Annual Report 2020

Melkassa Agricultural Research Center

Ethiopian Institute of Agricultural Research

Annual Report 2020

Editorial team

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Ethiopian Institute of Agricultural Research

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Preface

This Annual Report highlights the major research findings, achievements and services provided at Melkassa Agricultural Research Center (MARC) of the Ethiopian Institute of Agricultural Research (EIAR) in2020. The report includes the output in research wing in Crops, Livestock, Natural Resource Management, Agricultural Engineering, Agricultural Economics, Agricultural Extension and Communication, Plant Biotechnology, Plant Protection, and Technology Multiplication and Seed Research. The report provides a concise summary of findings that can be used by researchers and concerned development practitioners. This report isa vital document existed in the research tradition that needs to be renewed and upheld in the modern research communication system so that information or evidence is accessible in both soft and hard copies.

I am thankful to the research and support staff of MARC for their contributions to produce this report by making ground works and facilitations at every point. I am highly obligated to the organizing and editorial team who took the handwork in cleaning and shaping the bulk of data or information and presenting concisely in this handy document.

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Agricultural Economics Research

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The following are the major outputs of the Agricultural Economics Research Process.

1. Staff capacity development trainings

In 2020, different capacity development trainings were organized at MARC for the research staff. Five from MARC and four from Kulumsa ARC participated on scientific writing while five MARC research participating on automated data collection software (CSPro) training. Besides, two researchers participated on the use of data collected by CSA organized by the directorate. One researcher participated on awareness creation workshop organized by Oromia regional state investment bureau (December 24, 2020) on Integrated Agricultural Industrial Development Parks (IAIDP). On the workshop, the role of IAIDP in rural economic transformation and contribution of stakeholders were discussed.

2. Technical Efficiency of Irrig

farm income, and ownership of irrigation facilities have shown significant and positive impacts on the level of efficiency. We recommended that tomato growers should use pesticides with recommended rates. More prominently, efficient resource use (labor, fertilizer, land, and seed) should be farmers focus so that farmers benefit from increased efficiency from onion and tomato production.

3. Common bean production economics analysis in the Central Rift Valley (CRV) of Ethiopia.

This study investigated the economic viability of smallholder farmer's common bean production in the Central Rift Valley in Ethiopia. The data were analyzed using descriptive statistics, profitability ratio, and enterprise budget analytical methods. From the result labor, land, oxen draft power, fertilizer and seed were the major input costs of common bean production accounting for 43, 25.3, 14.7, 9.5 and 7.5 percent, respectively. From the result one can conclude that that farmer obtained about 14017 and 1807 (ETB) per hectare on average revenues from common bean grain and straw yield sales, respectively. The total variable cost of common bean averaged 12660 ETB /ha, with an average Gross Return (GR) of 15825 ETB /ha, which resulted in a Gross Margin (GM) of 3165 ETB /ha. The benefit-cost ratio (BRC) of 1.25 showing the enterprise is profitable. Adoption of improved varieties and management practices can improve the gains of farm households in the area.

4. The nexus of income diversification and welfare:

Income diversification plays an important role in addressing th adverse

analyses the impact of income diversification on household welfare. A two-

lower education achievement. Cultivated farm size was also found to encourage diversification. While fragmented poverty prevailed in the study area, significant improvements were observed over time. The results further show that income diversification has a positive influence on gross income while reducing the propensity of poverty. Furthermore, variables like farming experience, gender dependency ratio, cultivated land size, livestock, crop diversification index and agroecology are important factors affecting desirably both vulnerability and poverty levels.

5. Value creation and sorghum-based products: what synergetic actions are needed?

There is limited information on the extent of utilization of sorghum and value addition in the agro-processing sector in the country. The research explores the alternative uses, sorghum-based value-added products, and understanding of existing constraints for introducing the necessary interventions. Results show that the grains of teff, rice, and sorghum are majorly restricted to traditional food products. To a very limited extent, the agro-processing utilization of sorghum is more attributed to the manufacturing of baby foods and feed products. The physical features and nutritional qualities of sorghum products, experience and awareness gaps, and consumer perceptions remain to be the major barriers that limit the competitiveness of sorghum. The complex nature of the system demands empirical research, agribusinesses, and development actors to join hands embarking on the enhancement of nutrition, capacity development, product innovations, and demand creation. Moreover, enhancing farm productivity and the marketable surplus to come up with the inconsistency of supply is crucial for the competitiveness of sorghum.

Agricultural Extension and Communication Research

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Major achievements

On-farm demonstration: demonstration of improved onion (Robaf and Nafis) and sorghum (Tilahun, Argiti, and Melkam) varieties with their production practices were demonstrated in Shanen-Kolu, Gololcha, Lode Hetosa, Adama and Boset districts on 71 farmers'fields (15 women).

The mean yield obtained from the onion demonstration field shows Nafis variety have a better yield performance than the newly released variety, Robaf, in all districts.

Table 1. Yield performance of onion varieties in the demonstration districts

Parameter	Mean demonstration yield over the location				
	Adama (4)	Boset (3)	Lode Hetosa (2)	Gololcha (4)	Shanen Kolu (4)
Potential yield (qt/ha) Robaf					320
Demonstration Yield (qt/ha) of Robaf	146.5	138.0	160.6	145.5	272.6
Demonstration Yield (qt/ha) of Nafis	201.6	208.2	168.2	155.9	257.1
Yield gap over the check (qt/ha)	-55.1	-67.7	-7.6	-10.4	15.5
Percent gap	-27.4	-32.5	-4.5	-6.7	6.0

The mean yield obtained from the sorghum demonstration shows Melkam is the standard check, have better yield performance than the newly released varieties, Tilahun and Melkam in both districts.

Table 2. Yield Sorghum in the demonstration districts

Location	Variety	Number of farmers	Min. yield	Max. yield	Mean yield	SD
Gololcha	Tilahun	27	20.8	33.3	25.9	3.48
	Melkam	27	25	46.9	30.6	7.66
	Argiti	27	22.5	44.9	28.8	6.48
Shanen Kolu	Tilahun	30	25.8	36.6	32.6	3.19
	Melkam	30	33.8	39.6	37.1	1.7
	Argiti	30	28.6	36.6	34.3	1.9

Note: Min.=Minimum; Max.= Maximum

Preferred varieties of common bean and sorghum were scaled up with their recommended production practices through large-scale demonstration approaches in Gololcha, Shanan Kolu, Adama, Shalla, and Shashamene districts. For the common bean, 60 hectares of land was planted to common beanby participating 56 farmers. For the sorghum, 173.5 hectares were covered by participating 383 farmers (346 men and 37 women).

Training: As part of the demonstration, training was organized for farmers, development agents (DAs), and experts. In sum,163 stakeholders were trained on the production and management of improved technologies of onion, common bean, sorghum and maize.

Table 3. Summary of a trainee by technology and expertise and gender

Trainee	Common bean			Onion			Sorghum		
	M	W	Total	M	W	Total	M	W	Total
Farmers	0	0	0	29	9	38	0	0	0
DA	11	2	13	5	0	5	40	2	42
Experts	13	2	15	13	4	17	33	0	33
Total	24	4	28	47	13	60	73	2	75

Note: M=men, W=women

Field days: Field days and media (print and audiovisual) were parts of technology demonstration and promotion. A total of 3430 participants including government officials and farmers at large participated in the field day and gave feedback about the technologies demonstrated (Table 3). During the field days and MARCvisit by various stakeholders, a printed leaflet was

produced in Amharic and Afan Oromo and disseminated to 1000 users.

Table 4. Field day participants in the demonstration (onion, sorghum and common bean) field

Participants	Male	Women	Total
Farmers	2530	662	3192
DAs, Experts, Gov Officials	210	28	238
Total	2740	690	3430

Media coverage's: Common bean and sorghum technologies demonstrated on farmers' fields were also popularized through media.

Table 5. Media coverage in the demonstration

Crops	Location	Media	Minutes on air	Total broadcast
Common bean	Adama	ETV	3.5	2
		OBN	3.4	8
Sorghum	Shanen Kolu	OBN	3.13	4
	Boset	OBN	5.0	2

Exhibitions: MARC participated in the Adama city agricultural exhibition conducted for a week. During our stay, we promoted technologies related to natural resources, mechanization, sorghum, beans, sericulture, vegetable, fruit, and maize. One thousand persons visited our technologies.

Publications

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Agricultural Engineering Research

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Agricultural Engineering Research process has been working on 11 government funded project (45 activities) and 4 external funded projects (6 activities). This activity focuses mainly on technology and information generation, evaluation of developed technologies, promotion or demonstration and multiplication of improved technologies, and giving training for end users. Presently, Agricultural Engineering Research Process is working on small horsepower tractors and engines driven technologies to be availed by its two national programs. The Agricultural Field Machinery Research program and the post-harvest and Product Processing Engineering research programs that are currently functional programs. Thus, this annual report is prepared to highlight the key finding of activities that has been executed in 2020.

Farm Power and Field Machinery Research Program

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Major achievements

1. **Determination of appropriate tillage combination and/or frequency for tef, wheat and barley crops**

A field trial was conducted on tillage combination and frequencies for tef cultivation at Debre Zeit and Melkassa; and wheat cultivation at Kulumsa Agricultural Research Centers. In each location various treatments were applied in RCBD design

in three replications. Data such as field capacity during primary and secondary tillage, soil penetration resistance, sheer resistance, moisture content, plant height, spike height, plant population, weed and tiller, biomass and yield were collected. The treatments used at KARC were; (i) Ploughing with disc plough and harrowing with disc (D+H), (ii) Ploughing with moldboard and harrowing with disc (M+H), (iii), Ploughing with mold board, ripping once along the counter and harrowing with disc (M+R+H). The treatment used at DZARC were; (i) Ploughing with disc and twice harrowing with disc plough(D+2H), (ii)Ploughing with disc and harrowing with disc (D+H), (iii)Ploughing with disc plough, harrowing with disc and compaction (D+H+C), (iv) Ploughing with disc, twice harrowing with disc harrowand compaction (D+2H+C), (v) Ploughing with moldboard, twice harrowing and compaction (M+2H+C) and (vi)Ploughing with moldboard, ploughing with disc plow and harrowing (M+D+H). The experiment was also conducted at MARC.

The treatments used were: (i) Ploughing with disc plough and harrowing with disc harrow (D+H), (ii) Ploughing with disc plough and twice harrowing with disc harrow (D+2H) and, (iii), Ploughing twice with disc plough and harrowing with disc harrow (2D+H). Data analysis result at DZARC trial site showed that M+D+H and M+2H+C gave higher yield and lower weeding time than the rest during the trial pried. At KARC, wheat trial, M+2H and M+R+H resulted in more yield and lower weeding time than the rest.

In general, as frequency of tillage increases, weeding time decrease but the time of ploughing and costs such as fuel and maintenance of tractor and implements increase; as a result, duration of maintenance time reduced. In order to suggest the type of tractor and implement combination at different location, further concrete evidence should be collected.

2. Development of tef seed row planting machine for smallholder farmers

Three successive versions of tef row planting machines namely: hand cranked front pack and backpack and battery-operated front pack were generated and field evaluated at MARC and DARC. The result showed that there is significant difference in field capacity, seed rate and number of tillers per plant between manual row planting and developed row seeders. However, there is no significant yield variation observed between treatments.

Fig.1 Front pack tef row planting machine

3. Development of medium horsepower tractor drawn multi-crop seed drills

A medium size (40 hp) tractor driven, nine row multi crop planter was developed for row planting of cereal crops such as, wheat, barley and tef seeds (Fig 2). It consists of a frame, small furrow opening shovels, seed and fertilizer boxes with fluted type seed metering and scooping type fertilizer metering devices which allows incorporation of both seed and fertilizer at a desired rate. The planter can be used for planting on flat surfaces by creating small furrows with the help of shovel type furrow opener generally under rainfed condition. Furthermore, the planter was provided with four main furrow making bodies for the planting of three rows in one bed under irrigated condition. Depending on agronomic recommendation for different crops, the seed and fertilizer rate can be regulated with an adjustment knob incorporated on metering unit. Based on field

performance evaluation the planter has actual field capacity of 0.17 hr/ha 8.75 /ha fuel consumption, 125-150 kg/ha wheat seed and can apply the desired rate of fertilizer.

