

*Full Length Research Paper*

# On-Farm Demonstration of Improved Varieties of Faba bean (*Vicia faba*L.) in Gemechis, Chiro and Tullo Districts of West Hararghe Zone, Oromia National Regional State of Ethiopia

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The experiment was carried out in Gemechis, Chiro and Tulo districts of West Hararghe Zone with the objectives of enhancing production and productivity of faba bean on farmers' fields and to improve linkage among stakeholders and create awareness on improved faba bean varieties. Three kebeles were selected purposively based on faba bean production potential. Accordingly, Walenso Defo kebele from Gemechis, Arbarakate from Chiro district, and Terkanfata kebele from Tulo district were selected. Seven farmers and one Farmers Training Center were included participated depending on their interest to the technology, managing the experiment, have appropriate land for the experiment and taking the risk of experiment. Two improved varieties namely Hachalu and Tumsa with local variety were shown and evaluated. The experiment was demonstrated on 100 m<sup>2</sup> demonstration plots and DAP 100 kg/ha at the time of sowing applied to each demonstration plot with recommended seed rate. Both quantitative and qualitative data was collected through observation, group discussion on field day and data recording sheet. Descriptive statistics like mean and tabulation were used to analyse the crop performance concerning yield of the experiment harvested from demonstration plot. Improved varieties along with local variety were also analysed through independent t-statistics. While qualitative data were analysed through simple ranking and summarization. Partial budget analysis was also used to analyse the economic benefit gained from the experiment. The result of the study indicated that Hachalu was ranked first in terms of yield, seed color and disease resistance. As discussed from partial budget analysis, Hachalu variety has more economic advantage than both Tumsa and local variety. Therefore, Hachalu variety was recommended for further popularization and scaling up in study area and similar agro ecology.

**Key words:** Faba bean, demonstration, varieties, yield advantage.

## INTRODUCTION

Pulses are important food crops due to their high protein and essential amino acid content. The seeds of pulse crops are typically made up of 20 to 25% protein as

compared to 6 to 10% protein content in major cereal crops. Pulses are also rich in dietary fiber and usually have only small amounts of oil. The protein of pulse

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seeds is high in the amino acids lysine and methionine, making pulses nutritionally complementary to cereals, which are deficient in these two essential amino acids. Pulses are the main source of protein in the diet of vegetarians, and feature prominently in the traditional cuisine of virtually every region of the globe (Sitou and Mywish, 2011).

The main faba bean producers are China (1.65 Mt), Ethiopia (0.61 Mt), France (0.44 Mt), Egypt (0.29 Mt) and Australia (0.19 Mt) (FAOSTAT, 2009). It is a hardy crop and can withstand rough climates, especially cold ones. China is the largest producer of faba beans which gives East Asia the largest share in world total area harvested (38%) and total production (42%). The next largest faba bean growing regions are sub Saharan Africa and MENA, each covering 19 and 18% of world area, respectively (Sitou and Mywish, 2011). Faba bean is a valuable protein-rich food that provides a large sector of the human populations in developing countries with a cheap protein source, thus partly compensating for the large deficiency in animal protein sources. It is one of the earliest domesticated food legumes and is now cultivated on large areas in many countries due to its high nutritive value in terms of energy and protein contents (24 to 30%) (Sahile et al., 2009).

Grain legumes occupy about 13% of cultivated land in Ethiopia and their contribution to agricultural value addition is around 10%. Pulses are the third-largest export crop of Ethiopia after coffee and sesame, contributing USD 90 million to export earnings in 2007/2008 (IFPRI, 2010). In total, the area cultivated with the selected legumes is more than 1 million hectares but production/ha is low and far below the potential production (USAID, 2011). Common bean and chickpea are major legumes, with both a production of more than 200,000 MT grain. On the world market, Ethiopia ranks 6th in chickpea production and 14th in production of common bean. Among African countries, Ethiopia is the largest producer of both chickpea and common bean (ICRISAT, 2011).

In Ethiopia, faba bean is the crop that has the highest absolute production and the largest area cultivated. Ethiopia is also the second largest producer of faba bean in the world after China (Ronner and Giller, 2012). Faba bean is the most important pulse crop in terms of area coverage and total annual production in Ethiopia. This crop has manifold advantages in the economic lives of the farming community in the high lands of the country. It is a source of food, feed, cash to farmers and also play significant role in soil fertility practices. However, currently its share in the countries pulse export is small. Faba bean covers 427,696.80 ha leading the pulse category in area and production (CSA, 2017). The productivity of faba bean varieties under traditional farming system is found to be around 0.7 ton/ha, which is very small. However, there is a possibility to improve the situation using improved varieties, which can give a

better yield than the one's widely used now. Mechara Agricultural Research Center has conducted participatory variety selection of different improved varieties which are developed by different research centers. Therefore, McARC recommended two varieties namely, Hacalu and Tumsa for further promotion on farmers' fields. Thus, this study was initiated to enhance production and productivity of faba bean on farmers' fields and to improve linkage among stakeholders and create awareness on improved faba bean varieties.

