW trapping efficacy on both maize and sorghum crops. Maximum number of FAW recorded in pheromone trap (644) followed by Molasses trap (571) during the experimental season at MARC on maize. Similarly number of FAW trapped in phermone trap(724) followed by molasses trap (650) during the experimental season on Sorghum at Miesso. This is in line with somchai-2001, reported that 387 lepodopteran were trapped in molasses trap on vegetable (cabbage) pest management (Thailand). Similarly, according to Berhanu Weldu-2016, 7011 months were trapped in mollases trap on 428 farmer's fields. In pheromone trap only FAW and very few other insects were trapped, because of trapping specificity. But in molasses trap, insects from Diptera, other lepidopteran, colleoptera and hymenoptera were also trapped. On the other hand, the experiment at miesso (Sorghum) trapped maximum number of FAW (724) compared to MARC(maize) experiment (647). Even though maximum number of FAW was trapped in pheromone trap, almost equivalent number of FAW was also recorded in molasses trap both on maize and sorghum (Figure1 and Figure2). It was confirmed that, molasses can trap FAW next to phermone trap, as the results, it is better to evaluate the efficacy of molasses for the management of FAW.

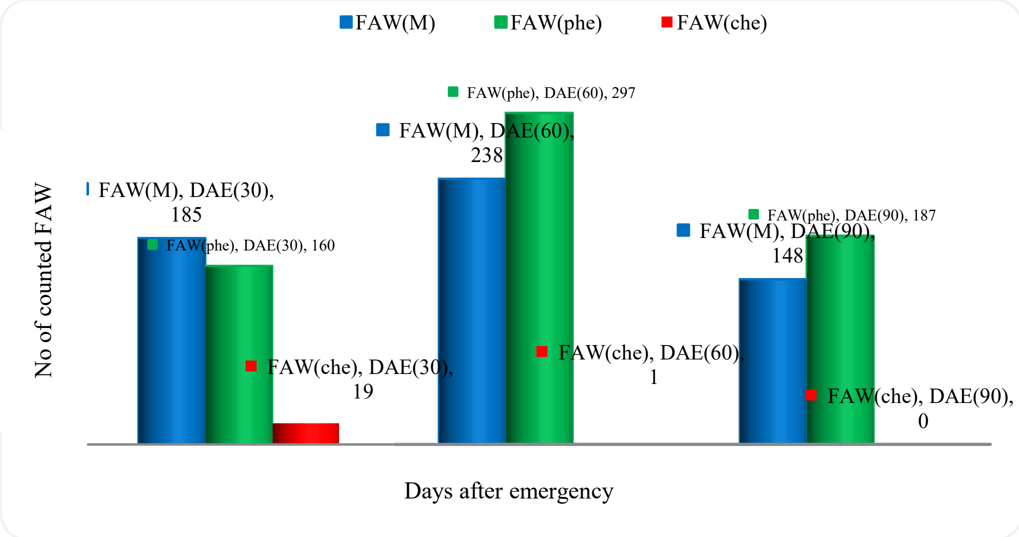


Figure1: Trapping efficacy of molasses and phernmone traps on FAW on maize at MARC

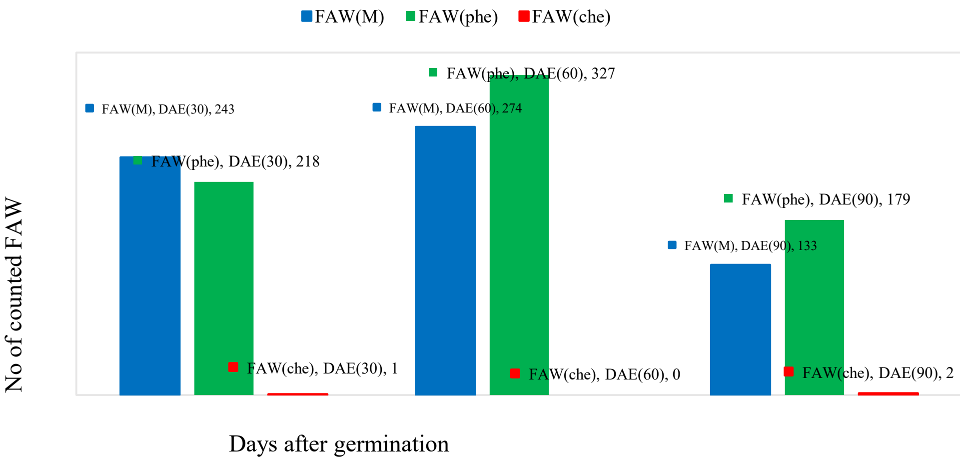


Figure 2: Evaluation of trapping efficacy of molasses and phernmone traps on FAW on Sorghum at Miesso

rb g i f f fb ; The activity is completed

Bd j j j rfi 6; Field evaluation of bio-pesticide against the fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) on maize

P ckfd j f; To evaluate bio-pesticide against the fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) on maize

Bd j j f j e; June 2019 - June 2021

S f jcrfi f) *; Ahmed Ibrahim, Abiy Fikadu and Gashawbeza Ayalew

S f fe c ; Ahmed Ibrahim

Zfb g f ; January - December 2019

T b g i f h f ; The activity was implemented for the first year and data collection and analysis were completed.

Ef jh ; RCBD

U fb f ; Nembicidine, Azadirachta Indica,Metaharzium anisopliae (campaige), Beauvera bassian (botanigard 22wp), Radiant, Lume-500 and untreated check

M db j ; MARC

S f m

Significant differences were observed among the treatments. Significantly lower leaf damage was recorded in biopesticide treatments from 60die to 90 dae compared to untreated check. On the other hand, uniform leaf damage rating was recorded in the untreated check and biopesticide from 15dae to 45dae. Significantly lower leaf damage rating was recorded in chemicals compared to both untreated check and biopesticide.

Table1:The effects of biological control application on FAW on maize at MARC

Tr. No	Treatments	Number of plants after thinning	Number of plants at harvest	FAW leaf damage rating 15dae	FAW leaf damage rating 30dae	FAW leaf damage rating 45dae	FAW leaf damage rating 60dae	FAW leaf damage rating 75 dae	FAW leaf damage rating 90 dae
1	Nembicidine	100.00a	89.00c	3.32a	3.89b	5.21bac	5.62bc	5.73bc	4.97b
2	Azadirachta Indica	97.70b	89.00c	3.51a	4.55ab	4.67bc	4.67c	4.67d	4.96b
3	Biotrin	98.7ab	90.7bc	3.23a	4.85ab	5.41ab	5.50bc	5.13dc	5.08b
4	Metaharzium anisopliae (campaige)	98.00ab	89.33c	4.00a	4.17ab	3.48c	6.00b	5.91b	5.47b
5	Beauvera bassian (botanigard 22wp)	98.00ab	84.33d	3.83a	5.00a	5.67ab	5.83b	5.50bc	4.8b
6	Radiant	98.7ab	96.00a	3.80a	1.00c	1.67d	1.33d	1.00e	0.33c
7	Lume 500	99.30ab	95.00ab	3.67a	1.50c	0.85d	0.00e	0.33e	0.00c
8	Untreated check	97.7b	79.34e	3.20a	4.83ab	6.5a	7.30a	7.83a	6.33a
CV		1.25	2.91	17.65	15.87	24.9	12.97	9.03	14.35
LSD		2.1617	4.5397	1.1	1.06	1.79	1.02	0.7144	1.01

