

Evaluation of Newly Released Common Bean Varieties through On-Farm Demonstrations in ATJK and Shalla Districts of Oromia Regional State, Ethiopia

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Abstract: *The study was conducted in Adami Tulu Jedo Kombolcha (ATJK) and Shalla districts of Oromia regional state, Ethiopia during 2016-2017 cropping season. The objectives of the study were to evaluate the newly released improved common bean varieties (SER-125 and SER-119) with their production technologies in farmers' fields by comparing them with the existing variety called Nasir. A total of 32 interested farmers were purposively selected and hosted the demonstrations. The improved common bean varieties SER-125 and SER-119 performed well and have given a mean yield of 2715 kg/ha and 2945 kg/ha respectively. The existing variety has given a mean yield of 2235 kg/ha. The improved varieties had yield advantage over the control. The highest yield increment (770 kg/ha) was recorded by SER-119 variety with a 36.15% yield advantage over the control (Nasir) and the lowest yield increment was 360 kg/ha with a 15.38% yield advantage by SER-125. The utilization of improved varieties under on-farm demonstration recorded higher average gross returns (22382 birr/ha) and net returns (12923 birr/ha) compared to control plot average gross returns (16986 birr/ha) and net returns (8733 birr/ha). Therefore, the office of agriculture of the respective districts should further popularize to a large number of farmers in similar areas. Seed producer enterprise, cooperatives or organized seed producer farmers groups should continuously and consistently multiply and supply the seeds of this variety so that there is sustainable seed supply for SER-119 and SER-125 varieties in the area.*

Keywords: *Common Bean, Demonstration, Improved, Varieties*

1. INTRODUCTION

In Ethiopia, agriculture is the leading sector which contributes to nearly 34% of the country's gross domestic product (GDP) and 71% of employment. Crop production makes up 72% percent of the total agricultural GDP, of which cereals production covered 79.9%, pulses 13.2% and oil seeds 6.9%. (ATA, 2018).

Common bean (*Phaseolus vulgaris* L.) is one of the most important pulse crops grown in Ethiopia in terms of both area and quantity produced. The crop is cultivated in different parts, mainly Oromia, Amhara and Southern Nations Nationalities and Peoples Region (SNNPR). Their share of the national common bean production is 51% for Oromia, 24% for Amhara and 21% for SNNPR (CSA, 2018). Almost all common beans are produced under rainfed conditions by smallholder farmers on less than 0.5 hectares (Ephrem, 2016). The crop is one of the most important cash crops and sources of protein for farmers in many lowlands and mid-altitude zones. It is also widely intercropped with maize and sorghum to supplement farmers with additional income and to maintain soil fertility (IBC, 2012). Common bean farmers preferred the crop because of its fast maturing characteristics that enable households to get cash income required to purchase food and other household needs when other crops have not yet matured (Berhanu *et al.*, 2018).

The area under common bean production in Ethiopia during 2007/2008 was 231,443.06 hectares rose to nearly 306,186.59 hectares in 2017/2018 and the production from 2,414,176.41 quintals to 5,209,793.27 quintals. At the same time, the number of common bean producer farmers increased from 2,147,871 to more than 3,622,330.00. The average productivity of the crop also increased from 10.4 kg per hectare to 1700 kg per hectare in the last ten years (CSA, 2018).

The Ethiopian Institute of Agricultural Research (EIAR), have released and popularized a number of improved varieties (high yielding, early maturity and disease resistant, varieties meeting the requirements for local consumption and export markets) and management practices since early 1960s to enhance the productivity of common bean and income. However, due to the availability of high yielding varieties, suitable production environment and economic and food security importance of the crop, the actual smallholder farm yields (1700 kg per hectare) are by far below the potential yield (3500 kg per hectare) at research stations and 3000 kg per hectare for research managed farmers field (MoANR, 2016; Zerihun, 2017; Berhanu *et al.*, 2018).