## METHODOLOGY

### Description of the study area

The study was conducted in Chiro, Gemechis and Tulo districts of the West Hararghe zone of the Oromia National Regional State. Chiro which is the capital town of the zone, is located in West Hararghe zone of the Oromia national regional state at about 324 km east of Finfine, the capital city of Oromia regional national state. Normally, the district is divided into three major agro-ecological zones. These are lowland with 22 kebeles, mid land with 13 kebeles and highland altitude with 4 kebeles. The district bordered with Mieso in the north, Gemechis in the south, Guba-koricha in the west and Tulo in the east. The district is mainly characterized as steep slopes and mountains with rugged topography, which is highly vulnerable to erosion problems (Figure 1). It has a maximum and minimum temperature of 23 and 12°C, respectively and the maximum and minimum rainfall of 1800 and 900 mm, respectively (Gosa, 2016). Rainfall type is bimodal and erratic in nature. Main rainy season is from June to September for the highland and midland areas and from March to April for the lowland. Short rainy season is from March to May for highland and midland and for that of lowland around July. The amount of the rainfall is relatively adequate in the highland and midland than the lowland.

Gemechis district is one of the fourteen districts in West Hararghe zone, which is located at 343 km east of Addis Ababa and about 17 km south of Chiro, which is the capital town of the zone. The district is situated at the coordinate between 8° 40'0" and 9° 04'0" N and 4° 50'0" and 41° 12'0" E. The soil of the study area was dominantly loamy soil (Desalegn et al., 2016). Gemechis town is located on the top of a hill and its climate is 70% cold and cloudy. The woreda has many small cities located at 20 to 45 miles away from each other. Sogid, Sire, Metadhab, and Degaga are the major ones. Transportation for commuting is a major problem of the woreda (Encyclopedia).

Tulo district has 45,670 ha of land area and located at 370 km southeast of Addis Ababa. The altitude of the district is 1750 m above sea level with mean annual rainfall of 1850 ml and mean annual temperature of 23°C. The production system is mixed type in which extensive husbandry management of livestock have been practiced (Tulu and Lelisa, 2016).

### Farmers and site selection

The activity was conducted for one year in Gemechis, Chiro and Tulo districts of West Hararghe zone. Walenso Defo *kebele* from Gemechis district, Arbarakate *kebele* from Chiro district and Terkanfata *kebele* from Tulo district were purposively selected depending on their faba bean production potential. Seven farmers and One FTC were selected based on their interest to the technology, model farmers, managing the experiment and have appropriate land for the experiment.