Table 2;The effects of biological control application on FAW on maize at MARC

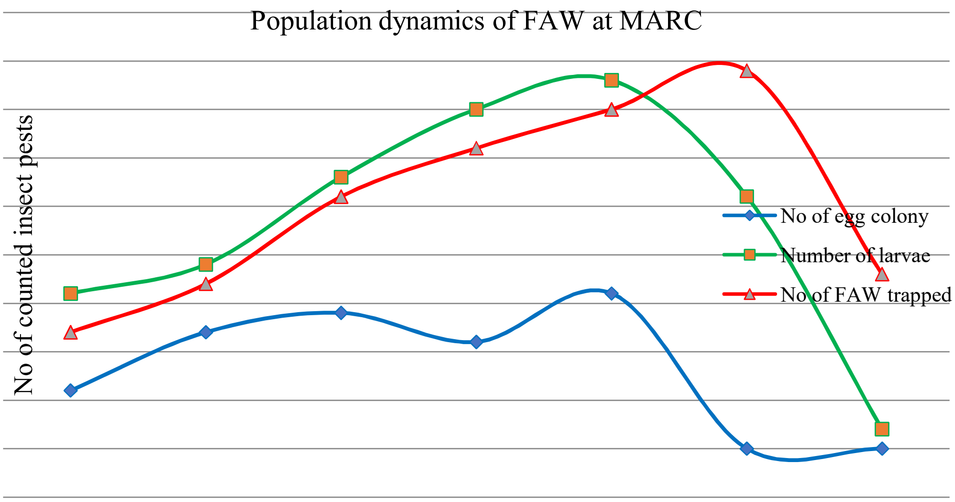
Tr. No	Treatments	No of tassels attacked by FAW	No of plants not produced tassel due to FAW damage	No of cobs and silk attacked by FAW	Yield qt/ha
2	Nembicidine	4.00edc	0.00b	4.33dc	38.96abc
3	Azadirachta Indica	1.33ed	0.00b	2.00dc	39.00abc
4	Biotrin	4.33dc	0.00b	5.33bc	39.00abc
5	Metaharzium anisopliae (campaige)	9.00b	0.00b	9.67b	38.33bc
6	Beauvera bassian (botanigard 22wp)	7.67bc	0.00b	3.00dc	37.7dc
7	Radiant	0.67ed	0.00b	0.33dc	41.00ab
8	Lume 500	0.00e	0.00b	0.00d	41.76a
9	Untreated check	19.33a	2.67a	24.67a	35.00d
DW			40.03	61.23	47.42
MIE			4.06	0.3575	5.1217

rb g i f f fb ; the activity will be continued

kfd 4; Study on population dynamics of FAW on sorghum and Maize
P ckfd j f; U Study population dynamics of FAW on maize and sorghum
kfd f j e: June 2019 - June 2021
Bd j j j rfi2; Study on population dynamic of FAW
Bd j j f j e; June 2019 - June 2021
S f jc rfi f) *; Ahmed Ibrahim, Abiy Fikadu and Gashawbeza Ayalew
S f fe c ; Ahmed Ibrahim
Zfb g f ; January - December 2019
T b g i f h f ; The activity was implemented for one year and all the necessary data collection was completed for the first year
Ef jh ; RCBD
U fb f ; Maize and Miesso
M db j ; MARC

S f m

Number of trapped adults were increasing from 15dae to 75 dae, then declined 75dae. Besides, number of egg mass colony and larvae was increasing as the days after emergency was increasing from 15dae to 45 dae. However, Number of egg mass colony and larvae counted was declined after 45 dae.



Gjh f 2; Population growth status of FAW at MARC on maize
rb g i f f fb ; The activity will be continued

kfd 5; Pre-verification and Verification of pesticide against pests
kfd f j e; June 2018 - December 2019
Bd j j j rfi 2; Verification of FENZ 500 EC against Fall armyworm on Maize
P ckfd j f; To Verify FENZ 500 EC against Fall armyworm on Maize
Bd j j f j e; June 2018 - December 2019
S f jc rfi f) *; Ahmed Ibrahim, Abiy Fikadu and Gashawbeza Ayalew
S f fe c ; Ahmed Ibrahim
Zfb g f ; January - December 2019
T b g i f h f ; All the necessary data collections were completed, analyzed and reporting processes are underway
Ef jh ; RCBD

U fb f ; Tested chemical, standard check and untreated check
M db j ; MARC

S f m
Significant differences were observed among the treatments. Significantly lower leaf damage was recorded in the tested chemical and almost equivalent result was observed with the standard check. As the results, the tested chemical was recommended for the end users.
rb g i f f fb ; completed
Bd j j j rfi 3; Verification of PYROSTM 480 EC against Fall army worm on Maize
P ckfd j f; To Verify PYROSTM 480 EC against Fall army worm on Maize
Bd j j f j e; June 2018 - December 2019
S f jc rfi f) *; Ahmed Ibrahim, Abiy Fikadu and Gashawbeza Ayalew
S f fe c ; Ahmed Ibrahim
Zfb g f ; January - December 2019
T b g i f h f ; All the necessary data collections were completed, analyzed and reporting processes are underway
Ef jh ; RCBD
U fb f ; Tested chemical, standard check and untreated check
M db j ; MARC

S f m
Significant differences were observed among the treatments. Significantly lower leaf damage was recorded in the tested chemical and almost equivalent result was observed in with the standard check. As the results, the tested chemical was recommended for the end users.
rb g i f f fb ; completed

Bd j j j rfi 4;Verification of High-clop Gold 180 CS against fall army worm on Maize
P ckfd j f; To Verify of High-clop Gold 180 CS against fall army worm on Maize
Bd j j f j e; June 2018 - December 2021
S f jc rfi f) *; Ahmed Ibrahim, Abiy Fikadu and Gashawbeza Ayalew
S f fe c ; Ahmed Ibrahim
Zfb g f ; January - December 2019
T b g i f h f ; The activity is new and not yet started
Ef jh ; RCBD
U fb f ; Tested chemical, standard check and untreated check
M db j ; MARC
S f m; The activity is new and not yet started
rb g i f f fb ; The activitywill be implemented starting from Sene-2020

h b ;M rb e mfmF mh

kfd 2; Enhancing production and productivity of lowland pulses (Mung bean, Cowpea, Pigeon pea and others)for livelihood improvement through generation and promotion of demand driven and climate-smart technologies in Ethiopia
kfd f j e ; January 2017 to June 2020
Bd j j j rfi; Yield loss assessment of Cowpea against Aphids
Bd j j f j e ; January 2019 to December 2019
P ckfd j f; To assess yield loss caused by aphid
S f jc rfi f) *; Mulatwa Wondimu and Birhanu Amsalu

S f fe c ; Mulatwa W.

Zfb g f ; January - December 2019

Ef jh ; RCBD

U fb f ; Two variety (Bole and White wonder) of Cowpea were used Spraying Dimethoate 400g/L after 3, 6, 9 and 12 weeks of crop emergence

M db j ; Miesso

T b g i f h f

Spraying of Dimethoate 400g/L after 3, 6, 6+9, and 3 weeks of after crop emergence on Bole and White wonder variety showedsignificantly lower yield losses due to Aphids respectively

S f m

Table 1. Effect of Dimethoate 400g/L spraying on severity score (1-5) and yield qt/ha, against Aphids on Cowpea in, 2019

Time of spraying (Dimethoate 400g/L)	Severity score (1-5)	Grain Yield kg/ha	**Zjfm m &**
3 WAE(Bole)	0.00	800a	9.43
6 WAE(Bole)	0.00	883.3a	0.00
9 WAE(Bole)	0.00	516.7a	41.50
12 WAE(Bole)	1.00a	550.0a	37.73
3+6 WAE(Bole)	1.00a	500a	43.39
6+9 WAE(Bole)	0.00a	641.7	27.35
3+9 WAE(Bole)	0.00a	475a	46.22
3+6+9+12 WAE(Bole)	0.00	550a	0.00
Control	1.00	358.3	59.44
3 WAE (White wonder)	0.00a	616.7a	30.18
6 WAE (White wonder)	1.00a	475a	46.22
9 WAE (White wonder)	0.00a	566.7a	35.84
12 WAE (White wonder)	0.00a	408.3a	53.78
3+6 WAE(White wonder)	0.00a	500a	43.39
6+9 WAE(White wonder)	0.00a	416.7a	52.82
3+9 WAE(White wonder)	0.00a	525a	40.56
3+6+9+12 WAE (White wonder)	0.00a	425a	51.88
D m	**3/1b**	391.7a	55.65
LSD (0.05)	1.55	3.05	
CV (%)	17.55	26.64	

D dm j

Based on three-year results, spraying of Daimethtoate at the rate of 400g/L in 3 weeks and a combination of 3+6+9+12 after crop emergence resulted in lower yield losses due to aphid on Bole & White wonder varieties.

rb g i f f fb ; This research activity is completed

Bd j j 3/ Screening of bean genotypes for their resistance to BSM (Sugar bean & Red mottled)

Bd j j f j e ; January 2019 to December 2019

P ckfd j f; to screen the resistance reaction of bean genotypes to bean stemmagot

S f jc rfi f) *; Mulatwa Wondimu and Birhanu Amsalu

S f fe c ; Mulatwa W.

