Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.8, No.11, 2018

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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Abstract
In west hararghe Zone there was no improved technology of faba bean done on farmer's field and no high yield variety and drought resistant variety demonstrated to reach farmers widely in future.The experiment was carried out in Gemechis,Chiro and Tulo districts of West Harerghe 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 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 demonstrated and evaluated. The experiment was demonstrated on 100m^2 demonstration plots. Both quantitative and qualitative data were 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 trough 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 it was 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.
Keywords: Faba Bean, Demonstration, Varieties, Yield advantage

1. Introduction

Faba bean (*Vicia faba* L.) is referred to as broad bean, horse bean and field bean and it is the fourth most important pulse crop in the world (Sainte, 2011). 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. 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 (24-30%) (Sahile et *a*l., 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 2007/08 (IFPRI, 2010). In total, the area cultivated with the selected legumes is more than 1 million hectare but production per 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, E. and Giller, K.E.,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.

Many problems in the study area were raised by development agent and farmers concerning the production and productivity of faba bean. Among this lack of improved varieties, introduction of new varieties to the

locality without conducting variety trial by only considering similar agro-ecological conditions and there are also insect pests interfering with the growth performance of this crop. 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.

Objectives

1. To enhance production and productivity of faba bean on farmers` fields and
2. To improve linkage among stakeholders and create awareness on improved faba bean varieties.

Methodology

2.1 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 during 2016 cropping season. Chiro is the capital town of West Hararghe Zone, which is located at about 324 km East of Adiss Ababa. Normally, the district is divided into three major agro-ecological zones. These are lowland with 22 *Kebeles*, Midland with 13 *Kebeles* and highland altitude with 4 *Kebeles*. The district bordered with Miesso in the North, Gemmechis in the South, Guba-koricha in the West and Tulo in the East. It has a maximum and minimum temperature of 23^{o}C and 12^{o}C, respectively, and the maximum and minimum rainfall of 1800 mm and 900 mm, respectively (Cited in Gosa , 2016).

Gemechis district is located at 343 km East of Addis Ababa and about 17 km South of Chiro. The district is situated at the coordinate between 8^{0} 40'0" and 9 04'0" N and 4^{0} 50 '0" and 41^{0} 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.

Tulo district has 45,670 hectares of land area and located 370km South East of Addis Ababa. The altitude of the district is 1750 meters above sea level with mean annual rainfall of 1850ml 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).