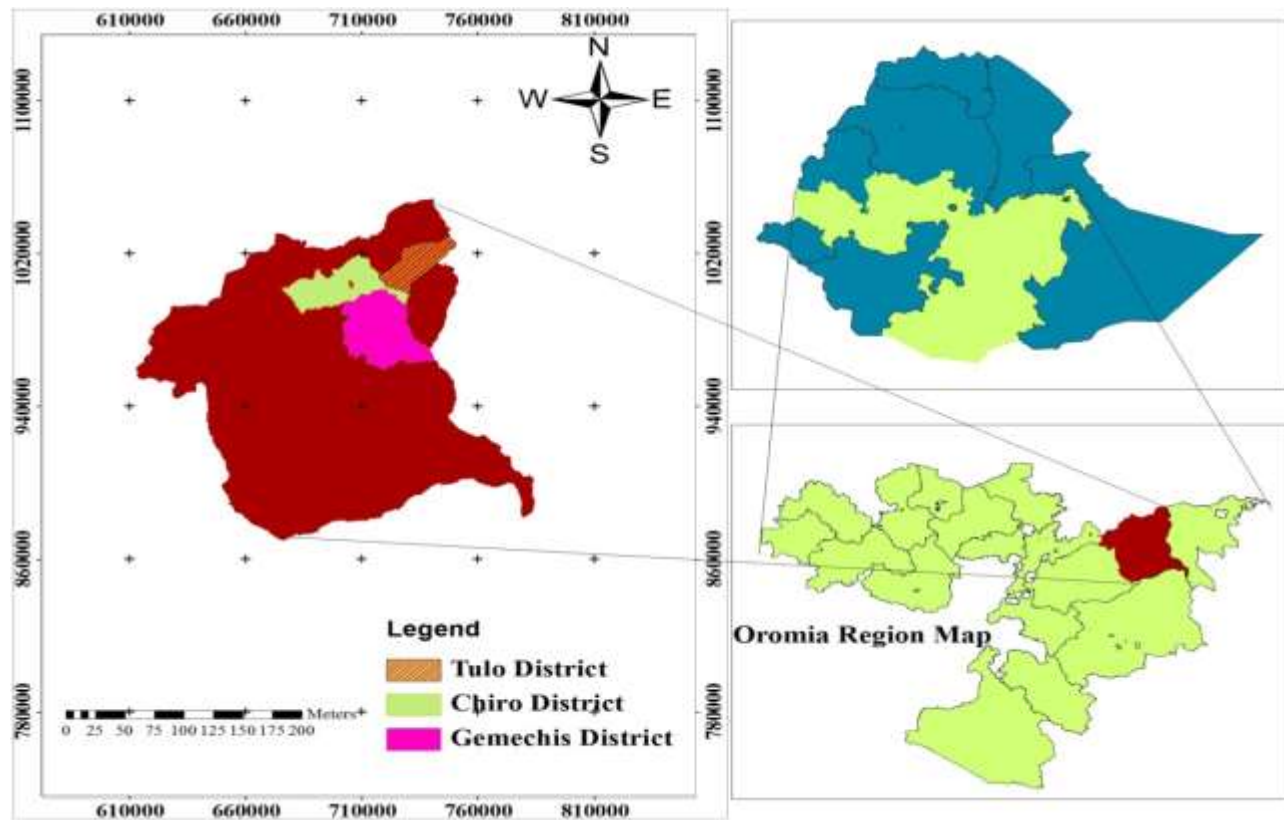


Figure 1. Map of study area.

#### Experimental design (Single plot side by side design)

Two improved faba bean varieties namely Hachalu and Tumsa were demonstrated and evaluated with local variety. The experiment was demonstrated on 10 m × 10 m (100 m<sup>2</sup>) demonstration plots and DAP 100 kg/ha at the time of sowing applied to each demonstration plot with recommended seed rate. Row sowing methods were applied with 10 cm between plant and 40 cm between rows. The required management like weeding, thinning out application at the growing stage was done.

#### Data collection methods

Both quantitative and qualitative data were collected through observation, group discussion on field day and data recording sheet. Data like farmer preference on disease and pests resistance, early maturity, drought tolerant, grain color, and yield data were collected through the prepared data collection sheet/record sheet by organizing mini field day and observation on farmer's field.

#### Data analysis

Descriptive statistics like mean and tabulation were used to analyse the crop performance concerning yield and yield components of the experiment harvested from demonstration plot. Improved varieties along with local variety were also analysed through paired t-statistics. While qualitative data were analysed through simple ranking and summarization. Partial budget analysis was also used to analyse the economic benefit gained from the experiment

## RESULTS AND DISCUSSION

### Crop performance on the farmer's field

The mean yield of Hachalu and Tumsa were 20.14 and 16.45 qt/ha with standard deviation of 17.88 and 12.20, respectively and the mean and standard deviation of the local variety were 19.83 and 16.73, respectively (Table 2). The mean yield of Hachalu variety was greater than both Tumsa and local varieties.

### Yield advantage of the crop Varieties

Yield difference of Hachalu from local is  $20.14 - 19.83 = 0.31$

Yield difference of Tumsa from local is  $16.45 - 19.83 = -3.38$

Percent of yield increase over local is given by yield of improved variety minus yield of local variety divided by yield of local variety and multiply by 100.

Thus, percent of yield increase of Hachalu over local check is  $(0.31 / 19.83) \times 100 = 1.56\%$

The result in Table 2 indicated that maximum yield were

**Table 1.** Shows experiment location, trials and varieties used.

Location	Kebele	No. of trail farmers	Varieties	Area covered (m <sup>2</sup> )
Gemechis	Walenso Defo	3	Hachalu, Tumsa and Local varieties	300
Chiro	Arbarakate	3	Hachalu, Tumsa and Local varieties	300
Tulo	Terkanfata	2	Hachalu, Tumsa and Local varieties	200
Total	-	8	-	800

Source: Own Computation (2017).