Fig. 2 A 40hp attached multi crop planter during performance evaluation.

4. Development of tractor drawn potato row planter

Tractor drawn potato planter was developed for planting operation that can be mounted by 40 hp tractor. The planter consists of scooping type tuber seed metering mechanism, seed tube, and furrow openers, drive wheel and power transmission. The performance evaluation of the planter was carried out at MARC. The planter was evaluated at the speed of 3.0, 3.5 and 4.0 km/h. The seed rate in these operating speeds were 1962.67, 2016.67 and 2103 kg/ha respectively. The average mechanical damage recorded at different hopper filling level (¼ fill, ½ fill and full) was 2.83, 3.38 and 4.46 % respectively. The average germination rate was also obtained as 88.54 %. The average depth of seed placement was found to be 12.18 cm whereas the seed spacing varied from 29.92 to 31.3 cm. The average fuel consumption of the planter was recorded as 10.50 liter/ha.

Fig. 3 A 40hp attached potato planter during performance evaluation.

5. Development of tractor drawn 4 bottoms ridger

The developed prototype was a four-bottom ridge maker capable of making three ridges in one move. It was designed and developed to be drawn by mid horsepower range four-wheel tractors (40 hp and more). Field evaluation results of the ridger showed that, it can make a furrow depth and width of 23.8 and 50 cm respectively. The field capacity of the tractor was 0.89 ha/hr while the tractor was operated at 4.49 km/hr. To make the implement easily maneuverable, the implement was designed to have a total working width of 2 meters and adjustable wings. Only one operator is required to make ridges using this implement.

Figure 4. Tractor mounted ridge maker under operation

6. Technology multiplication distribution and train

- A total of 892 piece of farm implements (200 moldboard plow, 300 tie-ridger, 3 wheat planters, 387 rippers, 2 manually operated lime spreader) were multiplied and distributed to the users in Oromia, Amhara, Tigray and Sidama Regional States with the provision of practical training on the use, handling and adjustment of the technologies. Of these, a total of 405 technologies were distributed in different places. Theoretical and practical trainings were provided for 439 technology users in line with technology distribution. During the events, 245 male and 43 female farmers, 47 male and 21 female development agent, 50 male and 21 female agricultural experts and 9 male and 4 female experts working on disability. Three hundred fifty-one male and 88 female farmers, 290 agricultural experts and district officials were participated.

7. Technical services offered to different

6. Department workshop gave various services for different customers within the center such as maintenance service, prototype manufacturing for the other research departments and other stakeholders.
7. More than 500 people visited the department from different organizations and institutions such as the Ministry of Agriculture, district bureau of agriculture, university students and high and elementary school students

8. Research reports prepared on root crops, appropriate tillage combination for major crops, tef row planting machine, and appropriate mechanization technologies selection and cropping calendar under different agro-ecologies, level of mechanization for coffee production and application and use of on previously generated mechanization technologies.

Fig 5. Technical performance evaluation of the HiSUN HS 750 model and HiSUN SECTOR E1 UTVs with MOINCO

Covid-19 mitigation measures was done by developing, batch producing and distributing 59 hand free leg pressed water dispenser to different research center and organization

Fig 8. Hand free leg pressed water dispenser during distribution for end users

More than 60% Agricultural Engineering Research Directorate G+1 office building work has been constructed (first floor was casted).

Fig. 9 Agricultural Engineering Research Directorate Office building Status

- 10,000 liters holding capacity Elevated water tank tower was constructed.

Fig. 10 Constructed elevated water tank tower

Workshop and office maintenance (gutter work, painting of interior, and exterior wall), garage finishing work (garage door, entrance concrete, painting of interior and exterior wall), rest rooms maintenance (overall maintenance and automatic sensor hand drier installation) was conducted.

Fig. 11 A, worn-out gutter, B, New prepared gutter, C, Structure installation for gutter and workshop exterior wall maintenance, D, garage entrance construction and sliding door fitting, E Workshop and office after maintenance and F, Rest room maintenance

- Department vicinity landscaping was conducted

Fig. 12 Figure showing department vicinity landscaping by planting different tree and grass variety

- Cold room and seed shelf construction was conducted for Lowland Pulse and Sorghum National Research program at MARC.

Fig.13 Cold room and seed storage shelf constructed

Publications

Bisrat Getnet and Yared Deribe 2019. Agricultural Mechanization Survey in the major regions of Ethiopia, in Baseline survey in Agricultural Mechanization for Agricultural Mechanization in Africa proceeding, published by Korea-Africa Food & Agriculture Cooperation Initiative (KAFACI), National Institute of Agricultural Sciences (NAS), Rural Development Administration (RDA), ISBN 978-89-480-0442-7 93520, August 2019.

Bisrat Getnet, Mersha Alebachew and Melese Ageze 2019. Research on Pre-harvest Technologies for Rice Production in Ethiopia in "Advance in Rice Research and Development in Ethiopia" book. Ethiopian Institute of Agricultural Research, Pp 177-184, ISBN: 978999446664.

Postharvest Handling and Processing Engineering Research Program

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Major achievements

1. Modification of Tef wheat barley cleaning type 5TF Chinese made thresher

The Chinese made cleaning type rice and wheat thresher was modified to improve its durability, ease of local fabrication and improve its performance efficiency on tef threshing and cleaning. Accordingly, technical inspection of the modified thresher showed that the fast wear and tear problem on the body was rectified with the use of appropriate material type/thickness for a reasonably acceptable strength. Local fabrication of the technology was made possible with the modification on the threshing drum fixing component and mechanism. Furthermore, technical evaluation results of the modified thresher showed good performance both on threshing and cleaning efficiency and therefore the thresher has been in use and demonstrated to a lot of farmers around MARC and MARC. As a result, fabrication drawing was prepared for technology transfer in a reverse engineering.

2. Development of mango pulper

Mango juice extracting machine powered by one hp single-phase electric motor was developed to aid the processing of mango juice in the country (Fig 1). The machine has an average juice extraction capacity, extraction efficiency and extraction loss of 86.41 l/hr,78.94% and 11.18%, respectively. The edible part of mango is well drained at 40 sec processing retention time. At this time, it has an extraction capacity of about 86.41 l/hr. Increasing the retention time beyond 40sec to extract the edible mango juice can no longer increase the juice capacity. It can be used for small scale mango juice extraction in the rural and urban communities and can be scaled-up for small scale commercial

processing. The extractor was portable, easy for operation, repair and maintenance while all the construction materials are locally available with affordable price for local production.

Fig. 1 Prototype mango pulper

3. development o

Fig. 2 Prototype refractance window drier

4. Developed a floating feed pelleting equipment

This work is aimed at improving a simple single screw food extruder for peletizing fish and poultry feed at a low cost for small scale commercial animal fish and poultry farming and feed processors. It is driven by a 3 hp, three-phase electric motor and consists of hopper, auger feed conveyor, screw and barrel assembly, die and pulley drive system. The improvement was carried out using engineering principles with due consideration to cost, ease of operation, serviceability, durability, and performance. Accordingly, the following modifications were made on the existing prototype.

- Die assembly modified to rectify restricted material flow and to ease up fabrication process.
- Auger type feeding mechanism were designed and integrated/attached to the hopper/to have uniform raw material inflow and thus a smooth extruder operation system made possible.
- Product cutting mechanism was designed and included to cut the final product to an appropriate fish/poultry feed size

The primary test showed that the selected pelleting equipment can deliver cylindrical pellets which can float on the surface of water. The pellets size produced by the pelletizer was in the

range of 2–8 mm diameter, which is suitable for fish and poultry farming. The machine was produced using locally sourced materials and therefore can be promoted to target users

5. Development of stationary and mobile fish smoking facilities

Two smoking facilities (stationary and mobile type) were designed for the smoking and drying of fish and meat. The stationary type fish smoking structure was a natural convection smoker designed and constructed from a rectangular cement hollow block. The size of the structure is 150cm×150cm×120cm (W×L×H) and has separate fire burning chamber and a smoking/ drying chamber. The heat from the fire causes a warm column of smoky air and passes to the smoking and drying chamber through the cement pipe that connects the two chambers. The mobile type on the other hand is an electrically heated fish smoking prototype developed using stainless steel and mild steel for fabrication of the inner and outer walls respectively. For insulation purpose light weight glass fiber material was used between them. In both fish smoking types, the fish are hung on a framework or laid on trays. Primary evaluation of the devices indicated that the moisture content of the fish was reduced to a safe moisture content within the time frame of averagely 3.5 hours.

6. Evaluation and development of animal feed chopper

A feed chopping machine was designed and fabricated to alleviate the challenge of manual feed chopping and reduce postharvest losses (Fig 3). The design of the machine was based on the gathered information from the literatures review and internet searches having the same concept as of forage chopper machine. Availability of the materials, simplicity and ease of machine operation and repairs and adaptability of the machine to small-scale farm owners are the criteria considered in the design of the technology. The machine is powered by a diesel engine of 5hp with a maximum operation speed of 3000.What unit. It consists of the feed inlet, the blade holder plate, the cutting blade, the chopper house, the frame stands assembly, the

power transmission assembly, and the material outlet. The performance of the machine was evaluated using sorghum forage variety (Chelenko) with treatments of the Engine seed, Feed rate and Feed thickness using factorial design with three replications. The heights mean Chopping capacity of (581.24kg/hr), the finest of (shortest) mean cut length (6.23 mm), the heights chopping efficiency of (0.97) and the mean lowest fuel consumption of (0.50ml/s) was recorded. The operation speed was observed to be highly significant among the treatments, at significance level of 0.01. Based on the result obtained it is recommended to use a power source with higher horse power and speed and electric motor in areas where electric power is available to avoid vibration.

Fig 3 Newly developed engine/motor driven prototype feed chopper

7. Promotion and demonstration of postharvest technologies

During the report period five private service providers were established to run their own business on threshing/shelling of major cereal crops. The threshing/shelling machines with engine set were given to selected individual service providers on a return basis. As a result:

- A lot of farmers from (i) Bofa, and Weliso, (ii) Assela/Kulumsa,(iii) Boset and Shalla (iv) Adama/Waqe Tiyo and (v) Gololcha/Chancho were obtained a threshing/shelling service on maize, wheat, beans, tef and sorghum respectively in each district.

- Service providers benefited from generated income for the given-out services.
- A total of 296 farmers, 19 development agents and 15 experts were trained and demonstrated on use and operation of engine driven improved cereal threshing technologies (maize sheller, tef thresher, sorghum thresher and wheat /barley threshers)

8. Development and adaptation of milk churning equipme

Animal Science Research

Apiculture and Sericulture Research Program

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Major Achievements

A study on collected and introduced mulberry accessions/varieties was made for previous years in different locations. After successive selections, the best performing mulberry varieties namely S-13 and K-2 were planted for verification trail along with the local check. These varieties wereevaluated by the Variety Release Committee and therefore, they are accepted and officially released for use as feed plants of mulberry silkworms in the country since September 2020.

A study was also started to determine plant population density of mulberry plant (row spacing of 60cm, 75 cm and 90 cm; and plant spacing of 45 cm, 60 cm, 75 cm and 90 cm) for high quality and biomass yield and therefore data collections are carried out. A study was also conducted with the objectives to evaluate performance of different castor accessions/germplasms and their rearing effect on eri- silkworms. In 2020 selection, 30 best performing castorgerm plasms were evaluated. Out of which 12 germplasms have been advanced and planted for further evaluation. In addition, maintenance of different silkworm strains (Eri and Mulberry) and feed plant accessions/ varieties (Mulberry, Castor and Cassava) have been undergoing and hence, all the available accessions/varieties of feed plants and strains of silkworms were maintained and evaluated under field and laboratory conditions.