Table1. Common bean varieties released between 2011 and 2015

Name of Variety	Altitude (m)	Seed color	Productivity (Kg/ha)		Year of release
			Research field	Farmers field	
SAB 736 (Ado)	1450-2000	Large White	2000-2500	1800-2200	2015
SAB 632 (Tafach)	1450-2000	Speckled	2200-2600	1900-2400	2015
SER-119	1450-2000	Red	3300	2500	2014
SER-125	1450-2000	Red	3500	2200	2014
Dendesu (KAT B9)	1300-1650	Red	2200-3000	1900-2300	2013
Adda (KATB1)	1300-1650	Yellow	1900-3300	1700-2500	2013
Awash-2	1450-2000	White	2800-3100	1800-2200	2013
Morka (ECAB-0056)	1400-2200	Red mottled	2500	2000	2012
GLP-2	1400-2200	Red mottled	3000	2200	2011

Source: Berhanu *et al.*, (2018); MoANR, (2016)

According to Amanuel and Girma (2018), the low national yield is related to the low adoption of improved production technologies, lack of improved varieties and poor cultural practice. Yetayal and Lema (2019), also reported disease and pest, drought, poor availability and the high price of improved seed and unstable product price are major constraints of common bean production. The objective of this study, therefore, is to demonstrate the newly released improved common bean varieties (SER-125 and SER-119) with their production technologies in farmers' field, evaluate and select the best-fit variety for future large-scale technology demonstration and popularization.

2. MATERIALS AND METHODS

2.1. Description of the Study Area

ATJK district is one of the districts of East Showa Zone of Oromia Regional State, bordered by Dugda district to North and Arsi Negelle district from South while Zuway Dugda district from East and SNNP regional state is from West. It is found at 168 km South of Addis Ababa with total area of 140,324.6 km². The area receives mean annual rainfall of 690 mm and it has an altitude between 1500 and 2300 meters above sea level (Bezabeh *et al.*, 2010; EEPCo, 2013). The major economic sectors of the district are crop production, animal husbandry, and fishery. The main crops produced are a maze, common bean, *teff* and wheat (Jemila, 2014).

Shalla district is one of the districts of West Arsi Zone of Oromia Regional State, bordered by Siraro district to South, on the west by the SNNP Region, on the north by Shalla Lake, and on the east by Shashamane, its western boundary is defined by the course of the Bilate river. It is found 279 km south of Addis Ababa with total area of 140,324.6 km². The area receives annual rainfall ranging from 1000 to 1200 mm and the main growing season (rainy season) is from June to September. The altitude of the district is estimated to be in the range between 1000 and 2300 meters above sea level. The mean annual temperature of the district lies between 22°C and 25°C. Agriculture is the primary economic activity and about 95% of the population engaged. The major crops produced in the district are maize, wheat, common bean and *teff* (Ahmed, 2018).

2.2. Farmers Selection and Demonstration Field Establishment

For the study, two kebeles from each district, Anono Shisho and Oda Anshura from ATJK district and Awara Gama and Funde Ejerso kebeles from Shalla district were purposively selected based on their accessibility and potential to common bean production. From the four kebeles, a total of 32 common bean producer farmers were selected to host the demonstration based on their interest in the common bean technology, willingness to manage and allocate field trial for the activity and willingness of collaboration with extension agents and researchers. For the demonstration full technology packages of common bean were provided and each selected farmer encouraged to prepare about 0.25 hectare of land. The varieties (SER-125 and SER-119) that have been released from the research were cultivated side by side to demonstrate and compare their performance with the one that farmers are using (Nasir). Initially, farmers were trained about improved common bean production practices (seed rate, fertilizer rate, planting dates and protection), the improved varieties characteristics and recommended agronomic practices.

2.3. Recommended Agronomic Practices of Common Bean Cultivation

Farmers were advised to plough their land three times before planting common bean. Planting time depends on the onset of rainfall. Usually, when rainfall starts in mid-June, planting during late June and mid-July is recommended. It is recommended common bean to be sown in rows with a seed rate of 100 kg/ha. The spacing between rows should be 40 cm, and seeds in the row 10 cm apart. In poor soil, adding 100 kg/ha of DAP during planting is recommended. When the plants are deficient in nitrogen, they show leaf yellowing, at this moment, 50-100 kg urea could be applied as top dressing before flowering. Hand weeding should be done twice. Accordingly, farmers should undertake the first hand weeding two weeks after planting, and the next weeding five weeks after sowing. To control most important yield-reducing diseases, such as bacterial blight, anthracnose, and rust; using clean, disease-free seeds and avoiding repeated cropping in the same field and planting disease-tolerant varieties is recommended (Teshale *et al.*, 2008).

2.4. Data Collection and Analysis

The activity data were collected by the researchers directly from the field. Farmer's perception of the varieties was recorded from focus group discussion during the evaluation process. The collected data were analyzed using descriptive statistics and preference ranking based on farmers' set criteria.