**Table 2.** Yield summary of the faba bean varieties on farmers field (N=8).

Variety	Min.	Max.	Sum	Mean (qt/ha)	Std. Dev.
Hachalu	7.02	51.47	161.09	20.14	17.88
Tumsa	5.47	39.44	131.63	16.45	12.20
Local	5.52	49.91	158.63	19.83	16.73

**Table 3.** Statistical comparison of faba bean varieties (N=8).

t-test	Hachalu and Tumsa	Hachalu and Local	Tumsa and Local
Difference	-3.690	-0.310	3.380
Standard error	7.653	8.657	7.321
95% CI	-20.1038 to 12.7238	-18.8780 to 18.2580	-12.3212 to 19.0812
t-statistic	-0.482	-0.036	0.462
DF	14	14	14
Significance level	P = 0.6371	P = 0.9719	P = 0.6514

scored from Hachalu variety (51.47 qt/ha). Yield increased in percentage of improved variety of Hachalu over local check were 1.56%. This indicated that using improved variety of Hachalu were relatively more productive than local variety with the same area and management. The minimum yield was scored due to insufficient rainfall encountered in the area cropping season 2016. It was concluded that Hachalu variety has more yield advantage than Tumsa and local variety.

### Statistical implication of experiments

There is no statistical difference between the yield of improved varieties and local check on farmer's field at 5% significance level (Table 3).

### Capacity building and experiment evaluation

Mini field day was organized on faba bean technology with consideration of different stakeholders (Farmers, DAs and Experts of the district) at Arbarakate kebele of Chiro district. Thus, 26 male and 5 female households participated on field day organized at Chiro (Arbarakate PA). Extension personnel (one male) and three male

development agents also participated with farmers to evaluate the experiment. For variety selection on field, researcher has divided farmers into three groups with combination of DAs and extension personnel (SMS). The group of farmers and DAs led by SMS put their own criteria to evaluate the technology by observing on field. Each group has given his own value to the experiment on demonstration plot (Figure 2). As shown in Table 4, the values given by group of farmers were summarized and its average was ranked by their participation.

Table 4 shows that farmers, development agents and experts have selected Hachalu and Tumsa varieties as the first and second, respectively based on overall averages of selection criteria.

### Economic benefit gained

Costs incurred and benefit gained from the project is discussed in detail as follows. The result of Tables 5 and 6 indicated that maximum gross margin (30,204.38 Birr/ha) and net benefit of (14,394 Birr/ha) were gained from Hachalu variety with same inputs and costs incurred to it with Tumsa during the project life time. Minimum gross margin (24680.63 Birr/ha) and least net benefit (8,871 Birr/ha) were recorded from Tumsa variety (Tables



**Figure 2.** Technology evaluation and selection on field day prepared at Chiro district.

**Table 4.** Participants preference of the variety selection on mini field day.

Variety	PE	SS	NB	SS	DR	DrR	EM	PH	TS	Rank
Hachalu	4.7	4.3	4	4.17	4.3	4.3	3.5	4.5	33.77	1st
Tumsa	3.5	3	3.7	3.5	4.3	4.7	3.5	3.7	29.9	2nd
Local	3.58	4	4.4	4.3	2.5	2.83	4.5	3.7	29.81	3rd

5=Excellent, 4=very good, 3=good, 2=Fair, 1=Poor. PE=Plant establishment, SS=stem strength, NB=number of branches, SS=seed size, DsR= disease resistance, DrR=drought resistance, EM=early maturity, PH=plant height and TS= total score. Source: Own Result (2016).

**Table 5.** Cost incurred to the projects.

Variety	Cost of inputs (ETB)				
	Plough	Sowing	Seed	Fertilizer	Total
Hachalu	6670	5340	2500	1300	15,810
Tumsa	6670	5340	2500	1300	15,810
Local	6670	5340	2300	1300	15,610

Source: Our Result (2017).

5 and 6). It can be concluded that using improved variety of faba bean (Hachalu) was economically profitable than Tumsa variety at the study area.

## CONCLUSIONS AND RECOMMENDATIONS

From the result of the study Hachalu variety have maximum mean yield and 1.56% more yield advantage than local variety. From the demonstrated varieties,

Hachalu and Tumsa varieties were selected based on overall averages of selection criteria. From the result of the study, there was yield advantage of Hachalu over Tumsa and local check. There is no statistical difference between the yield of improved varieties and local check on farmer's field at 5% significance level. Even if there is no significant difference between mean yield of improved varieties and local check, Hachalu variety has relatively more yield advantage than local variety. From partial budget analysis, Hachalu variety has more economic

**Table 6.** Net benefit gained from the project.

Variety	Average yield (kg/ha)	Market price of output Birr/kg	TR (P*Q)	TC	Net benefit
Hachalu	2013.625	15	30,204.38	15,810	14,394
Tumsa	1645.375	15	24,680.63	15,810	8,871
Local	1982.875	15	29,743.13	15,610	14,133

Source: Our Result (2017).

advantage than local variety. Therefore, Hachalu variety was recommended for further scaling up and popularization in the study area and similar agro ecology by concerning body.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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