Furthermore, lines of cassava plant *(Manihotspp)* as an alternative feed for eri- silkworms was evaluated. Seven cassava

lines were collected and evaluated in four locations. Generally, it is proved that all cassava varieties were eaten by the eri silkworms. Therefore, the best varieties in terms of biomass production and nutrient content will be identified after completion of required analysis. In addition, feed supplementation of castor leaves with flours of protein rich crops like soybean, cow pea and amaranths initiated and good results are recorded.

Moreover, demonstration and popularization of silk production and beekeeping was undergoing to effectively transfer knowledge and technologies among different stakeholders for wider impact. Therefore, technologies such as proven silkworm strains (Eri, Mulberry), silkworm rearing techniques, feed plant varieties (Castor, Mulberry) and production methods as well as honeybee hives and honey and wax production techniques were demonstrated for several stakeholders and beneficiaries. The approaches for demonstration efforts include trainings, follow ups, seed and material support and awareness creation efforts. Trainings were provided on silkworm rearing, mulberry and castor feed plants cultivation and silk processing methods to more than 1000 beneficiaries (me, women. youth small farmers and investors, etc.) of which more than 90% was carried out in collaboration with *icipe*. Visitors of the center and technology exhibition venues were provided with all the required information and informative leaflets and manuals to increase their awareness about the technologies.

Demonstration of apiculture technologies was made for 70 beekeepers. In regard to technology multiplication efforts, more than1700 silkworm laying, 12000 mulberry cuttings and 500 kg castor seed were multiplied. Out of these, about 1500 silkworm laying, 10,000 mulberry cuttings and 400 kg castor seeds were provided to small scale and commercial farmers to support silk production endeavors in Ethiopia. In addition, 20 modern bee hives were provided to selected small scale and innovative beekeepers to increase their honey production and productivity and to be used as demonstration plots to their surrounding

farmers. Furthermore, research results were published to be used as information and reference sources, which include two articles in proceedings and two articles in journals.

Feeds and Nutrition Research Program

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Major Achievements

- National variety verification trials were conducted on two candidate varieties of sorghum screened from local landraces, three candidate varieties of Brachiaria grasses introduced from Brazil via BeCA ILRI Hub, and one candidate variety of short to intermediate maturity pigeon pea conducted both on-farm and on-station at Melkassa, Mieso and Negele Arsi was part of the annual plan of the Feeds and Nutrition Program for year 2020 fiscal year. The candidate varieties have shown higher forage biomass yield and nutritive values compared to the standard checks. The candidates were evaluated for field performance at each of the three locations by National Variety release Committee delegated by the ministry of agriculture.
- A technical support/ backstops were provided to assist government and private institutions to establish forage pasture fields. Accordingly, technical support was given for the National palace of the Federal Government of Ethiopia to establish four hectares of irrigated Alfalfa fodder bank at the Melkassa palace site. The forage team and the management of the Melkassa Agricultural Research Center assisted in a land preparation, tillage equipment including tractors, in getting seeds, in leveling and filed layouts, crop management including irrigation systems, harvesting and curing. The forage team also provided technical advises in construction of curing and storage warehouse shown in Fig 1 below. Similarly, for the Mekia Super Arsiti farm, located at Melkassa, the forage team of MARC has provided technical backstops and planting materials of Brachiaria Mulato-II and Zihone three Elephant grasses to establish forage pastures on two hectares of land.

Fig 1. Irrigated Alfalfa fodder bank at the Melkasa site of the National palace of the Federal Government of Ethiopia

With a USAID supported Livestock Systems Innovation Lab (LSIL) trilateral (EIAR-Kansas State University-Florida University) project on linking cattle nutrition to human nutrition, we conducted on-farm trials in Adama, Boset and Lume districts. In total, there were five farmers involved in the trial. The farmers were provided with different varieties of sorghum belonging to one of early or late maturity dual purpose (gran cum forage) varieties so far released for grain production. Four choppers were also distributed to four of the farmers which they returned on finishing chopping the forage sorghum biomass produced. Field days were organized to share the result of the demonstration with other farmers and development workers. As a result, the on-farm trials were visited by 59 farmers, 29 development agents and experts as well as by 16 researchers. The future plan is to expand the demonstration work to reach to 100 farmers by the upcoming season.

Crops Research

Field Crops

Lowland pulse Res

b) Candidate

of 24 lowland pulse varieties of breeder seed have been multiplied. The multiplied seed are under process of dissemination for public and private seed producers.

Table 1. Early generation common bean seed multiplied (tons)

Type of crop	Amount multiplied	Number of varieties multiplied
Common bean	51.5	20
Mung bean	5	2
Cowpea	14	2
Total	70.5	24

3. Capacity development

The National Lowland Pulses Research Program, in collaboration with other partners engaged in enhancing the capacity of development actors (Bureau of agriculture experts, development agents), seed growers. Trainings were organized in room as well as video-based training. In general, a total of 10 training schedules were delivered and a total of 237 trainees were trained. The detail of the training has given at the Table 2 below.

Table 2. Capacity building by coordinating center and collaborative centers in common bean

Ser No	District	No of trainee		Total
		Male	Female	
1	AJ	25	5	30
2	Dugda	8	1	9
3	Ziway Dugda	11	1	12
4	Negelle Arsi	11	3	14
5	Shalla	19	0	19
6	Tach Gaint	18	0	18
7	Seda Muja	11	1	12
8	Boset	17	3	20
9	Dodota	36	6	42
10	Sire	29	9	38
11	South Gondar	12	11	23
	Total	197	40	237

4. Demonstration & field day

The National Lowland Pulse Program promotes lowland pulse-based technologies using demonstration trial, field day and promotional materials using government as well as externally funded projects. To promote these technologies the program

collaborates with different projects and NGO's. Thus, the program supports the promotion of lowland pulses through availing varieties to be demonstrated and through giving a technical support and promotional materials. Accordingly, a total of 34 demonstration trials were implemented on farmers' field in collaboration with different partners as indicated at Table 3 below. A total of 351 (27% of females) participants were participated in the in collaboration with different stakeholders and projects. Detail illustrated in Table 3 and 4.

Table 3. Number of demonstration and their participants per districts

No	Institution /center	Number	Location
1	MARC	2	Oromia (Adama, Shalla)
2	Kulumssa ARC	3	Oromia (Assasa, Kulumusa, Zewaye Duguda)
3	Chiro ARC	2	Oromia (Meisso)
4	Ambo ARC	6	Oromia (Guder, Nono)
5	Debre ziet ARC	4	Amhara (Menjar Shenkre)
6	Shire Mitsebri ARC	2	Tigray
7	Welkite ARC	3	SNNP (Enseno, Abeshge)
8	SG-Africa	4	Tigray (MerebLehke, Kola Temben)
		5	Oromiya (Ana Sora, AdollaRade, Negele Arsi
		3	SNNP (Angacha, Soro)
	Total	34	

Table 4. Number of field days conducted with partners in lowland pulses

No	Institution/center	No of field days	Location	Male	Female	Total
1	MARC	3	Oromia (Adama,)	57	3	60
			Oromia (Shalla)	40	10	50
			Oromia (N/Arsi)	25	6	31
2	Debreziet ARC	1	Amhara (Minjar)	38	18	56
3	TachGayint Union	1	Amhara (TachGayint)	60	44	104
4	2Scale (Amhara)	1	Amhara (Zigeme)	35	15	50
	Total	**6**		**255**	**96**	**351**

5. Publications

Lung'aho M, Fenta AB, Wanderi S, Otim A, MwabaC, F Nyakundi, and MM Abang (2020). Protein and Amino acid composition of different Quinoa (*Chenopodium quinoa* Willd.) cultivars grown under field conditions in Ethiopia, Kenya, Uganda and Zambia. Afr. J. Food Agric.Nutr. Dev. 20(5): 16563-16584. https://doi.org/10.18697/ajfand.93.19960.

Erana Kebede, Berhanu Amsalu, Anteneh Argaw & Solomon Tamiru(2020). Eco-physiological and physiological characterization of cowpea nodulating native rhizobia isolated from major production areas of Ethiopia, Cogent Biology, 6:1, 1875672

Erana Kebede, Berhanu Amsalu, Anteneh Argaw & Solomon Tamiru (2020). Symbiotic effectiveness of cowpea (*Vignaungu iculata* (L.) Walp.) nodulating rhizobia isolated from soils of major cowpea producing areas in Ethiopia, Cogent Food & Agriculture, 6: 1763648

Maize Improvement for Drought Stress, Heat Prone and Irrigated Areas

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Major achievements

1. Executive summary

Low moisture, heat stresses and irrigated maize research has been doing research since its establishment in 1993. In 2020/21 copping season 20 main activities has been proposed and 18 of them were conducted through government budget and small grant funds (STMA, Nume and AGRA and MERCI projects). MERCI project has been supporting the breeding project in general to modernize it and increase its efficiency. It has no separately registered well defined activities but it has been involved assisting in breeding activities which are also supported by the government fund.

2. Summarized activities implemented in the budget year

A total of 558 hybrids from introductions and local breeding nurseries (Quality Protein Maize-QPM and Conventional Maize-CM were evaluated at2–3 locations under Product Concept 3, from those materials 15% of the hybrids will be advanced to the next stages of trials. In Product Concept 5 about 1532 hybrids from introductions and local breeding nurseries (Quality Protein Maize-QPM and Conventional Maize-CM) were evaluated at2–3 locations from which 15% of the hybrids were selected and will be advanced to the next stages of trials. Ninety-six inbred lines were evaluated for per se under the two product concepts and 20% of them showed better adaptation to the local conditions. Around 485 inbred lines were test crossed with two testers during the off season and from successive crosses about 715 crosses were evaluated under PREP trials across three locations in 2020 main season. Thirty-seven lines advanced from F4 to F5 (inbred line development form Melkassa1 population) on off season. Forty-six successful breeding crosses will be

advanced to F2 during 2021off-season. Advancement of F3 to F4 generation a total of 12 populations (around 100 plants per population) were selfed to form F4 populations during the main season and around 50 selected ears will be planted ear-to-row. Each row will be crossed to one opposite tester during 2021 off-season. A total of 20 Lines are selected for single cross formation and were planted already in 2021off season. Sixty-five intermediate maturing lines were selected based GCA and heterotic group for test cross formation of PC5 and the test cross Nursery is planted already in 2021 off season.

3. Major achievements by discipline

A. Technology generation

From July 2019, up to December 2020 variety verification was Conducted for two Candidate varieties name WE7210 andWE8216 across three on station and six on farms. The Variety Release Committee Evaluated and released the hybrids WE7210. WE7210 renamed as MH141 was released as new variety while the other candidate WE8216 was rejected. The mean yield performances of the candidate varieties were much higher than the standard checks used both on farm and on station. The mean yield for WE7210* (Candidate1) was 6.7tonha^{-1} with a yield advantage of 31.6% over MH140 at Dhera (On station) while the mean yield of WE8216** (Candidate2) was 6.2tonha^{-1} with yield advantage of 21.5% at the same station. At Bishola on station candidate1 had a yield advantage of 32.9% while Candidate-2 had 28.6% while the mean yield was 6.2tonha^{-1} and 6tonha^{-1} respectively. On farm condition, Candidate1 had a yield advantage of 70.2% and 100.8% at Ziway and Meki respectively whereas Candidate2 had almost the same yield advantage of 37% over the same locations as compared to MH140 (Table 1).