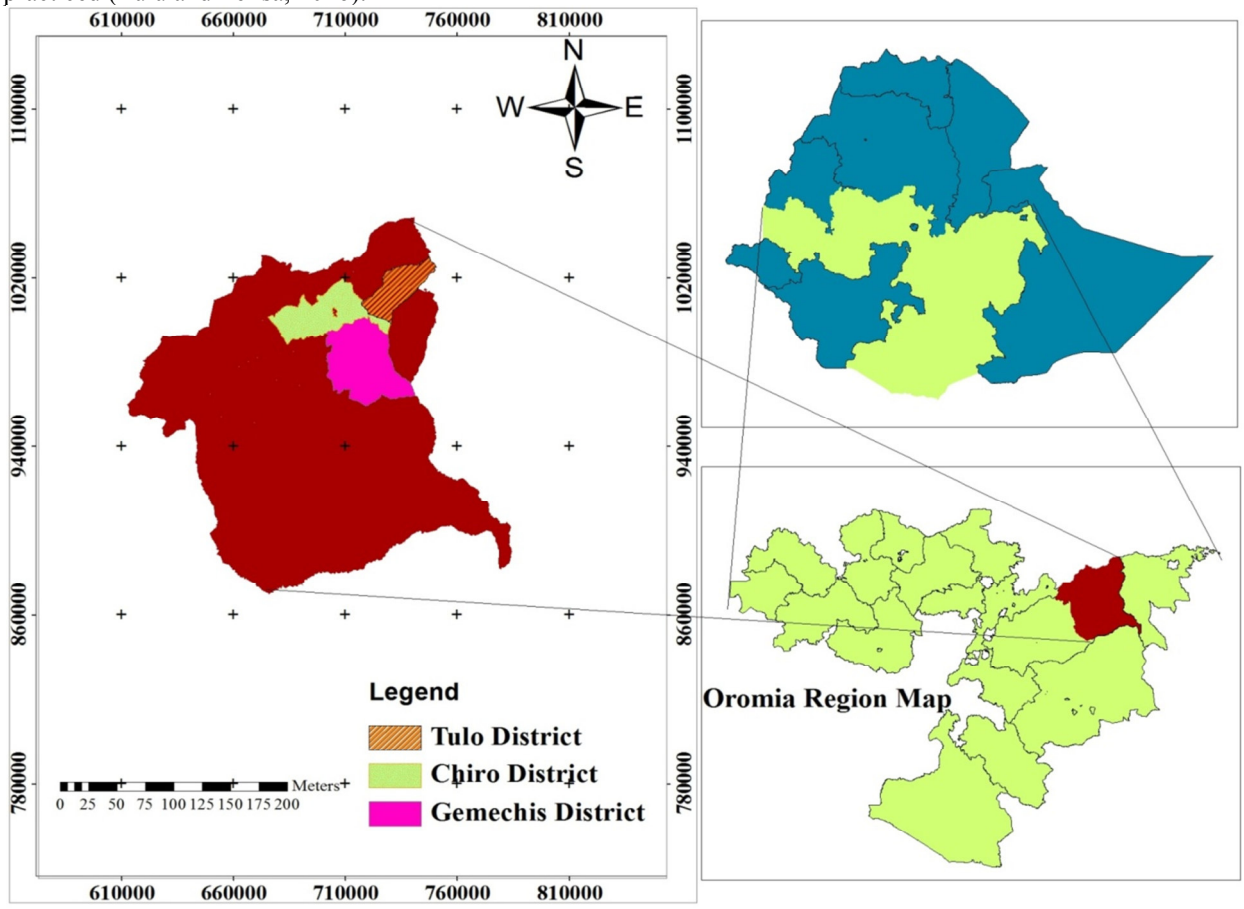

Figure 1. Map of study area

2.2. Farmers and Site Selection

The activity was conducted for one year (2016-2017) 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 (Table 1). Eight farmers were selected based on their interest to the technology, model farmers, managing the experiment and have appropriate land for the experiment.

2.3 Research Design

Two improved faba bean varieties namely Hachalu and Tumsa were demonstrated and evaluated with local variety. The experiment was demonstrated on 10m by10m ($100m^2$) demonstration plots and DAP 100kg/ha at the time of sowing were applied to each demonstration plot with recommended seed rate. Seeds were planted in a rows of 40cm spacing and drilled at 10cm. The required management like weeding and thinning out were done.

Table1: Shows experiment location, farmers participated and area covered in study area.

Districts name	***Kebele***	**No. of trial farmers**	**Area covered (m^2)**
Gemechis	Walenso Defo	3	300
Chiro	Arbarakate	3	300
Tulo	Terkanfata	2	200
Total		**8**	800

2.4 Data collection methods

Both quantitative and qualitative data were collected through observation, group discussion on field day and data recording sheet.Data like farmer's preference on disease and disease, weeds and insect reaction, 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.

2.5 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 independent t-statistics. While qualitative data were analysed trough simple ranking and summarization. Partial budget analysis was also used to analyse the economic benefit gained from the experiment.

3. Results and Discussion

3.1 Crop performance on the farmer's field

The mean yield of Hachalu and Tumsa were 20.14qt/ha and 16.45qt/ha with standard deviation of17.88and 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

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

Varieties	Min	Max	Sum	Mean	Std. Dev.	Yield difference from local	% yield increase over local check
Hachalu	7.02	51.47	161.09	20.14	17.88	0.31	1.56%
Tumsa	5.47	39.44	131.63	16.45	12.20	-3.38	-
Local	5.52	49.91	158.63	19.83	16.73	-	-

The result on Table 2 indicated that maximum yield were 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 were scored due to insufficient rainfall encountered us in the area 2016. The mean yield obtained was higher than the yield gained during Participatory Variety Selection trial, Hachalu variety mean yield recorded 14.37 and 8.08 Qt/ha whereas Tumsa variety was 4.45 and 5.85 Qt/ha at Chiro and Gemechis, respectively (Wondimu et al., 2016). But, lower than national production 20.58Qt/ha (CSA, 2017).

3.2 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: Statistical comparison of faba bean varieties (N=8)

varieties	Mean	t	df	Sig. (2-tailed)
Hachalu Local	30.75	.475	12	.643
Tumsa Local	-337.500	.475	10.587	.644

3.3 Capacity building and experiment evaluation

Mini field day was organized on Faba bean demonstration trial with consideration of different stakeholders (Farmers, DAs & Experts of the district) at Arbarakate *kebele* of Chiro district. Thus, Twenty six (26) male and five (5) female farmers, and extension personnel (one male) and development agents three male were participated to evaluate the experiment. For variety evaluation on field, researcher has divided farmers into three groups with combination of DAs and Extension personnel (SMS). The group of farmers and DAs leaded by SMS were set their own criteria to evaluate the varieties. Each group has given his own value to the experiment on demonstration plot. As it was discussed in Table 4 the values given by group of farmers were summarized and its average was ranked by their participation.

Table 4: Participant's preference on the variety selection in the mini field day

Varieties	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

Note: 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

Table 4 indicates that farmers, development agents and experts have selected Hachalu and Tumsa variety as a first and second respectively based on overall averages of selection criteria's.