Zfb g f ; January - December 2019

Ef jh ; RCBD

U fb f ; 27 Sugar bean & 27 Red mottled bean materials

M db j : Negelle Arsi and Areka

T b g i f h f

For the last two years this activity were conducted, however the BSM population was very low, due to the sporadic nature of the pests, but insignificant results were recorded from filed trials (Table 1) On the other hand at the same district but nearby kebeles BSM infestation was very high on Areka experimental trials of bean materials, due to this it will be extended for one year with early planting of bean plants.

Table 2. Response of Bean genotypes to Bean stem maggot at Negelle Arsi location in, 2018/19.

Genotypes	Dead seedling	No of Pupa	Color	Yield kg/ha
DAB-530	8.5a	1.33a	Brown	1600a
DAB-490	2a	3.67a	Brown	1383.3a
DAB-543	1a	1.5a	Brown	1650a
DAB-515	2a	5a	Brown	2166.7a
DAB-492	1a	1a	Brown	2083.3a
DAB-499	5a	3a	Brown	1450a
DAB-506	3.67a	4.67a	Brown	1900a
DAB-510	0	0	-	2266.7a
DAB-512	0	0	-	2083.3a
DAB-475	0	0	-	2116.7a
DAB-487	1a	2a	Brown	2466.7a
DAB-489	3a	7a	Brown	2023.3a
DAB-539	1a	2a	Brown	2250a
DAB-540	2	3a	Brown	1700a
DAB-525	1	3a	Brown	1966.7a
DAB-528	2a	1.5a	Brown	2583.3a
DAB-541	4	7a	Brown	1666.7a
DAB-537	0	0	-	2300.a
DAB-523	4a	3a	Brown	1966.7a
DAB-538	0	0	-	2100a
DAB-522	1a	2a	Brown	2183.3a
DAB-530	1a	1a	Brown	2200a
DAB-490	1a	1a	Brown	2066,7a
DAB-543	0	0	-	2266.7a
DAB-515	1a	2a	Brown	2516.7a
DAB-492	1a	2a	Brown	2233.3a
DAB-499	3	5.5a	Brown	2066.7a
CV	32.4	37.5		

rb g i f f fb : It will be extended for one year

Bd j j 4/ Screening of Cowpea Landraces for resistance to Cowpea Bruchids (*Callosoborucus maculates)*

Bd j j f j e: January 2019 to December 2019

P ckfd j f; to evaluate the resistance reaction of cowpea land races to bruchids

S f jc rfi f) *; Mulatwa Wondimu and Birhanu Amsalu

S f fe c ; Mulatwa W.

Zfb g f ; January - December 2019

Ef jh ; CRD

U fb f ; 105 cowpea land races

M db j : Melkassa

T b g i f h f

Initially the experiment was planned based on 324 cowpea land races, however, only105obtained during experimentation and screened under laboratory reared adult for the first year. From the screened materials, total hatchability was less than ten in fourteen Cow pea land races (Table 3). The rest 219landrace were obtained after the first 105 land races started screening for the first year. As the results, the lately arrived 219 materials also must be screened and based on this, one more year requested to conduct the lately obtained materials and conclude the result of landraces.

Table 3. The number of hatched adults less than 10 bruchids adults

O	Ob f gMb e bdf	B f bhf gd fb be m	N b O g d fb be m
1	NLLP-CPC-07-77-B	0.00	0
2	NLLP-CPC-07-72	0.33	1
3	NLLP-CPC-07-01	1.00	2
4	NLLP-CPC-07-06A	1.00	3
5	NLLP-CPC-03-39B	1.33	4
6	NLLP-CPC-07-17A	1.67	4
7	NLLP-CPC-07-48C	2.67	8
8	NLLP-CPC-07-64A	3.00	9
9	NLLP-CPC-07-101	3.00	9
10	NLLP-CPC-07-18B	3.00	9
11	Bekure	0.33	1
12	NLLP-CPC-07-02A	3.00	9
13	NLLP-CPC-07-51	3.33	10
14	NLLP-CPC-07-33B	3.00	9

rb g i f f fb : It will be extended for one year

kf d 3: Generation and Promotion of bird pest management technologies for enhanced crop
production and productivity in Ethiopia

kf d f j e ; January 2017 to June 2020

Bd j j j rfi: Yield loss assessment of Sorghum grain yield due to Quelabirds

Bd j j f j e : January 2019 to December 2019

P ckf d j f; to assess the yield loss of sorghum caused by quelea birds

S f jc rfi f) *; Mulatwa Wondimu, Selshi G/meskel

S f fe c : Mulatwa W.

Zf b g f : January - December 2019

Ef jh ; RCBD

U fb f ; Three management options (Birds caring, Bag covered, Mesureol and control

M db j : Melkassa

T b g i f h f

In 2019 trial, Bird scaring plot recorded the lowest yield losses due to quelae birds (0%) followed by chemical (Mesurol) treated plots (44.92%) (Table, 2). But higher yield loss was recorded in untreated control (82.749%) followed by Bag covered plots (76.59%)

S f m

Table 4: Response of three management option's in yield loss of Sorghum in, 2019

No	Management options	Stand count	Yield of 40 rows/kg	Totalyield kg/ha	Yield loss (%)
1	Birds scaring	410	41	84.6	-
2	Chemical (Mesurol)	390	8.2	46.6	44.92
3	Bag covered	372	15.4	19.8	76.59
4	Control	421	8.8	14.6	82.74

Zjfm m)Ef j fe jfm. f jfm0Ef j fe jfm* 211

rb g i f f fb : It will be extended for one year

S f fb di df ; Plant Protection

h b ; Agricultural Entomology (Horticulture)

kf d 2; Development of Pest Management Technologies for Warm Season Vegetable Crops

kf d f j e ; July 2017 to June 2020

Bd j j 2; Evaluation and rotational use of registered insecticides for resistance management of thrips affecting onion

Bd j j f j e ; July 2017 to June 2020

P ckfdj f; To evaluate the efficacy of selected insecticide and rotational use for managing insecticide resistance on onion thrips
S f jc rfi f) *; Gashawbeza Ayalew and Abiy Fekadu
S f fe c ; Abiy Fekadu
Zf b g f ; January - December 2019
T b g i f h f
Ef jh ; RCBD with three replications
U fb f 0 ; three insecticides applied as sole and in different rotational sequence along with checks
M db j 0 ; MARC

S f m
Selected insecticides from the previous season were evaluated in different rotation schemes. Among sole applied insecticides, radiant resulted in lower thrips population and higher yield. In the rotation group, insecticide Fighter followed by Radiant and Curador performed better in reducing thrips infestation (Table 1).

Table 1. Thrips number and yield of onion treated with different insecticides applied as sole and in different rotation schemes at Melkassa, 2019

O /	U fb f	O / g i j 06 rb				Zjfm)Lh0 m *
		Date_1	Date_2	Date_3	Total	
1	FFRRCC	236	312	313	861	21.1
2	FFCCRR	259	366	427	1052	19.9
3	RRFFCC	260	353	397	1010	22.4
4	RRCCFF	192	238	438	868	20.8
5	CCFFRR	311	409	338	1058	21.2
6	CCRRFF	292	293	391	976	21.9
7	CCCCCC	268	449	487	1204	18.5
8	RRRRRR	323	302	288	913	21.1
9	FFFFFF	243	401	453	1097	18.8
10	KKKKKK	357	348	583	1288	18.1
11	Untreated	810	763	1103	2676	15.3

*FF – Fighter, RR – Radiant 120 SC, CC - Curador
rb g i f f fb ; The activity will be repeated

Bd j j 3; Evaluation and rotational use of registered insecticides for resistance management of the tomato leaf miner, *Tutaabsoluta*, affecting tomato
Bd j j f j e ; July 2017 to June 2020
P ckfdj f; To evaluate the efficacy of selected insecticide and rotational use for managing insecticide resistance on tomato leaf miner
S f jc rfi f) *; Gashawbeza Ayalew and Abiy Fekadu
S f fe c ; Abiy Fekadu
Zf b g f ; January - December 2019
T b g i f h f
Ef jh ; RCBD with three replications
U fb f 0 ; three insecticides applied as sole and in different rotational sequence along with checks
M db j 0 ; MARC

S f m
Selected insecticides from the previous season were evaluated in different rotation schemes. Among sole applied insecticides, Belt resulted in lower damaged fruit both by number and

weight. From the rotation group, Belt SC 480 followed by Avuant150 SC and Tracer 480 SC performed better (Table 2).