Table1. Mean Yield of Candidate varieties and the standard checks on farm and on station conditions

Variety	On Station		YldAdv	On farm		YldAdv
WE7210*	Dhera	6.7	31.6	Ziway	5.0	70.2
WE8216**	Dhera	6.2	21.5	Ziway	4.0	37.3
MH140	Dhera	5.1	0.0	Ziway	2.9	0.0
WE7210*	Bishola	6.2	32.9	Meki	3.3	100.8
WE8216**	Bishola	6.0	28.6	Meki	2.2	37.6
MH140	Bishola	4.7	0.0	Meki	1.6	0.0
WE7210*	Miesso	4.2	0.0	AJ	NA	NA
WE8216**	Miesso	3.7	-12.0	AJ	NA	NA
MH140	Miesso	4.2	0.0	AJ	NA	NA

YldAdv=Yield Advantage over the check (%), *=Candidate 1, **=Candidate2; AJ= AdamituluJidoKombolcha

B. Early generation seed P

Sorghum Improvement Research Program

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Major achievements by discipline

1. Technology generation

National Sorghum Research program has classified country sorghum research agroecologies into four major agroecologies namely, Highland, Intermediate, Dry and Wet lowlands. Sorghum varieties and hybrids are primarily evaluated for their superiority in yield, drought, disease and parasitic weeds *(Striga)*. Promising open pollinated varieties (OPVs) and hybrids were evaluated in major sorghum testing areas of the country during the 2020 cropping season. Out of these, two promising dual-purpose sorghum hybrids and OPVs were identified which will be further evaluated during 2021 cropping season. As a part of the national challenges, desert locust has affected our trials in Eastern and Northern part of the country.

2. Small and large-scale demonstrations

Appropriate seed delivery mechanisms like small seed packs were devised and promoted. Strategies for disseminating improved technologies like training of extension staff and farmers, distribution of small packs, on farm demos, cluster based large on-farm demos and field days have been used. To create awareness and demand on the recently released sorghum and finger millet varieties a total of 500small-scale demonstration plots on1170ha were established in Oromia, Amhara, Tigray, South and Benishangul Regional states. Field days, famer to farmer field visit and field tours were successfully accomplished to transfer experience of those farmers engaged in use of sorghum to other farmers not yet fully engaged to use the early maturing and high yielder sorghum varieties to ensure their food

security

Figure 1. Small and large-scale sorghum technology demonstrations

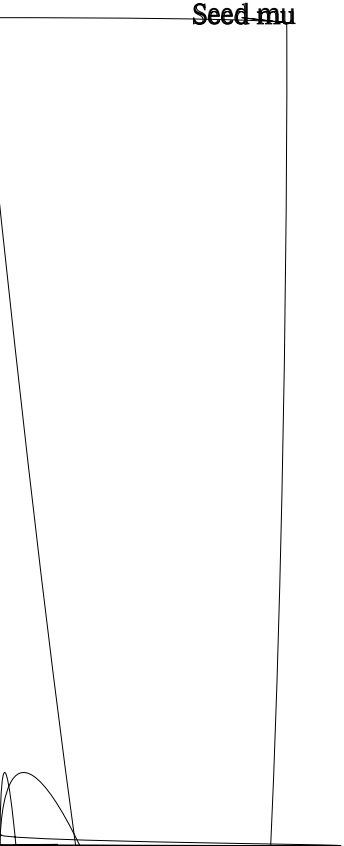


Figure 2. Hybrid sorghum certified seed production by Private seed companies, Ayu farm, Nov 2020.

Training (farmers and development agents)

Although, training to our key partners (farmers, agricultural experts and researchers) is a key milestone, the global COVID-19 pandemic hinders us significantly to achieve this goal. Training to 815 farmers [Male (578) & 237 (female)] were planned, however due the COVID-19 pandemic, this training is postponed until it's safe to give the training. However, the program manages to give training for 100 agricultural experts serving at federal and regional states on sorghum production technologies.

1. Services provides: training (given and or received), major workshops organized or participated,

- Prepare draft guideline for international seed system conference in Ethiopia
- Organized consultative meeting on international seed system conference in Ethiopia
- Participated in annual SMIL II Project review and Planning Meeting
- Participated in annual Amhara Regional Agricultural Research Institute
- Farmers field days were organized in Gololcha, Shenen-Kolu and Miesso

- Theoretical and practical training was given to agricultural experts servingregional state bureaus and federal MoA.
- Training was given to Gondar Agricultural Research Center researchers
- Practical training given to private seed enterprise (Ethio-Agri CEFT) on hybrid sorghum seed production

2. Advisory services: advisory serviced given to students and other stakeholders, participation in committees and significant services provision (say in documents production, etc)

- Supervise 3 MSc and 4 PhD students
- Academic course on plant molecular physiology was given to Hawassa university PhD students
- Technical backstopping to public and private seed producer on sorghum hybrid
- Revise sorghum production packages along with Ministry of Agriculture

3. Seeds and planting materials, farm implements prod

Publications

Gezahegn Girma, Habte Nida, Alemu Tirfessa, Dagnachew Lule, Tamirat Bejiga, Amare Seyoum, Moges Mekonen, Amare Nega, Kebede Dessalegn, Chemeda Birhanu, Alemnesh Bekele, Adane Gebreyohannes, Getachew Ayana, Tesfaye Tesso, Gebisa Ejeta and Tesfaye Mengiste (2020) A comprehensive phenotypic and genomic characterization of Ethiopian sorghum germplasm defines core collection and reveals rich genetic potential in adaptive traits. The Plant Genome.

Habte Nida, Gezahegn Girma, Moges Mekonen, Alemu Tirfessa, Amare Seyoum, Chemeda Birhanu, Kebede Dessalegn, Tsegau Senbetay, Alemnesh Bekele, Adane Gebreyohannes, Getachew Ayana, Tesfaye Tesso, Gebisa Ejeta and Tesfaye Mengist. (2021). Genome wide association analysis reveals seed protein loci as determinants of variations in grain mold resistance.2021. Theory and Applied Genetics.

Tirfessa, A., McLean, G., Mace, E., van Oosterom, E., Jordan, D. & Hammer, G. 2020. Differences in temperature response of phenological development among diverse Ethiopian sorghum genotypes are linked to racial grouping and agro-ecological adaptation. Crop Science. doi:10.1002/csc2.20128.

Tirfessa A., Tesso, T. Adugna, A., Mohammed H. and Kimabi, D. 2020. Genetic diversity among Ethiopian sorghum [Sorghum bicolor (L.) Moench] gene bank accessions as revealed by SSR markers. African Journal of Biotechnology. 19(2). pp. 84-91. Vol. 19(2), pp.84-91, February, 2020.

Liben, F.M.,Wortman, C.S. and Tirfessa, A. 2020. Geospatial modeling of conservation tillage and nitrogen timing effects on yield and soil properties. Agricultural Systems 177 (2020) 102720.

Amare S, Amare N, Kedanemaryam W, Taye T, Diriba T, Alemu T, Habte N, Adane G, Sewmehone S, Tsegaye G, Chalachew E, Hailemariam S, Tamirat B, Tokuma L, David J, Emma M, Daniel N, Ligaba A and Meron B. 2020. Multi environment and spatial analysis of early maturing sorghum [Sorghum bicolor (L.) Moench] genotypes in dry lowland areas of Ethiopia. African Journal of Agricultural Research. 19(2). pp. 84-91. Vol. 15(2), pp.278-290, February, 2020

Agronomy and Crop Physiology Research Program

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1. Major outputs and achievements

1.1. Major outputs of the program

The program conducted eight experimental trials in 2020. Five of the activities were funded by government and three of them were externally funded activities. Seven experimental trials were conducted on-station and one of the experiments was conducted on farmers training center (FTC). The experiments were well monitored; important crop and soil data were collected; and the data were analyzed and reported for the 2020 cropping season. The activities were evaluated during the process, center and national program reviews for the crop year.

Research on response of sorghum hybrid (ESH-1) to different plant densities and N &P fertilizer rates was conducted to determine optimum plant density and application of inorganic N and P fertilizer rates for the recently released sorghum hybrid. This activity is completed in 2020 cropping season. The combined analysis across six-site seasons showed 40 kg N and 20 kg P can be used with plant population rate of 88,888 per hectare for the hybrid sorghum production in semiarid regions.

1.2. Major achievements of the progra

Geospatial modelling of conservation tillage and nitrogen timing e ects on yield and soil properties; and (iii) Maize yields from rotation and intercropping systems with different legumes under conservation agriculture in contrasting agro-ecologies. In addition, one of the program researchers had worked with soil and agronomy data standardization national committee and finally co-authored and published soil and agronomy data standardization guideline. The guideline has been printed and distributed to regional and national research centers for use.

1.2.2. Teaching and advisory services at higher institutions

Two researchers in the program were serving in advisory committee of graduate students who are pursuing PhD and MSc degrees at Arsi, Haramaya, and Jimma Universities. Researchers were serving in five PhD and five MSc graduate students advisory committees. The researchers examined six MSc and one PhD student's thesis for fulfillment of degree requirements. In

1.2.5. Serving in center committees

Researchers in the program were assigned in three different committee and serving Melkassa Agricultural Research Center (MARC) to facilitate and assist in achieving the center's needs. One of the researchers work with a committee assigned to plan and build dyke that can protect the center from flooding risk. One researcher served in bid committee, and the other one was in the MARC Saving and Credit Cooperative Society. All the three researchers were actively working with the committees to achieve the expected services.

Table 1. List of breeder seed multiplied of onion and shallot varieties

No.	Onion/shallot varieties	Net area planted (m2)	seed yield (kg)
1	Nafis	1584	200
2	Bombay Red	720	80
3	Nafid	352	40
4	Years	200	24
5	Tropix	150	18
	Tomato different varieties	4000	40
	Capsicums different varieties	6000	90

Trainings (stakeholders) A large number of subject matter specialists, students, development agents and farmers were trained on improved production technologies of vegetable crops. Several researchers from different federal and regional research centers and universities were also got experience and trainings on research methodologies, trial field management, nursery management, grafting techniques, seed production and data collection techniques.

National Subtropical Fruit Research Program

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1. Executive summary (number o

strengthened. Nursery sites and mother blocks of fruits were established to capacitate and sustain the demonstration and the promotion of avocado and mango technologies. A total of 55 farmers were involved in the demonstration of both crops and were benefited both financially and nutritionally. Some farmers started multiplying planting materials of these varieties from their own mother blocks and nurseries while other neighboring farmers were supported by the research centers.

c. Seed multiplication and distribution

A total of 34,774 seedlings of papaya, 1685grafted mango seedlings, 1830grafted avocado seedlings,600 banana suckers, 450budded citrus planting materials were multiplied and distributed to clustered based fruit growers, private farmers, universities, farmers' unions, farmers' associations, fruit microenterprises, industries, private and public research, seed/seedling producing enterprises, development institutes, NGOs and MoA offices.

More than 7555mango and 6100avocadoscion bud woods were prepared and distributed to clustered based fruit growers, private farmers, universities, farmers' unions, farmers 'associations, fruit micro enterprise, industries, private and public research, seed producing enterprises, development institutes, NGOs and MoA offices. More than1.8 kg of citrus rootstocks seeds wereprovided to research centers.

Table 1. Papaya seedlings disseminated to four clusters, 2012/13

Region	Zone	District	Kebele	No. of seedlings
Oromia	East Shewa	Adama	Melka oba	2662
Oromia	East Shewa	Adama	Wonji (Kuriftu, Shewa)	1183
Oromia	Arsi	Dodota	Direkiltu (Melkaoba)	1091
Oromia	Arsi	Dodota	Direkiltu (Melka denboba)	384
Amhara	North Shewa	Minjar-Shenkora	Chercha	846
Amhara	North Shewa	Minjar-Shenkora	Eranbuti	707
Amhara	North Shewa	Minjar-Shenkora	Arerti	447
		Total		7520

d. Training (farmers and development agents)

A total of 154 male and 20 female farmers, subject matter specialists, development agents and students were trained on improved production of tropical and subtropical fruit crops researchers from federal and regional research centers, and university instructors were briefed about tropical and subtropical fruit crops production, management, and postharvest handlings. They gained experiences on research methodologies, trial field management, nursery establishments and handling, grafting techniques, seed production, preparation and handling, planting materials preparations and management, and data collection techniques.

3. R

laboratory, and irrigation/fertigation facilities needed to be given due attention.