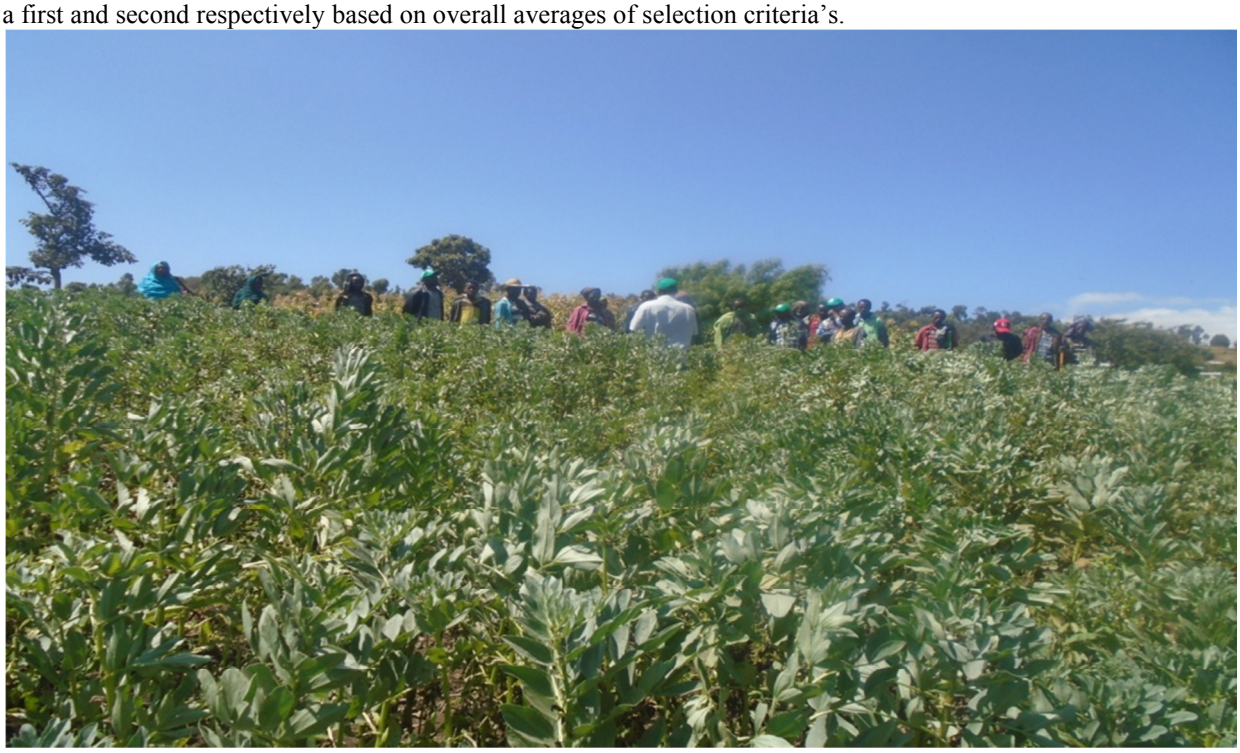

Figure1:Technology evaluation and selection on field day prepared at Chiro district.

3.4. Economic benefit gained

Costs incurred and benefit gained from the project is discussed in detail as follows. The result of Table 6 & 7 indicated that maximum gross margin (30,204.38Birr/ha) and net benefit of (14,394Birr/ha) were gained from Hachalu variety with same inputs and costs incurred to it over Tumsa during the project life time. Minimum gross margin (24680.63Birr/ha) and least net benefit (8,871Birr/ha) were recorded from Tumsa variety (Table 6&7). It is conclude that using improved variety of Faba bean (Hachalu) was economically profitable than Tumsa variety at the study area.

Table 6. Cost incurred to the project

Varieties	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

Table 7. Net benefit gained from the project

Variety	AverageYield(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

4. Conclusions and Recommendations

4.1 Conclusions

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 were selected based on overall average selection criteria's. From the result, there was yield advantage of Hachalu over Tumsa and local check. 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 due to drought and disease tolerant than local cultivar. Furthermore, Hachalu has more economic advantage than local variety.

4.2. Recommendations

Therefore, Hachalu variety was recommended for further scaling up and popularization in study area and similar agro ecology by concerning body. It is required to popularize through clustering and farmers to farmer linkage to disseminate this technology widely in study area.

Acknowledgments

The authors would like to express profound gratitude to Oromia Agricultural Research Institute (OARI) and Mechara Agricultural Research Center (McARC) for financial support and facilitating this work. We especially very thankful to Socio Economic Research Team for their kind technical support throughout achievement of the experiment. Generally, we would like to express our especial thanks to editorial boards and editors of Development and Agricultural Economics for their cooperation to edit this paper in detail for Journal Article.

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