Table 2. Fruit damage and marketable yield of tomato Treated with different insecticides as sole and in different rotation scheme against the tomato leaf miner, *T. absoluta*, Melkassa 2019

O /	**U fb f**	**f df *T. absoluta* eb bhfe g j**		**N b l f bcrfi g j**	
		O cf	**fjhi)l h***	**O cf**	**fjhi)l h***
1	AATTBB	5.3	5.8	385	30.3
2	AABBTT	5.6	4.7	331	28.7
3	TTAABB	7.3	7.9	316	27.7
4	TTBBAA	7.8	7.3	405	32.7
5	BBAATT	4.0	4.2	378	31.1
6	BBTTAA	5.9	6.6	455	36.7
7	AAAAAA	5.4	5.9	301	24.9
8	TTTTTT	8.6	9.3	346	29.0
9	BBBBBB	3.8	4.1	442	35.1
10	CCCCCC	10.0	9.5	378	30.9
11	Untreated	35.3	30.0	192	18.7

**AA – Avaunt 150 SC, BB – Belt SC 480, TT – Tracer 480 SC

rb g i f f fb ; The activity will be repeated

Bd j j 4; Effect of trap direction and position on capture size of *Tuta absoluta* in tomato field

Bd j j f j e ; July 2017 to June 2020

P ckfdj f; To evaluate trap direction and postion on cupturing efficacy of *Tuta absoluta* of tomato

S f jcrfi f) *; Gashawbeza Ayalew and Abiy Fekadu

S f fe c ; Abiy Fekadu

Zfb g f ; January - December 2019

T b g i f h f

Ef jh ; Split plot

U fb f 0 ; 5 trap directions and 3 trap positions

M db j 0 ; MARC

S f m

Traps positioned at crop surface trapped significantly higher number of moths than traps positioned at ground level and 30cm above the crop surface. Traps placed in the East direction trapped higher number of moths, while those in the North direction and center of the field captured lower number of *T. absoluta* adults (Table 3 and Table 4).

Table 3. Number of T. absouta moths trapped on traps placed at different position of the crop

O /	**U fb f**	**Eb f 3**	**Eb f 25**	**Eb f bm**
1	Above crop surface	62	48	1358
2	Crop surface	106	118	2417
3	Ground	63	83	1707

Table 4. Number of *T. absouta* moths trapped on traps placed on different directions in the field

O /	**U fb f**	**Eb f 3**	**Eb f 25**	**U bm**
1	North	60	75	1464
2	East	99	135	2562
3	South	65	68	1618
4	West	100	84	2018
5	Central	63	54	1475

rb g i f f fb ; The activity will be repeated

Bd j j 5; Integrated effect of Host plant resistance and insecticides on whiteflies and their damage on tomato
Bd j j f j e ; July 2017 to June 2020
P ckfdj f; To evaluate the host resistance and insecticides on tomota whiteflies
S f jc rfi f) *;Gashawbeza Ayalew and Abiy Fekadu
S f fe c ; Abiy Fekadu
Zf b g f ; January - December 2019
T b g i f h f
Ef jh ; Split plot, with three replications
U fb f 0 ; 4 tomato varieties with and without insecticide application
M db j 0 ; MARC

S f m

- Whitefly population was similar in both insecticide treated and untreated plots (Table 5)
- The Varieties released by the MARC vegetable breeding team gave higher marketable fruit yield (number and weight) than the tomato yellow leaf curl virus resistant varieties introduced from South Korea (Table 6).

Table 5. Effect of insecticide on whitefly infestation and damage

O /	U fb f	N fb i j fgm /	U bmG j /	U bmg j /
1	Without insecticide	546.6	136.4	13.6
2	With insecticide	531.8	191.7	17.5

Table 6. Effect of host plant resistance on whitefly infestation and damage

O /	U fb f	N fb i j fgm O /	U bmG j O /	U bmg j fjhi
2	K1220	597	90	8.2
3	K1217	618	67	6.7
4	Fetan	406	272	24.9
5	ARP tomato	511	227	22.4

rb g i f f fb ;

Weed Science Research Program

S f fb di df ; rb fd j

h b ; Weed Science Research

kfd 2; Enhancing Production and Productivity of Lowland Pulse (Mung bean, Cowpea, Pigeon pea and others) for Livelihood Improvement through Generation and promotion of Demand Driven and Climate-smart Technologies in Ethiopia.

kfd f j e ; July 2017 to June 2020

Bd j j j rfi 2; Determination of Weed-Crop Competition Period for Mung bean Production in the Central Rift Valley of Ethiopia.

Bd j j f j e ; July 2017 to June 2020

P ckfd j f; to estimate the effect of the timing of weed removal and the duration of weed interference on mung bean yield and to determine the optimum timing for weed control.

S f jc rfi f) *; Workishet Taye and Amare Fufa

S f fe c ; Workishet Taye

Zfb g f ; January - December 2019

T b g i f h f

The critical period for weed control (CPWC) is a period in the crop growth cycle during which weeds must be controlled to prevent yield losses. The preliminary result of the study indicated that 2to 5 weeks period after Mung bean emergence, critical for weeds competition. Knowing the CPWC is useful in making decisions on the need for and timing of weed control. Continuous weed growing caused in 58.8 to 93.07% reduction in yield as compared to weed free plots. This showed that the competitive ability of a given density of weeds emerged with high dependent on the duration they remained in the field with Mung bean. The preliminary result also indicated that the damaging effect of early weed competition was more severe than the late competition.

Ef jh ; RCBD

U fb f ; 14 treatments

M db j ; Melkassa and Negelle Arsi

S f m

Table 1. Mean yield and yield component data of Melkessa Location

Treatments	I	DC	M	6	Z)l h0i b*	2111T	CN
Weed free 7 DACE	33.3	0.1	8.7	92.0	277.8	0.03	4.0
Weed free 14 DACE	31.7	0.2	9.6	91.7	416.7	0.07	3.5
Weed free 21DACE	46.0	0.3	10.1	95.3	375.4	0.07	2.9
Weed free 28 DACE	47.0	0.3	37.8	89.3	459.4	0.28	3.1
Weed free 35 DACE	36.3	0.4	10.1	105.0	695.6	0.20	2.7
Weed free 42 DACE	45.0	0.5	10.9	90.0	694.4	0.31	2.1
No weed control	50.0	0.1	9.3	72.3	277.8	0.20	4.8
Weedy for 7 DACE	46.7	0.5	10.3	92.3	1112.2	0.11	2.0
Weedy for 14 DACE	49.7	0.4	10.3	90.7	1111.8	0.57	2.0
Weedy for 21 DACE	45.7	0.4	10.2	80.7	972.6	0.30	1.1
Weedy for 28 DACE	50.7	0.2	9.3	85.7	833.9	0.31	1.5
Weedy for 35 DACE	48.0	0.3	9.1	88.0	834.3	0.09	2.0
Weedy for 42 DACE	47.0	0.2	8.8	91.3	694.4	0.05	1.7
Weed-free season	48.3	0.4	9.7	95.3	1246.9	0.08	0.6

Table 2/ Mean yield and yield component data of Negelle Arsi

Treatments	I	DC	M	6	Z)l h(i b*	2111T	N
Weed free 7 DACE	42.0	0.2	7.0	77.7	125.6	0.02	1.9
Weed free 14 DACE	42.0	0.3	8.3	81.7	146.5	0.02	0.9
Weed free 21DACE	48.7	0.3	7.9	81.7	224.6	0.06	1.1
Weed free 28 DACE	47.0	0.3	8.0	81.3	295.5	0.04	1.1
Weed free 35 DACE	45.3	0.6	8.0	82.7	171.0	0.03	1.3
Weed free 42 DACE	46.7	0.3	8.6	87.7	156.8	0.06	0.7
No weed control	51.7	0.3	8.7	64.0	105.0	0.02	2.2
Weedy for 7 DACE	49.7	0.7	9.0	87.0	583.0	0.21	0.1
Weedy for 14 DACE	51.7	0.4	8.0	97.3	582.6	0.06	0.0
Weedy for 21 DACE	46.0	0.7	7.7	89.7	548.1	0.05	0.1
Weedy for 28 DACE	51.0	0.8	9.0	93.0	470.9	0.05	0.1
Weedy for 35 DACE	49.3	0.6	8.0	89.7	462.0	0.07	0.3
Weedy for 42 DACE	49.7	0.4	8.4	86.0	398.2	0.06	0.3
Weed-free season	50.7	0.9	9.0	90.3	743.5	0.06	0.0

The mean yield data of one year shows that 35 DACE at Melkessa and 28DACE Negelle Arsi has recorded the highest yield and pod per plant. The highest weed biomass was recorded in both locations on Weedy control and Weed free for 7DACE.

rb g i f f fb ; the activity was completed in 2019 cropping season

Bd j j 3/ Effects of weed control practices on weeds and yields of mung bean (Vigna radiate L.) in the Central Rift Valley of Ethiopia.