4. Major challenges

- Limited germplasm and low genetic base for variety improvement. Introduction of germplasm and reputable/elite varieties of fruits from international sources is difficult as there is no strong linkage with international research institutions.
- Inadequate varieties for different production system and purposes. Perennial and semi-perennial nature of fruits makes the breeding program of fruits time taking to come up with improved varieties.
- Limited crop management, postharvest and processing technologies
- Nurseries, and modern irrigation infrastructure and facilities are not well developed.
- Low capacity (trained personnel, facilities and infrastructure) and technical staff.
- Research facilities like laboratory, greenhouse, shade net and lath house are largely unavailable.
- Insect pests (example white mango scale, avocado decline etc) and lack of sufficient pest control technologies.

5. Plan of the department

- Allocate sufficient research budget by the government to strengthen fruit crops research.

6. Publications

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ፍፁም ምሩፅ፣ ግርማ ክበደ፣ በድሩ በሺር፣ አስማረ ዳኘው፣እንድርያስ ገብረክርስቶስ. 2013. የማንጎ አመራራት፣መመሪያ በኢትዮጵያ የግብርና ምርምር ኢንስቲትዩት የመልካሳ ግብርና ምርምር ማዕከል ከግብርና ሚንስቴር የተሳትፏዊ አነስተኛ የመስኖልማት ፕሮግራም 2 (PASIDP_II) ጋር በመተባበር የተዘጋጀ አዲስ አበባ፣ኢትዮጵያ

Asmare Dagnew, Wegayehu Assefa, Girma Kebede, Edossa Etissa, Lemma Ayele, Mikiyas Damtew, Merkebu Ayalew, Agrnesh Mulugeta, Abel Debebe, Surfel Shiberu 2019.Research Achievements, Gaps and Future Prospects of Tropical Fruit Crops at Melkassa Agricultural Research Center (MARC)and Gemechu Olani

Edossa Etissa, Asmare Dagnew, Wegayehu Assefa, Lemma Ayele, Mikiyas Damtew, Girma Kebede, Merkebu Ayalew, Agernesh Mulugeta. 2019. Achievements, Gaps and Future Prospects of Sub-Tropical Fruit Crops Research at Melkassa Agricultural Research Center (MARC).

Climate, Geospatial and Bio-metrics Research

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Major out puts

Frost and Chilling Temperature Host Spot Assessment

Frost and chilling horticultural crop production risk obviously is putting horticulture production under serious problem, on top of other factors, in Ethiopia. Therefore, to early forecast where and when the frost chilling risk is about to happen prior to going for farming works. Frost hotspot characterization was done based on two basic temperature thresholds. One is when minimum temperature drops less than zero degree centigrade and the second one is when minimum temperature fall below two degree centigrade. Likewise, chilling hotspot areas are characterized under five and 10-degree centigrade minimum temperature.

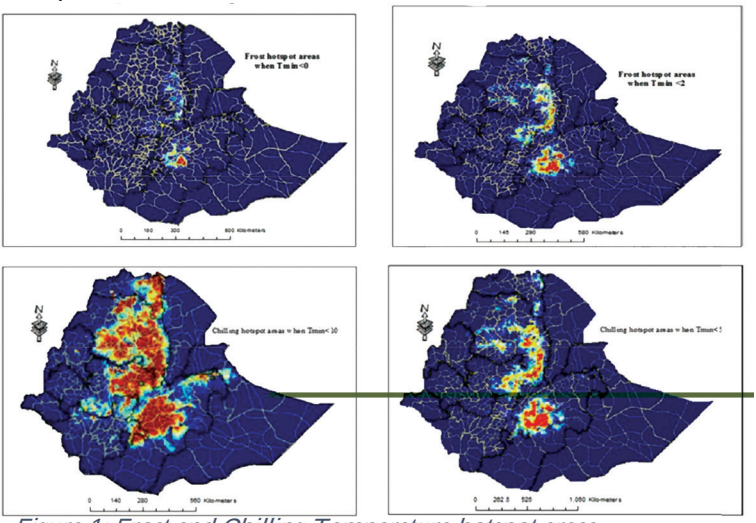


Figure 1: Frost and Chilling Temperature hotspot areas.

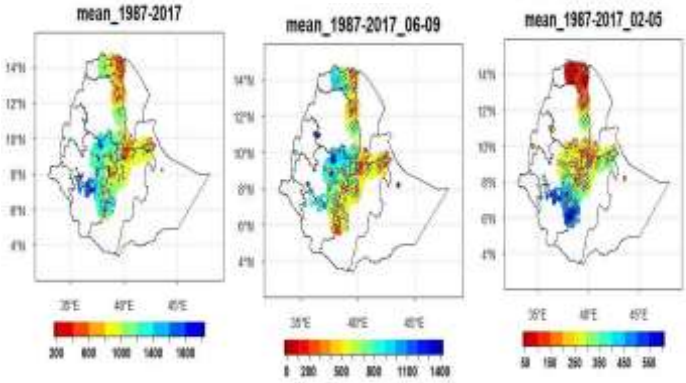

mean_1987-2017
mean_1987-2017_06-09
mean_1967-2017_02-05

Figure 3: Coefficient [illegible] the d) annual, e) JJAS and f) FMAM [illegible] distribution.

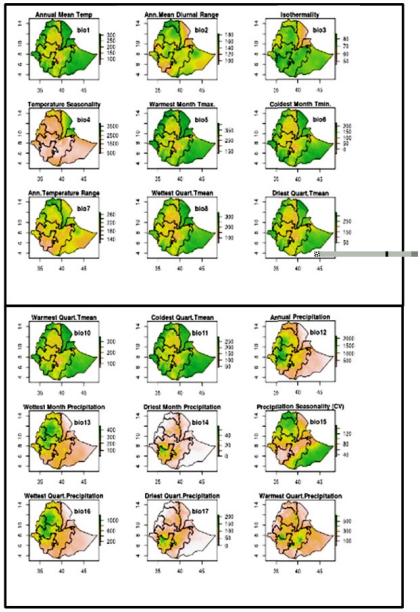
Annual rainfall is less va[illegible]areas (CV < 20%), Rainfall during JJAS is in most central, easter[illegible]n Ethiopia ranges from 10 – 25 % and Belg rainfall is highly va[illegible]0%).

Maximum and Min[illegible]ual Temperature

Bioclimatic zonati[illegible]s distribution suitability modeling of FAW

As all other spec[illegible]

mean temperature of the coldest quarter, Annual rainfall, Rainfall during the wettest month, rainfall during the driest month, rainfall seasonality, rainfall in the wettest quarter, rainfall in the driest quarter, rainfall of the warmest quarter, annual moisture index and Elevation. These vaiables are prepared in map and ready for use. Each is coded as bio1 to bio19 with the last map of elevation.



Temperature based Bioclimatic parameters: https://rpubs.com/Olika_1/735098

Genetic Coefficient Estimated Ready for Use

Based on the observed phonological 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 site was used to estimate the Genetic Coefficients of corresponding varieties.

Table 1: 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 2: Estimated Genetic Coefficients for maize cultivars

Cultivar Name	ECO#	P1	P2	P5	G2	G3	PHINT
		1	2	3	4	5	6
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

Table 3: Estimated Genetic Coefficients for common bean varieties

Cultivar Name	CSDL	PPSEN	EM-FL	FL-SH	FL-SD	SD-PM	FL-LF	LFMAX	SLAVR	SIZLF
	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

1.5 Capacity development

Climate data are basic requirement in any research program therefore, inspection of instruments for replacement and maintenance have been made for selected EIAR weather stations during January to December 2020. This ensures climate data generation and archiving for sustained use.

Food Science and Nutrition Research

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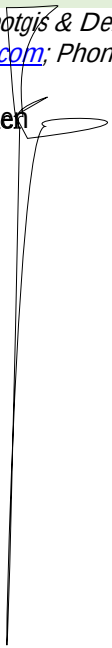
Major outputs of the food scien



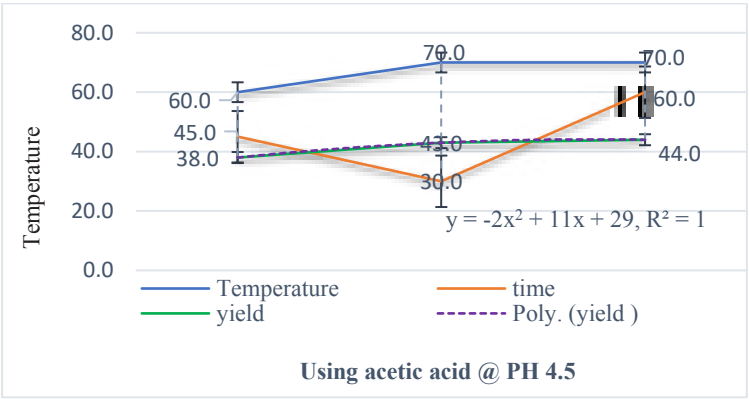


Figure 1. Effect of pH and temperature values on the extraction yield of pectin using acetic acid

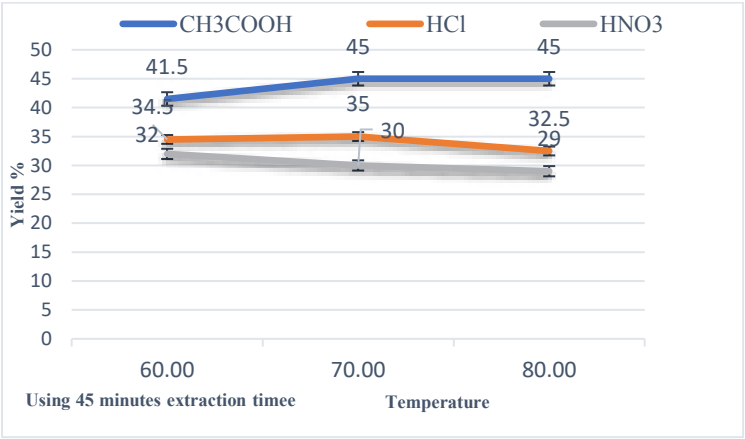


Figure 2. Effect of acid type and extraction time on the extraction yields of pectin

2. Predication of quality parameters of sorg

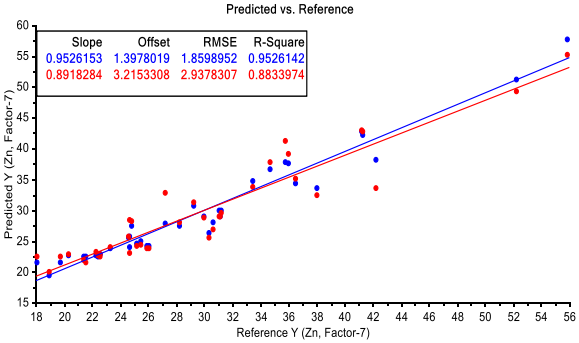


Figure 1. The plot of reference vs. predicted values of calibration and cross-validation for iron, protein, and zinc sorghum grain models, respectively.

3. Analysis of nutritional and anti-nutritional contents of finger millet varieties in Ethiopia

Finger millet (*Eleusine coracana*) is one of the richest sources of nutrients compared to other minor cultivated cereal crops. Even though, it has an abundant source of nutrients, the anti-nutrients basically phyto chemicals could hinder the bioavailability of macro and micronutrients. Twenty-two samples were collected and the nutritional and anti-nutritional contents of released and improved finger millet varieties were evaluated. A range of 3.72–7.68% for protein, 2.04–3.42% for ash, 1.024–5.83% for fat, 10.87–14.27% for moisture, 270-327mg/100g for calcium, 361.1–766.6mg/100g for iron, 102.4–583.0 mg/100g for zinc, 0.019-6.80% for tannins and 0.55-1.50% for phytate was observed among the varieties. The tannin and phytate contents were negatively correlated to Fe and Zn contents. Therefore, when selecting finger millet for Fe and Zn the levels of anti-nutritional contents need to be considered since they are important micro elements.