Bd j j f j e ; July 2017 to June 2020

P ckfd j f; to determine the effect of weed control practices on weeds and yield of mung bean.

S f jc rfi f) *; Workishet Taye and Amare Fufa

S f fe c ; Workishet T

Zfb g f ; January - December 2019

T b g i f h f

The major weed flora present in the experimental plots were grasses like *Euesine spp*., *Cyperus* and broad leaved weeds like *Xanthium strumarium, Nicandra physalodes, Guizotia scabra, Datura stramonium* and *Galinsoga parviflora*. Small number of weeds were recorded in the treatment consists of pre-emergence herbicides Dual gold with late supplementary hand weeding. Similarly weed biomass per meter square was also reduced by more than 50% when compared to weed check. The highest grain yield was obtained from weed free plot, the integration of s-metolachlor and hand weeding followed by twice hand weeding at 7 and 21 days after crop emergence. Whereas, the lower grain yield was obtained from weedy check. The result also indicated that herbicides alone are not effective without supplementary hand-weeding. This might be due to lately emerging of weeds.

Ef jh ; RCBD

U fb f ; 6 treatmens

M db j ; Melkassa and Negelle Arsi

Sf m

Ubc rfi 4/ Mean yield, yield component and Weed and crop biomass data at Melkessa and Negelle Arsi

Treatments	PH	CB	PL	PP5P	Y(kg/h)	1000SW	BM
N frhb b							
Weedy check	26.3	3	6.3	31.7	76.8	0.02	2.7
Twice HW at 7 & 21 DACE	40.3	0.4	7.7	45.7	103.5	0.03	1.7
S-metolachlor @ 0.96 kg ha-1	35.7	0.07	7.3	43.3	174.4	0.04	1.5
S-metolachlor +HW 28 DACE	37.3	0.02	7	34.7	248.2	0.04	1
S-metolachlor +HW14 & 28 DACE	42	0.1	8	49	299.6	0.03	1
Weed free	37.7	0.01	5.7	51.6	383.2	0.04	1.3
Ofhfrnfi B j							
Weedy check	46.3	0.4	8.3	43	104.6	0.02	1.1
Twice HW at 7 & 21 DACE	46	0.67	8.7	56.3	157.9	0.03	1.1
S-metolachlor @ 0.96 kg ha-1	50	0.6	8.3	54	295.2	0.05	0.7
S-metolachlor +HW 28 DACE	49	0.73	8.7	45.7	376.8	0.04	0.3
S-metolachlor +HW14 & 28 DACE	48.7	0.6	8.7	60.7	415	0.04	0.7
Weed free	47.7	0.02	8	67.7	466.7	0.06	0.1

S-metolachlor at the rate of 0.96 kg ha-1+ hand-weeding at 28 days after emergence and S-metolachlor at the rate of 0.96 kg ha-1+ hand-weeding at 14 and 28 days after emergence has recorded the highest mean yield in both locations. Weedy check and Twice hand-weeding at 7 & 21 days after emergence has recorded the highest weed biomass mean.

rb g i f f fb ; the activity was completed in 2019 cropping season

Technology Multiplication and Seed Research Process

Kedir Oshone
E-mail: kedirosh@gmail.com; phone: +215-922379546

S f fb di df ; Ufdi mh N mj njdb j b e Tffe S f fb di

kfd 2; Development of seed production and postharvest management techniques

kfd f j e; July 2017 – June 2019

Bd j j j nfi 2; Assessment of seed quality of maize seed varieties (Zea mays L.) stored in different storage structures for various durations under different environments at MARC

P ckfd j f; to assess the seed quality of maize seed varieties (Zea mays L.) stored in different storage structures for various durations under different environments at MARC

Bd j j f j e; July 2017 - June 2019

S f jc nfi f ; Kedir Oshone

S f fe c ; Kedir Oshone

Zfb g f ; January - December 2019

T b g i f h f

Storage structures have been purchased to store seeds. Seed purity and evaluation of germination at the initial stage have been carried out. Seed varieties have been stored under cold room & ambient environments. Seeds have been stored & second evaluation time will be started soon.

Ef jh ; CRD

U fb f ;

S1= storage environment (Ambient)

Crop = Maize

Varieties = Melkassa-2, Melkassa-4 and Melkassa 6Q

Packaging materials= Polypropylenes, Pro grain bags and PICS bags

S2= storage environment (cold room)

Crop = Maize

Varieties = Melkassa-2, Melkassa-4 and Melkassa 6Q, Packaging materials= Polypropylenes, Pro grain bags and PICS bags

M db j 0 ; MARC

S f m

Data, data interpretation and conclusion and plan for the next year

Table1: Data of pure seeds, 1000 seed weight, moisture content, germination &vigorisity

Varieties	SC	PS(%)	TSW (g)	MC (%)	SG %	SL (cm)	RL (cm)	SD W	VI-I	VI-II
Melkassa-2	Pbs	98	273.9	13	93	26.75	21.55	2.13	4491.9	198.0
Melkassa-4	Pbs	98.5	275	13.5	92.5	26.49	19.94	2.55	4294.78	235.8
Melkassa-6Q	Pbs	99	227.9	13	91.5	24.72	18.85	1.75	3986.66	160.1

Table 2. Maize stored in cold room with three different packing materials

Var*SS	SG1	SG2	SG3	MC1	MC2	MC3	TSW1	TSW2	TSW3
V1Pb	95.33ab	94.67ab	88a	14.63abc	14b	13.93b	286.30a	274.87a	274.87a
V1Gp	97.33ab	97.33a	76ab	14.77abc	14b	13.73b	281.60ab	275.40a	275.40a
V1PI	96.67ab	93.33ab	85.33a	14.43abc	13.87b	13.73b	268.67b	272a	272a
V2Pb	96.67ab	90.67ab	78.67ab	13.93c	14.30b	13.67b	270.37ab	260.50b	260.50b
V2Gp	97.33ab	82.67bc	74.67ab	14.47abc	14.33b	13.73b	272.63ab	265.97b	265.97b
V2PI	93.33b	82.67bc	62.67b	14.07bc	14.10b	13.57b	270.67ab	261b	261b
V3Pb	97.33ab	77.33c	74.67ab	15.53a	15.27a	15.27a	234.50c	220.80c	220.80c

V3Gp	98.67a	88abc	76ab	15.67a	15.23a	15.13a	227.60c	221.67c	221.67c
V3PI	96.67ab	86.67abc	90.67a	15.40ab	15.17a	15.07a	228.33c	221c	221c
LSD 5%	4.98	13.27	16.81	1.36	0.70	0.86	16.37	5.86	5.86
CV	5.35	2.82	3.53	3.01	8.78	12.48	3.67	1.35	1.35

The results indicated that among the maize seed varieties stored in cold room melkassa-6Q stored in PICS bag showed higher germination percentage (90.67%) at 18 months than the others which fulfilled national seed quality standards.

Table 3. Maize stored in normal room with three different packing materials

Var*SS	SG1	SG2	SG3	MC1	MC2	MC3	TSW1	TSW2	TSW3
V1Pb	89.33ab	82.67a	73.33ab	14.40b	14.13a	13.37a	281.83a	273.73a	267.53a
V1Gp	94.67a	80.67a	88.00a	14.47ab	13.60a	13.30a	281.13ab	271.17a	264.00a
V1PI	86.67ab	80.67a	60.00b	14.30b	13.50a	13.00a	281.00ab	269.00a	264.33a
V2Pb	84.00ab	82.67a	77.33ab	14.53ab	12.90a	13.87a	269.90bc	265.77a	266.13a
V2Gp	77.33ab	79.33a	77.33ab	14.63ab	12.87a	13.87a	267.73c	273.07a	260.73a
V2PI	68.00b	90.67a	89.33a	14.33b	12.87a	13.50a	268.33c	266.00a	259.67a
V3Pb	89.33ab	70.00a	62.67b	14.70ab	14.43a	14.03a	225.63d	225.13b	212.93b
V3Gp	80.00ab	88.67a	73.33ab	14.93a	14.40a	13.93a	229.70d	227.13b	213.57b
V3PI	80.00ab	81.33a	58.67b	14.63ab	14.37a	13.63a	226.33d	223.33b	211.67b
LSD 5%	23.18	23.93	25.2	0.50	1.65	2.45	11.61	11.79	24.41

Among the maize seed varieties stored in normal room melkassa-4 stored in PICS bag showed higher germination percentage (89.335%) at 18 months than the others which fulfilled national seed quality standards.

rb g i f f fb ;

The 4th round seed evaluation will be started soon.

Analysis for each seed quality parameters will be done after 4th evaluation completed.

kfd j rfi; Development of seed production and postharvest management techniques

kfd f j e; July 2017 –June 2019

Bd j j j rfi 3; Assessment of seed quality and quantity loss of common bean under existing threshing and processing methods

P ckfd j f; To assess seed quality and quantity loss of common bean under existing threshing and processing methods

Bd j j f j e; July 2017 - July 2019

S f jc rfi f ; Kedir Oshone

S f fe c ; Kedir Oshone

Zf b g f ; January - December 2019

T b g i f h f

Three varieties of common bean seed have been selected & planted in MARC by four replications during the main season of 2017/2018. After physiological maturity, all seed varieties have harvested & threshed by fourthreshing methods. Seed quality test parameters data for tractor treading; stick beaten, cattle treading &machine threshing methods have been taking. All initial physical, physiological seed quality data have been taking.

Ef jh : RCRD& CRD factorial

U fb f ;

Common bean seed varieties

Awash-02

- Awash-01
- Nasser

Threshing methods (4*3)

- Tractor treading
- Stick beaten,
- Cattle treading &
- Machine threshing

M db j ; MARC

S f m

Table4:-Data of pure, 1000 seed weight, moisture content, germination &vigor

Varieties	PS	IM	OCS	WS	TSW	MC	SG	SL	RL	SDW	VI-I	VI-II
A1	98	1.2	0.8	0	159.35	11.5	97	26.6	7.28	0.55	3286.36	53.35
A2	99	0.8	0.2	0	207.4	12	99	26.27	6.65	0.45	3259.08	44.55
Nasser	99.5	0.5	0	0	218.65	12.5	98	28.55	6.02	0.8	3387.86	78.4

Table 5.Interaction of common bean cultivars and packing materials using letters to denote differences in cultivars and threshing methods for NS, Abs, Ds, PS, IM, Ocs, Ws, MC and TSW.

TtO	U fb f Var. x Thre.	Uf fe ffe bmj b b f f PS %	IM %	Ocs %	Ws %	NS %	Abs%	Ds %	MC %	TSW g
1	V1xT1	98b	1.43ab	0.00a	0.57abc	82cd	6.67a	11.33cd	11.50bc	138.10f
2	V1xT2	97.27b	2.03a	0.00a	0.70ab	84.67c	6.67a	8.67d	11.10c	147.10e
3	V1xT3	98b	1.17bc	0.00a	0.83a	79.33de	8.67a	12bcd	10.90c	141.77ef
4	V1xT4	99a	0.93bcd	0.00a	0.07bc	76.67ef	8a	15.33abc	12.10ab	182.33b
5	V2xT1	99a	0.63cd	0.20a	0.17abc	73.33f	7.67a	19a	12ab	176.43cd
6	V2xT2	99a	0.87bcd	0.00a	0.13bc	76ef	7.67a	16.33ab	11.50bc	139.37f
7	V2xT3	99a	0.77bcd	0.00a	0.23abc	78.67de	7.67a	13.67bc	11.43bc	175.30cd
8	V2xT4	99a	0.87bcd	0.00a	0.13bc	81.33cd	6a	12.67bcd	11.67bc	184.33b
9	V3xT1	99.60a	0.40d	0.00a	0.00c	100a	0.0b	0.0e	12.70a	180.57bc
10	V3xT2	99a	0.57cd	0.33a	0.10bc	96ab	1b	3e	11.60bc	175.67cd
11	V3xT3	99.50a	0.33d	0.00a	0.17abc	94.67b	2.67b	2.67e	11.53bc	173.67d
12	V3xT4	99.20a	0.47cd	0.00a	0.33abc	95.33b	2.67b	2e	11.93ab	194.37a
MIE		0.81	0.71	0.34	0.69	4.63	3.30	4.76	0.78	5.49
DW		0.48	48.17	44.6	143.26	3.53	21.55	20.90	3.96	1.94

rb g i f f fb ;

Data analyses were completing.

kf d j rfi; Development of seed production and postharvest management techniques

kf d f j e; July 2017 – July 2019

Bd j j j rfi 4; Comparative evaluation of different packaging materials for common bean seed quality over various storage periods

P ckf d j f; To evaluate of different packaging materials for common bean seed quality over various storage periods

Bd j j f j e; July 2017 - June 2019

S f jc rfi f ; Kedir Oshone

S f fe c ; Kedir Oshone

Zf b g f ; January - December 2019

T b g i f h f

Three common bean seed varieties produced in 2018/19, cropping season and selected for storage. Before storage, 1st seed quality test parameters, Physical purity, thousand seed weight, Moisture content, Standard germination, Seedlings shoot & root lengths and Seedlings dry weight data were taken. Common bean varieties have stored in five packing materials at usual storage environment.

Ef jh : CRD

U fb f d cj b j ;

Ubc rfi2; treatments combination

V1p1mo	V1p1m1	V1p1m2	V1p1m3	V1p1m4	V1p1m5	V1p1m6
V1p2mo	V1p2m1	V1p2m2	V1p2m3	V1p2m4	V1p2m5	V1p2m6
V1p3mo	V1p3m1	V1p3m2	V1p3m3	V1p3m4	V1p3m5	V1p3m6
V1p4mo	V1p4m1	V1p4m2	V1p4m3	V1p4m4	V1p4m5	V1p4m6
V1p5mo	V1p5m1	V1p5m2	V1p5m3	V1p5m4	V1p5m5	V1p5m6
V2p1mo	V2p1m1	V2p1m2	V2p1m3	V2p1m4	V2p1m5	V2p1m6
V2p2mo	V2p2m1	V2p2m2	V2p2m3	V2p2m4	V2p2m5	V2p2m6
V2p3mo	V2p3m1	V2p3m2	V2p3m3	V2p3m4	V2p3m5	V2p3m6
V2p4mo	V2p4m1	V2p4m2	V2p4m3	V2p4m4	V2p4m5	V2p4m6
V2p5mo	V2p5m1	V2p5m2	V2p5m3	V2p5m4	V2p5m5	V2p5m6
V3p1mo	V3p1m1	V3p1m2	V3p1m3	V3p1m4	V3p1m5	V3p1m6
V3p2mo	V3p2m1	V3p2m2	V3p2m3	V3p2m4	V3p2m5	V3p2m6
V3p3mo	V3p3m1	V3p3m2	V3p3m3	V3p3m4	V3p3m5	V3p3m6
V3p4mo	V3p4m1	V3p4m2	V3p4m3	V3p4m4	V3p4m5	V3p4m6
V3p5mo	V3p5m1	V3p5m2	V3p5m3	V3p5m4	V3p5m5	V3p5m6

V= Varieties, P= packing materials, m= months

M db j ; MARC

S f m

Table6:- Data of pure, 1000 seed weight, moisture content, germination &vigorisity

Wb jf jf	T	JN	P DT	T	UT	N D	TH	TM	S M	TE	WI. J	WI. JJ
A1	98	1.2	0.8	0	159.4	11.5	97	26.6	7.28	0.55	3286.36	53.35
A2	99	0.8	0.2	0	207.4	12	99	26.27	6.65	0.45	3259.08	44.55
Nasser	99.5	0.5	0	0	218.7	12.5	98	28.55	6.02	0.8	3387.86	78.4

Initial (Table 1), the 2nd, 3rd and 4th seed quality test parameters activities were done after seed stored.The result indicated that Awash-1 common bean seed varieties stored in PICS bag and Jute bags packing materials showed higher germination percentage than the others at the 18 months. It is important to store Nasser variety in Polypropylene bag, metal silo and fertilizer bag not more than 12 months.

rb g i f f fb ;

Once the seed quality evaluations done data analysis will be done for each variety & storage structure.

kf d j rfi; Development of seed production and postharvest management techniques

kf d f j e; July 2017 – June 2019

Bd j j j rfi 5; Comparative evaluation of different packaging materials for sorghum seed quality over various storage periods

P ckf d j f; to evaluate different packaging materials for sorghum seed quality over various storage periods

Bd j j f j e; July 2017 – June 2019

S f jc rfi f ; Kedir Oshone

S f fe c ; Kedir Oshone

Zf b g f ; January - December 2019

T b g i f h f

Five packing materials were prepared. Varieties need to be stored were identified. Melkam, Gobiye&Dekaba, Extension was asked and reasons for extension are as follows: Seeds multiplied at Mekhone ARC rejected by regulatory body. Last year we tried to buy the seed from OSE but the seed also rejected by external regulatory body. So that due to shortage of approved pre basic sorghum varieties this activity was not done.