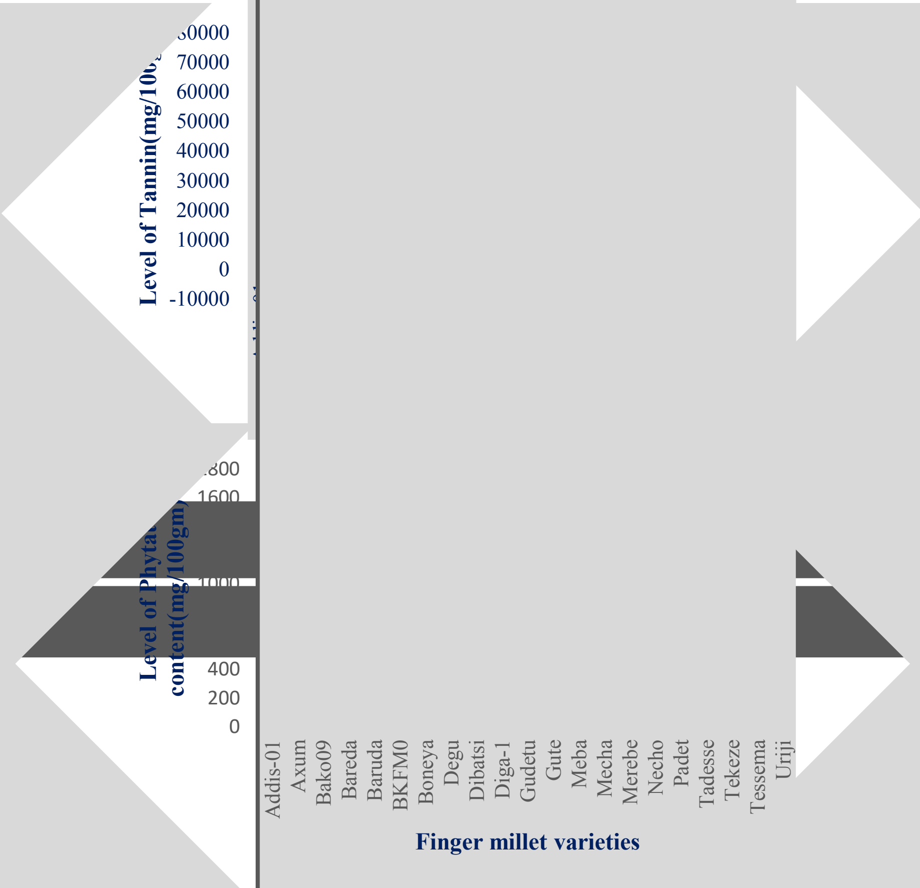


Figure 1. Ta ... es

4. Evaluatio ... of sorghum

Seven sorghu ... nalt for brewing. ... vort quality paran ... SH-4 had a prot ... nest starch cultivars sho ... han 80%

Melkam varieties had the highest germinative energy values of 88 and 67% at 12 hours respectively and while 100% of germination energy values were recorded at 24 hours. Varieties with high friability were Debere and Melkam which indicates high lautering performance. Varieties with low friability were Argiti and ESH-4 indicated that under modification can lead to poor mash conversion and high viscosity. The cross-correlations between amylose, starch, and protein showed a significant difference at $p<0.05$. The correlations between the amylose pairs of amylose-starch (0.686) and amylose-protein (0.685) were found to be high and positive. Yield was negatively significantly correlated to amylose, starch, protein, ash and moisture content (r = -0.705, -0.590, -0.441, -0.201 and -0.0.178) respectively. However, most of the cultivars fulfilled the quality requirements and within the acceptable range of the European Brewery Convention (EBC) and Assela Malt factory standard (Ethiopia). This study showed that the cultivars are promising as malting materials in beverage making. Some of the sorghum varieties have been identified to be useful as a nutritious source of food and for use in the malting industry.

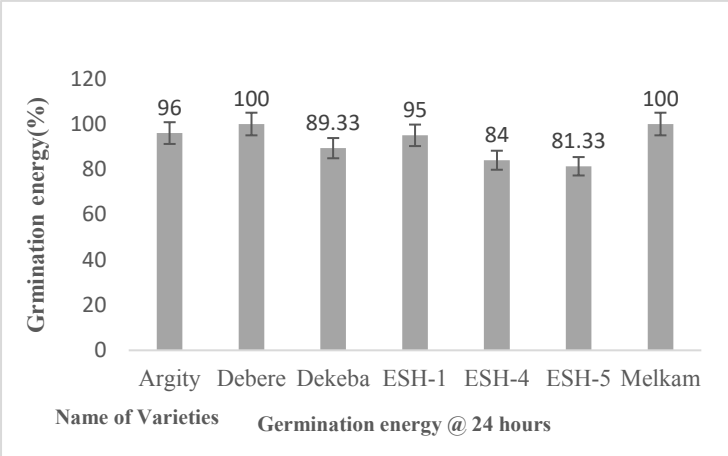


Figure 1. Germination energy at 12, 24 & 48 hours

5. Service given to other organiz

Design: RCBD
Treatment: 14
Location:
R

This trial is terminated. Similar N and P fertilizers validation will be evaluated after the completion of NP fertilizers trial on hybrid maize in the study area.

Project title 3. Integrated soil fertility management for soil health and crop productivity improvement

Project title 2. Organic Fertilizer Development

Activity title 1: Verification and Demonstration of Small Scale Vermiculture/ Vermi compost Production to Smallholder Farmers in the CRV of Ethiopia

Summary of the progress:

- Awareness creation training about vermi composting was given to 20 farmers and 3 DAs at Aduala area and Jogo Gudedo. Maintenance of vermi composting unit and multiplication of earth worms were conducted. Currently, there is sufficient number of earthworms to be provided to interested farmers or any other interested team to start vermi compost production. In the process over 10 quintals of vermi compost is produced to use for the experiments to be conducted using vermi compost as organic source of plant nutrient.

Design: Not applicable

Treatment: Not applicable

Location: MARC on station and Adulala

Result:

- From the vermiculture and vermicompost mass production unit established at MARC:
- About 12,900.00 (>4 kg) of vermiworms of the locally collected species was multiplied.
- Over 186,000.00 (>50 kg) of Eisenia. fetida was also multiplied
- They have been used for research purpose and are ready for distribution to farmers in Adama and Lume districts.

Plan for the next year:

Training plan is already planned to be conducted in near future before the main rainy season starts. This training will include only about 10 farmers who have shown interest following the awareness training. The training will be both on theoretical background and mainly on practical. Then five farmers who are ready by preparing the simple shelter for vermi composting bin, prepared feed stuff for vermiworms and who have sustainable water source for vermi composting will be given the starting vermiworms. Then they will be organized in FREG to facilitate learning opportunities among the farmers. Demonstration plots will be established on this farmers' field using the vermi compost produced.

Program. New Fertilizer product testing

Activity title 1: Evaluation of Mela Organix Natural Liquid Fertilizer on Tomato crop under Irrigated Condition in the Central Rift Valley of Ethiopia

Summary of the progress:

The experiment was started during the off-season under irrigation and is under way in the field in four districts (Fentalle on station, Adama/Wonji, Dugda, Bora).

Result

The result not yet presented here because it is in the field now.

Other accomplishments

Multiplication of vermiworms was done (about 150,000.00 vermiworms) and ready for distribution to interested farmers after practical training.

Advisory service to 5 MSc students at different Universities (Haramaya, Hawasa, Bahir Dar and Ambo Universities)

Soil Fertility and Agronomy data collection standard guideline was developed with financial support made by GIZ Ethiopia. Training was delivered to 24 researchers (11 from soil fertility and 13 from agronomy research programs) from 13 EIAR centers for two days (Nov 26 - 27/2020) at Adama.

Publications

Dejene Abera; Feyera Merga, Tesfaye Shimbir, Tesfaye Balemi, Teklu Erkossa, Mulugeta Demiss. 2020. Guideline for Agronomy and Soil Fertility Data Collection in Ethiopia: National Standard. Ethiopian Institute of Agricultural Research (EIAR). Addis Ababa, Ethiopia. 31 p

Dejene Abera, Bedru Beshir, Feyera M. Liben. 2020. The Role of Conservation Agriculture for Soil Quality Improvement: A Review. Ethiop. J. Agric. Sci. 30(4) 197-222

Integrated Watershed Management

Daniel Bekele
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Ac

Table1: Training participants

Title of training	Participants	
	Male	Female
Physical soil and water conservation	53	12
Biological soil and water conservation	62	12
Toltal	115	24
Grand total	139	

Advise

Irrigation and Water Harvesting Research

Tilahun Hordofa
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Activity 1. Determination of crop water requirement and crop coefficient for maize (*Zeamays L.*) using lysimeters.

Summary achievements

The field experiment was carried out at Melkassa Agricultural Research Center, Ethiopia during the wet growing season of 2017, 2018 and 2019, under lysimeter. The aim of this study was to estimate the seasonal water demand and crop coefficient of Maize *(Melkassa II)* for effective irrigation water planning and management. Crop coefficient (Kc) determined for each growth stages as the ratio of ETcto ETo. ETc determined by soil water balance equation and ETo computed by CROPWAT version 8.0 using the FAO Penman-Monteith equation. The seasonal ETc was found to be calculated for initial, development, mid-season, and late-season stages, respectively. The measured crop coefficient (Kc) values were also calibrated for those stages, respectively. Some of the Kc values found in this experiment differed slightly from the average of FAO estimation. This indicates that there is a need to develop Kc values for given local climate conditions and cultivars. The first- and second-year data were summarized and presented in Table 1. The third-year data were collected and analysis underway. Thus, all the three years data compiled results should be summarized and presented for complete document

Table 1: Crop water requirement and crop coefficient of maize under lysimeters

Growth Stages	Year-I		Year –II		Average	
	CWR	Kc	CWR	Kc	CWR	Kc
Initial	3.06	0.67	3.73	0.67	3.40	0.67
Dev't	4.07	0.97	4.70	0.99	4.39	0.98
Mid	5.52	1.21	6.25	1.25	5.88	1.23
Late	3.50	0.63	3.82	0.62	3.66	0.63

Activity 2. Determination of crop water requirement and crop coefficient for sorghum *(Sorghum bicolor* L.*)* using lysimeter.

Summary ac

Dawit Tesfaye
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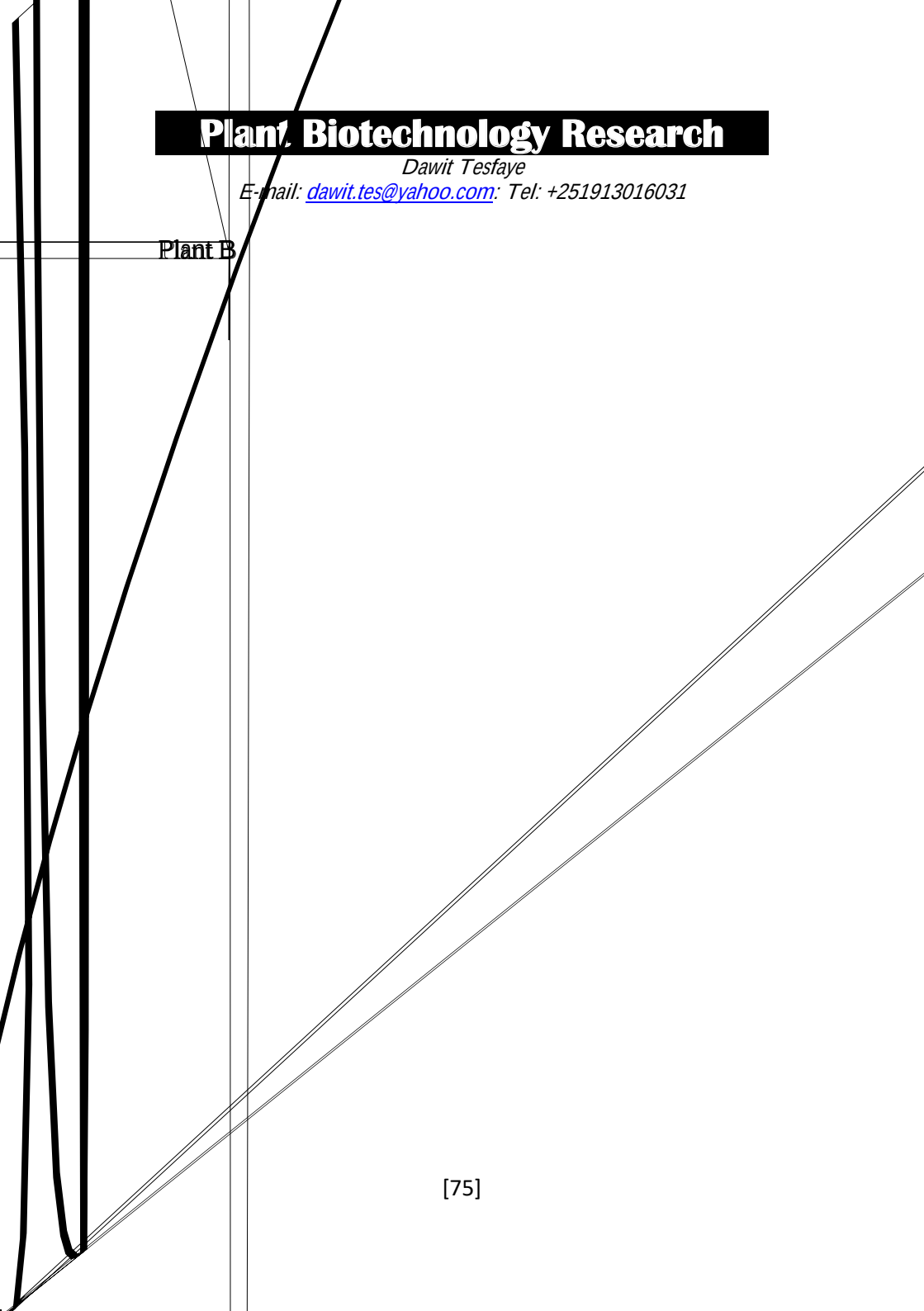