Ef jh : CRD

U fb f d cj b j ;

Table1: treatments combination

V1p1mo	V1p1m1	V1p1m2	V1p1m3	V1p1m4	V1p1m5	V1p1m6
V1p2mo	V1p2m1	V1p2m2	V1p2m3	V1p2m4	V1p2m5	V1p2m6
V1p3mo	V1p3m1	V1p3m2	V1p3m3	V1p3m4	V1p3m5	V1p3m6
V1p4mo	V1p4m1	V1p4m2	V1p4m3	V1p4m4	V1p4m5	V1p4m6
V1p5mo	V1p5m1	V1p5m2	V1p5m3	V1p5m4	V1p5m5	V1p5m6
V2p1mo	V2p1m1	V2p1m2	V2p1m3	V2p1m4	V2p1m5	V2p1m6
V2p2mo	V2p2m1	V2p2m2	V2p2m3	V2p2m4	V2p2m5	V2p2m6
V2p3mo	V2p3m1	V2p3m2	V2p3m3	V2p3m4	V2p3m5	V2p3m6
V2p4mo	V2p4m1	V2p4m2	V2p4m3	V2p4m4	V2p4m5	V2p4m6
V2p5mo	V2p5m1	V2p5m2	V2p5m3	V2p5m4	V2p5m5	V2p5m6
V3p1mo	V3p1m1	V3p1m2	V3p1m3	V3p1m4	V3p1m5	V3p1m6
V3p2mo	V3p2m1	V3p2m2	V3p2m3	V3p2m4	V3p2m5	V3p2m6
V3p3mo	V3p3m1	V3p3m2	V3p3m3	V3p3m4	V3p3m5	V3p3m6
V3p4mo	V3p4m1	V3p4m2	V3p4m3	V3p4m4	V3p4m5	V3p4m6
V3p5mo	V3p5m1	V3p5m2	V3p5m3	V3p5m4	V3p5m5	V3p5m6

V= Varieties, P= packing materials, m= months

M db j ; MARC

Sf m

Due to shortage of sorghum seed varieties the activity will be carried out in this season.

rb g if f fb ;

- Storing process will be carried out immediately after first seed quality test parameters will be completed.
- Seed storage & other quality parameters will be done.

kfd j rfi; Development of seed production and postharvest management techniques

kfd f j e; July 2017 – June 2019

Bdj j j rfi 6; Assessment of seed borne pathogens and physiological quality of common bean seeds produced under different seed production system in CRV.

Pckfdj f; **b**ssess seed borne pathogens and physiological quality of common bean seeds produced under different seed production system in CRV

Bdj j f j e; July 2017 – June 2019

Sf jcrfi f ; Kedir Oshone

Sf fe c ; Kedir Oshone

Zfb g f ; January - December 2019

T b gif hf

Seed samples were collected from different partners of East Shewa& West Arsi Zones& some quality parameters test were done last year & doing this year. Seed samples will be collected from different common bean seed producers' partners saved for planting purpose

Ef jh : CRD

U fb f ;

Farmers' seed varieties

FCUs seed varieties

M db j ; CRV

Sf m

Common bean seed varieties were collected from different seed sources of SNNPR.

Quality analysis of common bean seeds collected from different sources (purity, moisture contents, thousand seed weight, and germination) have been done

Healthy test of common bean seeds collected from different seed sources have been also done.

rb g if f fb ;

- Seed samples will be collected from different common bean seed sourcessaved for planting purposein the East Shewa zone.
- Seed samples will be collected & quality parameters will be done.
- Seed quality analysis will be done immediately after seed collection completed.

kfd j rfi; Development of seed production and postharvest management techniques

kfd f j e; July 2017 – June 2019

Bdj j j rfi 7; Comparative evaluation of different packaging materials for maize seed quality over various storage periods

Pckfdj f; evaluate different packaging materials for maize seed quality over various storage periods

Bdj j f j e; July 2017 – June 2019

Sf jcrfi f ; Kedir Oshone

Sf fe c ; Kedir Oshone

Zfb g f ; January - December 2019

T b gif hf

- Seed storing process has been done at usual storage environment
- Seed were stored in five packing materials and testing quality will be continued;

Ef jh : CRD

U fb f d cj b j ;

Table 1: treatments combination

V1p1mo	V1p1m1	V1p1m2	V1p1m3	V1p1m4	V1p1m5	V1p1m6
V1p2mo	V1p2m1	V1p2m2	V1p2m3	V1p2m4	V1p2m5	V1p2m6
V1p3mo	V1p3m1	V1p3m2	V1p3m3	V1p3m4	V1p3m5	V1p3m6
V1p4mo	V1p4m1	V1p4m2	V1p4m3	V1p4m4	V1p4m5	V1p4m6
V1p5mo	V1p5m1	V1p5m2	V1p5m3	V1p5m4	V1p5m5	V1p5m6
V2p1mo	V2p1m1	V2p1m2	V2p1m3	V2p1m4	V2p1m5	V2p1m6
V2p2mo	V2p2m1	V2p2m2	V2p2m3	V2p2m4	V2p2m5	V2p2m6
V2p3mo	V2p3m1	V2p3m2	V2p3m3	V2p3m4	V2p3m5	V2p3m6
V2p4mo	V2p4m1	V2p4m2	V2p4m3	V2p4m4	V2p4m5	V2p4m6
V2p5mo	V2p5m1	V2p5m2	V2p5m3	V2p5m4	V2p5m5	V2p5m6
V3p1mo	V3p1m1	V3p1m2	V3p1m3	V3p1m4	V3p1m5	V3p1m6
V3p2mo	V3p2m1	V3p2m2	V3p2m3	V3p2m4	V3p2m5	V3p2m6
V3p3mo	V3p3m1	V3p3m2	V3p3m3	V3p3m4	V3p3m5	V3p3m6
V3p4mo	V3p4m1	V3p4m2	V3p4m3	V3p4m4	V3p4m5	V3p4m6
V3p5mo	V3p5m1	V3p5m2	V3p5m3	V3p5m4	V3p5m5	V3p5m6

V= Varieties, P= packing materials, m= months

M db j ; MARC

S f m

Table 1**;** Data of pure, 1000 seed weight, moisture content, germination &vigor.

Varieties	SC	PS(%)	TSW (g)	MC (%)	SG%	SL (cm)	RL (cm)	SDW	VI-I	VI-II
Melkassa-2	Pbs	98	273.9	13	93	26.75	21.55	2.13	4491.9	198.09
Melkassa-4	Pbs	98.5	275	13.5	93	26.49	19.94	2.55	4294.8	235.88
Melkassa-6Q	Pbs	99	227.9	13	92	24.72	18.85	1.75	3986.7	160.13

Initial (Table 1), the 2nd, 3rd and 4th seed quality test parameters activities were done after seed stored. The germination result obtained from two season indicate that maize seed varieties Melkassa-4 and Melkassa-2 stored in PICS bags and Metal silo showed higher germination percentage than the others at the 18 months.Melkassa-6Q stored in metal silo and polypropylene bags lined with plastics/fertilizer bag/ showed the least germination percentage.

rb g i f f fb ;

So that the next seed quality tests parameters activities will be done accordingly.