University. Currently two students doing their MSc research in the TC laboratory and get advice on their study.

Capacity development

Regarding capacity building a new laboratory with 5 offices for the staff were built and completed and with the support of AGP_II the TC laboratory was getting furnished.

Publications

1. Allo, A.D., Dawi

7. Allo A. Dido, Kassahun Tesfaye, M. S. R. Krishna, Dawit T. Degefu and B. J. K. Singh (2020). Diversity within and among Ethiopian barley (*Hordeum vulgare L*.) landraces in resistance to barley net blotch. *Pyrenophora teres*. *Australasian Plant Pathology*.
8. Allo A. Dido, Kassahun Tesfaye, M.S.R. Krishna, Dawit T. Degefu and B. J. K. Singh (2020) Phenotypic diversity and population structure of Ethiopian barley (*Hordeum vulgare* L.) landrace collections. *Int. J. Adv. Res. Biol. Sci.* 7(12): 144-161.
9. Gui, F., Lan, T., Zhao, Y., Dawit T. Degefu, Le Kang (2020). Genomic and transcriptomic analysis unveils population evolution and development of pesticide resistance in fall armyworm *Spodoptera frugiperda*. *Protein and Cell*. Doi.org/10.1007/s13238-020-00795-7
10. Kefyalew Negisho, Surafel Shibru, Klaus Pillen, Frank Ordon, Gwendolin Wehner(2021). Genetic diversity of Ethiopian durum wheat landraces PLoS ONE; 16(2): e0247016.

Plant Protection Research

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Plant Pathology Research program

Major a

Fig. 1. [illegible]

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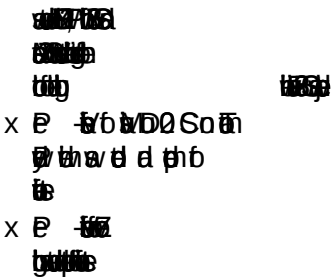

Agricultural Entomology Research Prog

3. From the study yield loss assessment of sorghum grain yields due to Quela birds on four management options (bag covered, birds scaring, Mesurol treated and untreated control). Two years (2017 and 2018) result indicted, yield loss percent of sorghum in bag covered treatment was very low when compared to untreated control and other options. Based on this information this management practices can be recommended to keep yield loss of Sorghum grain against Quelea Birds.
4. Efficacy of the bio-control agent BEAUVITECH® WP (*Beauveria bassiana*) against whitefly (*Bemisiatabaci*) on Poinsettia (*Euphorbia pulcherrima*) was verified along with a standard check insecticide Sivanto Prime SL 200 (Flupyradifurone) and untreated check treatments for one production season in 2020. Results of the verification test showed that, efficacy of the bio-control agent BEAUVITECH® WP (*Beauveria bassiana*) is comparable with the standard check insecticide and can be used as IPM component in commercial farms. Therefore, the bio-control agent BEAUVITECH® WP (*Beauveria bassiana*) is recommended for management of whitefly (*Bemisiatabaci*) on Poinsettia (*Euphorbia pulcherrima*).
5. Efficacy of the bio-control agent AMBLYTECH®M (*Amblyseiusmontdorensis*) against western flower thrips (*Frankliniella occidentalis*) on Verbena x Hybrida was verified along with a standard check insecticide Radiant 120 SC (Spinetoram) and untreated check treatments for one production season in 2020. Efficacy of AMBLYTECH®M (*Amblyseiusmontdorensis*) in controlling western flower thrips (*Frankliniella occidentalis*) was found comparable with the standard check insecticide Radiant 120 SC. Therefore, the bio-control agent AMBLYTECH®M (*Amblyseius montdorensis*) is recommended for management of western flower thrips (*Frankliniella occidentalis*) on Verbena x Hybrida.
6. Efficacy of the insecticide ITTISA 120 SC (Emamet in Benzoate 20g/l + Chlorfenapyr 100g/l) against the tomato leaf miner (*Tutaabsoluta*) on tomato was verified along with

a standard check insecticide Radiant 120 SC (Spinetoram) and untreated check treatments in two separate seasons. Results of the verification test revealed that, efficacy of the test insecticide ITTISA 120 SC is on par with the standard check insecticide Radiant 120 SC in controlling infestation and damage due to *Tuta absoluta* on tomato. Therefore, the insecticide ITTISA 120 SC (Emamet in Benzoate 20g/l + Chlorfenapyr 100g/l) is recommended for management of the tomato leaf miner (*Tuta absoluta*) on tomato.

7. Efficacy of the insecticide FIDELITY TM 400 WG (Sulfoxaflor 30% + Spinetoram 10%) for the control of cabbage aphid (*Brevicoryne brassicae*) on cabbage (*Brassica oleracea*) was verified along with a standard check insecticide Closer 240 SC (Sulfoxaflor) and untreated check treatments in two separate seasons. Results of the verification test showed that, the cabbage plot treated with FIDELITY TM 400 WG has very low number of cabbage aphid colonies per plant similar to the plot of the standard check insecticide in both seasons test. This result suggested that the efficacy of the test insecticide FIDELITY TM 400 WG is comparable with the standard check insecticide Closer 240 SC. Therefore, the insecticide FIDELITY TM 400 WG (Sulfoxaflor 30% + Spinetoram 10%) is recommended for the management of cabbage aphid (*Brevicoryne brassicae*) on cabbage (*Brassica olerac).*

Weed Science Research Program

Major achievements

1) Evaluation of Herbicides on common bean (*Phaseolus vulgaris* L.) weeds in the CRV of Ethiopia were done at Melkassa on station and Negelle Arsi. One-year data showed that, the highest grain yield was obtained from S-metolachlor 0.96 kg ha^{-1} with two hand weeding and followed by S metolachlor 0.96 kg ha^{-1} with one hand weeding and S metolachlor 0.96 kg ha^{-1} plus post emergence herbicide (Imazamox 80SL 480 /G and Sodium Aciflurfen + Clodinafop EC).
2) Pre-verification test were done on IRIS EC (Sodium Acifluorfen 16.5 %+ Clodinafop Propargyl 8% EC) at Melkassa on station and Negelle Arsi substation on common bean weeds and promoted for verification test.
3) Similarly, two verification tests were done, SELECT 120 EC (Clethodim) at 2L/ha with 200 L of water per hectare is recommended as an alternate herbicide for annual and perennial grass weeds in haricot bean and one is rejected due to low weed control efficacy on mango orchard field.

Trainings (stakeholders)

- Forty-five students from Bule Hora, 42 students from Selale and 50 students from Semara Universities, were shared an experience from Plant protection division of the Plant Pathology and Agricultural Entomology programs. In Addition, 3 Lecturers from Welkite, 2 lecturers from Dilla and 4 Lecturers from Dambi Dollo universities were also shared the experience and capacitated in the subject matter. Development agents and farmers located in Central Rift valley were trained on major diseases and insect pest of economically important crops and their management options.

Community Service

Locust outbreak in Ethiopia: Intervention of Melkassa Agricultural Research center in Controlling

October 20, 2020

A team having 14 members was organized by plant protection research process and common understanding was made by phone.

Objective: reduce the amount of damage by locust in East Shewa and Arsi districts

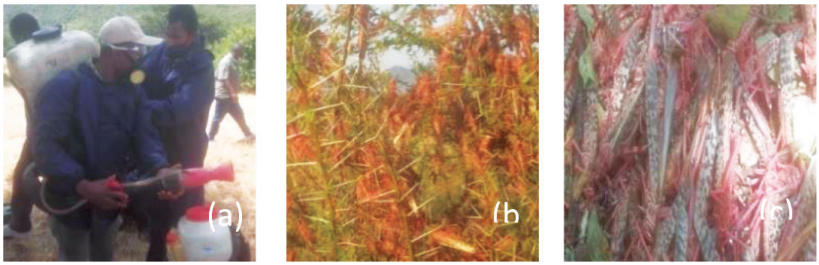

Figure 1. Intervention of Melkassa Agricultural research center on the outbreak of Locust, 2020; a. Motorized sprayer; b. settled locust; c. died locust on the ground due to spray of Dursuban.

- **Field Visit Report on Avocado pests at Lume and Ada'a districts**
- Those listed disease were identified in two avocado districts in the Central Rift Valley and the report was sent to the zone, Oromia Agricultural Office and districts for action.

Capacity development

1. One additional Plant Pathology Laboratory were rehabilitated by facilitating the condition in international standard requirements and made ready for an experiment and also serve as plant disease sample submission from the farmers and diagnosis laboratory.
2. Nine laboratory stools which cost a total of 49000 ETB were bought and started the service.
3. One Laboratory water distiller was bought and starts functioning.
4. Laboratory Incubator for insect peas raring was bought and starts functioning.