S f fb di df ; Technology Multiplication and Seed Research

kf d j rfi; Seed Systems analysis for selected commodities (Onion, tomatoes and pepper) in CRV

kf d f j e; July 2017 – June 2019

Bd j j j rfi 2; Assessment of major vegetables seed production and handling system in CRV

P ckf d j f; to assess the major vegetables seed production and handling system in CRV

Bd j j f j e; July 2017 – June 2019

S f jc rfi f ; Kedir Oshone

S f fe c ; Kedir Oshone

Zfb g f ; January - December 2019

T b g i f h f

Preliminary data were collected from East Shewa & West Arsi zones Zones. Five districts were selected from East shewa zone whereas three districts were selected from West Arsi zone. Potential Kebeles from each district were identified. Seed producing farmers from each kebele were identified and interviewed. Seed traders were identified from each districtand interviewed.

Ef jh ; CRD

U fb f ; Farmers, Onion, Tomatoes & Pepper varieties
M db j ; MARC & CRV

S f m
Preliminary data were collected from zones and districts AGNROs and experts. Cities &/ towns were identified and seed samples were purchased.
rb g i f f fb ;

- Group discussion, key informants and farmers' interview will be done soon.
- Data cleaning and entering process will be done.

kf d j rfi; Seed Systems analysis for selected commodities (Onion, tomatoes and pepper) in CRV
kf d f j e ; July 2017 – June 2019
Bd j j j rfi 3; Quality analysis of major warm season vegetables seeds collected from different seed sources
P ckf d j f; to analyze the major warm season vegetables seeds collected from different seed sources
Bd j j f j e ; July 2017 – June 2019
S f jc rfi f ; Kedir Oshone
S f fe c ; Kedir Oshone
Zf b g f ; January - December 2019
T b g i f h f

- Warm season vegetable seeds samples were collected from Zones, districts and Kebeles.
- Farmers' cooperative unions & seed traders were identified and seed samples were collected from them.
- Seed producing farmers were identified and seed samples were collected.

Ef jh ; CRD
U fb f ;
Collected onion, tomatoes & pepper varieties
M db j ; MARC
S f m ; Secondary data have been collected from different agricultural offices from Zones, Districts, Kebeles& seed dealers also.
Seed quality parameters (Moisture contents, Purity, thousand seed weight, germination & vigorisity) for each treatment were done in the laboratory at MARC.
rb g i f f fb ;
Data cleaning and quality analysis will be done soon.

kf d j rfi; EG Seed production, internal quality control and seed business management
kf d f j e ; July 2017 – June 2019
Bd j j j rfi 2.5; Field and laboratory seed quality evaluation for early generation varieties of different crops (Maize, Sorghum, common bean & worm season vegetable seed varieties)
P ckf d j f; f bmb f field and laboratory seed quality for early generation varieties of different crops (Maize, Sorghum, common bean & worm season vegetable seed varieties)
Bd j j f j e ; July 2017 – June 2019
S f jc rfi f ; Kedir Oshone
S f fe c ; Kedir Oshone
Zf b g f ; January - December 2019
T b g i f h f
Field and laboratory seeds evaluation of maize, sorghum, common bean and warm season vegetable (onion and pepper) seed varieties at field & lab condition were carried out.

Quality parameters of all seed crops were evaluated in comparison with national seed standards.

Ef jh ; CRD

U fb f ; Maize, Sorghum, C. bean & vegetable seed varieties

M db j ; MARC

S f m

Lab & field data were tested & correction measures (Field & lab standards) have been taken.

Table 1. Field and Laboratory evaluation result of EGS OPV maize production (Pre basic & Basic)

Bd j b f	**T b eb e**	**Zfb f m g bmj b b f f**
		2019
1. Field evaluations		
Rotation (min., crop season)	1	1
Isolation (min., m)	400	400
Off type (Max.,%)	0.1	0
Disease at final inspection (Max., %)	0	0
Filed inspection (Max., freq.)	3	3
Noxious weed plant at final inspection (Max., %)	0	0
2. Laboratory standards		
Pure seed (min. %)	99	99.9
Other seeds (max. %)	0.1	0
Noxious seed (max. %)	0	0
Inert matter (max. %)	0.9	0.1
Germination (max. %)	85	96
Moisture content (Max.%)	13	11.3

rb g if f fb 0 fb ; Laboratory seed quality evaluation for early generation seeds & quality analysis will be done.

S f m

Lab & field data were tested & correction measures (Field & lab standards) have been taken.

Table 2. Field and Laboratory evaluation result of EGS common bean production (Pre basic & Basic)

Activates	Standard	Year & results of quality parameters
		2019
2/ Gjf m f bmb j		
Rotation (min.cropp. season)	1	1
Isolation (min. m)	10	10
Off type (Max. %)	0.1	0
Disease at final inspection (Max.,%)	0	0
Filed inspection (Max)	3	3
3/ Mbc b b eb e		
Pure seed (min. %)	99	99.9
Other seeds (max. %)	0	0
Inert matter (max. %)	1	0.1
Germination (max. %)	75	92
Moisture content (Max. %)	12	12.5

rb g if f fb 0 fb ; Laboratory seed quality evaluation for early generation seeds & quality analysis will be done.

S f m

Field and Laboratory evaluation result of EGS Mung bean seed production (Pre basic & Basic)

Table 3. Field and Laboratory evaluation result of EGS mung bean production (Pre basic & Basic)

Activates	Standard	Year & results of quality parameters
		2019
2/ Gjf m f bmb j		
Rotation (min.cropp. season)	1	1
Isolation (min. m)	5	5
Off type (Max. %)	0.1	0
Disease at final inspection (Max. %)	0	0
Filed inspection (Max)	2	2

3/ Mbc b b eb e		
Pure seed (min. %)	98	99.9
Other seeds (max. %)	0.1	0
Inert matter (max. %)	1.9	0.1
Germination (max. %)	80	94
Moisture content (Max. %)	12	12

rrb g i f f fb 0 fb ; Laboratory seed quality evaluation for early generation seeds & quality analysis will be done.

kfd j rrfi; EG Seed production, internal quality control and seed business management
kfd f j e; July 2017 – June 2019
Bd j j j rrfi 6.9; Early generation seed multiplication of released (maize, mung bean, common bean & worm season vegetable) seed varieties
P ckfd j f; to multiply early generation seed of released (maize, mung bean, common bean & worm season vegetable) seed varieties
Bd j j f j e; July 2017 – June 2019
S f jcrrfi f ; Kedir Oshone
S f fe c ; Kedir Oshone
Zfb g f ; January - December 2019
T b g i f h f

N bj f ffe ;

- Maize seed varieties including lines (5) were multiplied at MARC.
- After physiological maturity each seed varieties were harvested
- Selection of seed varieties at cob level were done
- Selected cobs for seeds were threshed
- Seed cleaning process finished
- Each maize seed variety was tested for physical purity & physiological seed quality
- Seed distributions to different stakeholders were completed.

D cfb ffe ;

Seven common bean seed varieties were multiplied at MARC

- Each common bean seed varieties were tested for physiological maturity
- After physiological maturity each seed varieties have been harvested and threshed separately
- Seed cleaning process were done.
- Each common bean seed varieties were tested for physical purity & physiological seed quality.
- Seed distributions to different stakeholders were completed.

N h cfb ffe ;

One mung bean seed variety was multiplied at MARC

- Seed variety was tested for physiological maturity
- After physiological maturity seed varietyhave been harvested and threshed.
- Seed cleaning process was done.
- Mung bean seed variety was tested for physical purity & physiological seed quality.
- Seed distributions to different stakeholders were completed.

b fb fhf bcrrfi ffe;

- Onion seed variety of Nafis multiplication has been done.
- Harvesting, drying & threshing processes were done & seed distribution was in the progress.
- Even though the frost was occurred reasonable seed yield was obtained.
- Seed cleaning process was done& distribution process was carried out.
- Malkaawaze(pepper) seed multiplication was done.
- Seed cleaning process was completed and distributed to different stakeholders were also started.

Ef jh ; No design.
U fb f ;
Maize, mung bean, common beans& vegetable seed crop varieties
M db j ; MARC

S f m

- Raw seeds of common bean varieties obtained were 542.9 qt.
- Raw seeds of maize varieties obtained were 574.38 qt.
- Cleaned seed obtained from one mung bean variety was 4 qt.
- Cleaned merakofana (pepper) obtained was 80 kg.
- Cleaned melkaawaze (pepper) obtained was 16kg.
- A cleaned seed obtained from one onion variety was 16 kg.

rb g i f f fb ;Early Generation seed multiplication of improved crops varieties will be cleaned and distributed to different stakeholders.