Publications

Leaflet

1. leaflet was prepared and published on the management of newly emerged papaya disease: Black spot (*Asperisporium caricae*) by Endriyas Gabrekiristos and Bedru Beshir

Proceedings

1. Gashawbeza Ayalew, Mulatwa Wondimu, Birhanu Sisay and Abiy Fekadu. 2020. Review of Entomological Research on Lowland Horticultural and Field Crops: Achievements and Prospects *EIAR, Melkassa Center, P.o.box 436, Adama*
2. Mulatwa Wondimu and Abiy Fikadu. 2020. Achievements, Challenges and Prospects of Vertebrate Pest Research; *Melkassa agricultural Research Center P.o.box 436, Adama, Ethiopia;*

Journals

1. Mulatwa Wondimu, Emana Getu and Ahmed Ibrahim.2020. Effect of different rates of filter cake against bruchids (*Zabrotes subfasciatus* (Boheman) and *Callosobruchus maculatus* (Fabricius) (Coleoptera: Chrysomelidae) on common bean and cowpea. African Journal of Agricultural Research, Vol. 16(6), pp. 869-874, June, 2020 DOI: 10.5897/AJAR2020.14862.
2. Endriyas G., Daniel T. and Getachew A. 2020. Prospects of host resistance and biocontrol agent for the management of hot pepper Fusarium wilt (*Fusarium oxysporum* f.sp. *capsici*) in the Central Rift valley of Ethiopia. *Academic Research Journal of Agricultural Science and Research* Vol. 8(3), pp. 156-163, April 2020 DOI: 10.14662/ARJASR2020.130
3. Gabrekiristos E, Dagnew A. 2020. A Newly Emerging Disease of Papaya in Ethiopia: Black Spot (*Asperisporium caricae*) Disease and Management Options. J Plant PatholMicrobiol11: 488. doi: 10.35248/ 2157-7471.20.11.488
4. Gabrekiristos E.,Teshome D, Ayana G. 2020. Distribution and Relative Importance of Hot Pepper *Fusarium* Wilt (*Fusarium oxysporum* f.sp. capsici) and Associated Agronomic Factors in the Central Rift Valley of Ethiopia. Adv Crop Sci Tech 8: 437

5. Gabrekiristos E., Teshome D, Ayana G (2020) Cultural, Morphological and Pathogenic Variability among Isolates of *Fusarium oxysporum* f.sp. *capsici* Causing Wilt of Hot Pepper in Central Rift Valley, Ethiopia. Plant Pathol Microbiol. 11: 499. doi: 10.35248/2157-7471.20.11.499.
6. Gabrekiristos E., Ayana G (2020) In Vitro Evaluation of Some Fungicides against *Fusarium oxysporum* the Causal of Wilt Disease of Hot Pepper (*Capsicum annum* L.) in Ethiopia. Adv Crop Sci Tech. 8:43i3(:)3erum

Technology Multiplication and Seed Research

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1. Seed research activities

Summary of research findings (outputs)

Seed quality of maize (Zea mays L.) varieties stored in different packaging materials and cold store room for various durations were assessed. The results of initial seed quality tested indicated that all varieties were fulfilled the national seed quality standards. As the time of storage increased moisture contents of maize seeds were relatively decreased in general. It was done for all varieties by the six months interval for 24 months. The results indicated that among the maize seed varieties stored in cold room Melkassa-6Q variety was showed significantly higher MC % ($p< 0.05$) than Melkassa-2 & Melekssa-4 varieties throughout the storage duration. This is might be due to genetic characters of the variety. Therefore, it is advisable to store maize seeds in the cold store of controlled temperature & relative humidity for seed producers whereas for farmers those can't afford standardized cold store, relatively cold and aerated room is recommended.

The Variety packaging material interaction indicate that one or more of the varieties' responded to the different packaging materials in standard germination percentage. We can conclude thatMelkassa-2 can be stored in cold store room packing by PICS and Polypropylene bags for two years without losing its viability. Melkassa-4 exhibited the greatest germination loss (12.667%) when packed by PICS bag and stored in cold store room for eighteen months and appears to have caused the significant packaging material Cultivar interaction effect (**Fig.1).** Results suggest that Melkassa-4 may require other packaging material to maximize standard germination or reduce storage duration in EGS multiplication.

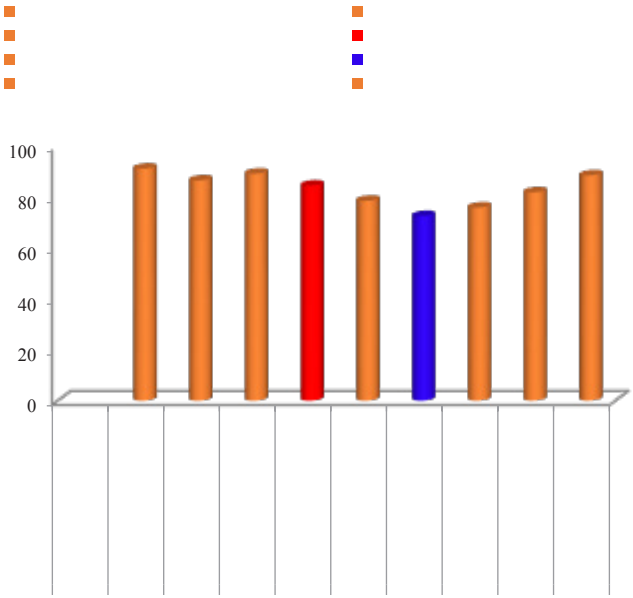

Figure 5.Variety×packaging material interaction effect

Seed quality of maize (Zea mays L.) varieties stored in different packaging materials at normal store room for various durations was assessed.

The analysis of variance in the 6 months storage duration indicated that there were no significant differences in packaging materials (p=0.280) but there were differences between cultivars (p=0.0004) for standard germination percentage. There was no significant "Packaging material × Cultivar" interaction effect (p=0.412). Using the LSD test, we found that Melkassa-4 and melkassa-2 cultivars had significantly higher germination (P<0.05) percentage than Melkassa 6Q cultivar. Their differences might be due to genetic characters of the cultivars. The interaction effect of different packaging materials with 6 months storage durations for maize SG test (%) indicated that, the highest mean values (100%) in PPl, Fb and Jute for M2 variety while it was followed by Pics (96.33) and Ms (90.33)

respectively. In M2 variety, the interaction effect of 12 months storage duration and packing materials, there is no such paramount statistical variation for PPl, Fb, Pics, Ms and Jute respectively, except for minor numerical mean value differences. The same thing is true in the case of the interaction effect of packaging materials and germination test conducted on 18 months storage duration as that of 12 months for variety M2.

Seed quality of common beans (*Phaseolus vulgaris* L.) varieties stored in different packaging materials at normal store room for various durations was assessed.

The analysis of variance indicated that, highly significant differences exist due to main effect of varieties on standard germination (SG1) at probability level ($p \leq 0.0003$) while there were no differences observed due to treatments as well as the interaction effects of varieties and treatments. Accordingly, in SG1, the highest germination (97.867%) was recorded in Nasser variety, followed by A1 (91.733%) and A2 (90.400%) with statistical parity with each other. In similar manner, the highest germination percentage (86.467%) was recorded for Nasser variety in SG2 while no significant variations were found for SG3 and SG4 respectively. From this result it can be asserted that, variety Nasser well fits germination standards set by ISTA (1993). Hence, it is very important to recommend common bean variety called Nasser for end users for planting stored for more than one year.

Seed borne pathogens and physiological quality of common bean (*Physeolus vulguris* L.) seeds produced by different seed producers were assessed.

Quality parameters of seed samples collected from different seed producers in CRV were analyzed. Accordingly, physical purity, physiological quality and seed healthy tests were done at MARC seed technology and pathology laboratories. The results indicated that standard germination of seed samples collected from formal seed sources were showed highly significant

differences (P<5%). Major fungicides identified on the seed collected from different seed sources were Pencilium, *Aspergillus* Spp., Haloblight, CBB,Fusarium, Halo blight, Phomopsis, Anthracnose, Alternaria and etc.

2. Early Generation Seed Multiplication (EGSM)

In 2020 cropping season, low land pulses & heat and drought tolerance maize seed varieties in addition to warm season vegetable seeds were multiplied at MARC. EGS multiplications were focusing on the field & lab seed quality standards to protect seed contamination occurring due to external factors. The produced seed varieties were evaluated for physical purity, genetic purity i.e., true to type, physiologically quality & free from seed borne diseases and insect pests. Fields were inspected three times by MARC seed research & internal seed quality control team whereas externally by Oromia Agricultural Inputs Control Authority based at Asella for seed certification. The inspectors were checked crops performance, isolation distance, crop rotation and off types of early generation seed multiplication fields having different crops varieties with different seed classes. Both internal and external seeds inspectors were inspecting EG seeds of different crops multiplied main seasons based on the national seed quality standards. The results indicated that all EGS crops multiplied at MARC in 2020 fulfilled the field and laboratory standards set by Ethiopia Standard Agency.

Seed samples were taken by inspectors from each seed crop variety and seed class multiplied at the main and off seasons by seed research and internal seed quality control team and Oromia Agricultural Inputs Control Authority to analyze moisture contents, physical purity, thousand seed weight, genetic quality, physiological quality and seed healthy. Laboratory results indicated that all seed crops varieties produced in 2020 main cropping season was fulfilled the national seed quality standards and recommended to distribute for different stakeholders.

3. Early Generation Seed delivery

EGS were distributed to different stakeholders after fulfilled all seed quality components based on the national seed quality standards. Among the total EG seed crops multiplied 1209.11 qt. at MARC all were distributed to different stakeholders. No carried over seeds at MARC. The distributions of EGS produced in 2020 main season at MARC were starting to different stakeholders.

Table 1. Crop types, total seed yield obtained, seed classes, quantities of raw seeds, certified seeds, allocated for further multiplication & PED, and quantity allocated for distribution produced at MARC (2020/2021).

Crops	Varieties	Seed classes	Quantity produced (Qt)	Quantity cleaned (Qt)	Quantity certified (Qt)	Quantity for further multiplication (Qt)	Quantity for PED (Qt)	Quantity for sale (Qt)
Maize	M2	Pbs	7	0	5	0	0	0
		Bs	429	405	405	0	5	400
	M4	Pbs				0	0	0
		Bs	81	62.5	62.5	0	2.5	60
	M6Q	Pbs	6	0		0	0	0
		Bs	128	109	109	0	5	104
	S-total		651	576.5	581.5	2	12.5	562
Common beans	A1	Pbs	30	17.4	17.4	2	0	15.4
	A2	Pbs	178	147	147	5	0.5	141.5
	SER119	Pbs	35.35	35.35	35.35	4	0	31.35
	SER119	Bs	45.9	45	45	0	3	42
	SER125	Pbs	44.7	44	44	5	0	39
	SER125	Bs	40.4	40.4	40.4	0	3	37.4
	SAB635	Pbs	11.4	9.16	9.16	2	1	6.16
	S-total		385.75	338.31	338.31	18	7.5	312.81
Mung beans	NVL	Pbs	16.25	16.25	16.25	1	1	14.25
	N-26	Bs	13	11.25	11.25	1	1	9.25
	S-total		29.25	27.5	27.5	2	2	23.5
Teff	Simada	Pbs	22	17	17	1	0.5	15.5
	Boset	Pbs	30	27	27	1	0.5	25.5
	S-total		52	44	44	2	1	41
Crops	Total	Pbs	380.7	313.16	318.16	21	3.5	288.66
		Bs	737.3	673.15	673.15	1	19.5	652.65
	G. total	Pbs+Bs	1118	986.31	991.31	22	23	941.31

Summary of MARC Staff by department and training level

Research program/department	PhD		MSc/MA		BSc/BA		Diploma		High school or below	
	M	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Crops	7	2	29	4	13	3	6	6	26	16
Natural Resources Management	3		10	2	6	3	3		5	3
Agricultural Engineering	–	–	11	–	8	2	7	2	2	2
Climate and Geo spatial	–	–	3	–	1	–	–	–	–	1
Agricultural Economics	1		3	1		–	–	–	–	1
Agricultural Extension and Communication	1*	–	4	–	2	1	1	–	2	–
Plant Protection	3	–	8	1	1	–	–	–	8	2
Animal Science	1	–	3		1	1	–	1	2	6
Food Science and Nutrition	–	–	1	–	7	2	–	1	–	1
Plant Biotechnology	1	–	4	–	–	–	–	1	–	2
Technology Multiplication and Seed	–	–	1		2		1	–	15	2
Human Resource and Development	–	–	–	–	1	2		2	1	–
Procurement and Finance	–	–	–	–	6	8	–	2	–	–
Information Communication Technology	–	–	–	–	1	–	2	2	–	1
Property Management	–	–	–	–	3	–	3		61	17
Internal Audit	–	–	–	–	–	–	–	1	–	–
Change Management	–	–	–	–	1	–	–	–	–	–
Anti-corruption and Ethics					1	2				
Transport Management	–	–	–	–	2	–	5	–	18	2
Finance and Procurement	–	–	–	–	6	7	1	1	–	–
Planning, Monitoring and Evaluation	–	–	1	–	–	–	–	–	–	–
Negelle Arsi Sub center	–	–	–	–	–	–	1	–	13	2?
Director Office	1*	–	–	–	–	–	–	1	–	–
Total	**17**	**2**	**77**	**8**	**55**	**22**	**28**	**21**	**140**	**56**

*Director Serving in managerial position most of his time.