3. RESULTS AND DISCUSSION

3.1. Yield Performance

A comparison of productivity levels between the improved varieties and the control (Nasir) is shown in figure 1. Production comparison between the improved varieties (SER 125 and SER 119) and the control (Nasir) was made. Nasir was selected to be used as a control because it is the variety most commonly grown in the study areas.

The result obtained from the newly released improved common bean varieties as well as the control is described below in figure 1. From the field demonstration conducted in 32 farmers farm, the mean yield performance of common bean varieties in the ATJK district was 2700 kg/ha, 2990 kg/ha and 2340 kg/ha for SER-125, SER-119 and Nasir respectively. The result obtained was higher than what was reported (1580 kg/ha) by the district agricultural office (ATJKDoA, 2018). The result also shows a 760 kg/ha yield increment by using only the recommended agronomic practices excluding the varieties. In Shalla district, the mean yield performance of improved common bean varieties was also found higher than that of the control (2130 kg/ha). In addition, comparing the mean yield of the control from the demonstration and the mean of common bean productivity in the area (1626) reported by the district agricultural office (SDoA, 2018), shows an increment in 504 kg/ha by using only improved agronomic recommendations by using the same variety. Comparing the varieties performance across locations, SER-119 and SER-125 with Nasir, the newly introduced variety (SER-119 and SER-125) performed very well. The result conforms with (EIAR, 2016) and suggests the positive effects of demonstrations over the existing farmers practice towards enhancing the yield of common bean with its positive effect on crop yield.

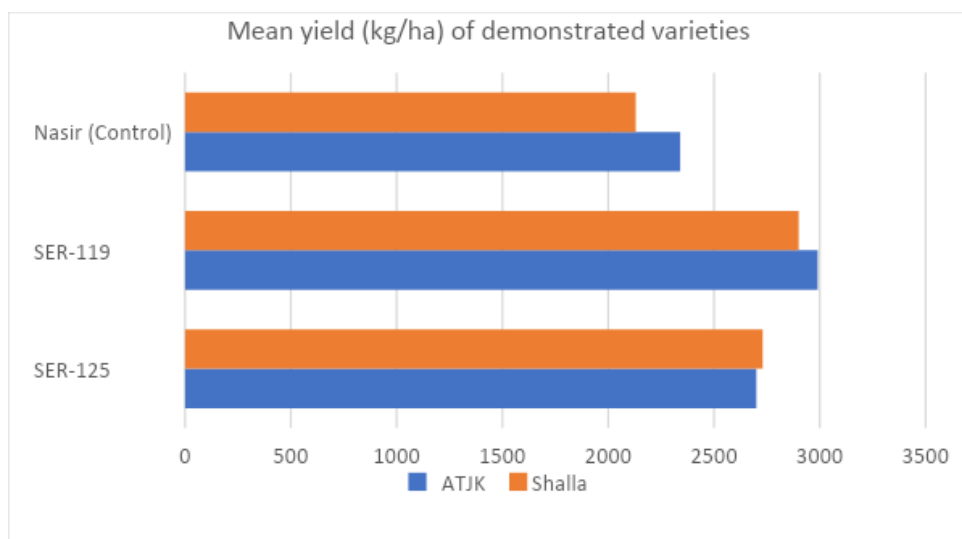


Figure1. Mean yield of varieties in ATJK and Shalla districts

3.2. Yield Gap and Advantage

The result of the study indicated in (Table 2) shows the recently released varieties of common bean have higher yield increment over the control in both districts. The larger yield increment was reported from Shalla district with 770 kg/ha (36.2 %) increment by SER-119 variety and yield increment of 600 kg/ha (28.2 %) by SER-125 variety over the control. In ATJK district, both the recently released improved common bean varieties have yield increment over the control with yield increment of 360 kg/ha (15.4%) and 650 kg/ha (27.8 %) respectively for SER-125 and SER-119. Similarly, yield increment in newly released varieties of crop from demonstrations plots was documented by Gebru et. al., (2019); Fistum and Gadissa (2019); Dhaka et.al. (2015).

Table2. On-farm demonstration field yield and yield increment of common bean varieties

Location	Variety	Min	Max	Mean yield	Yield increment (kg/ha)	% increase over control	SD
ATJK	SER 125	2600.0	2800.0	2700.0	360.0	15.4	367.2
	SER 119	2760.0	3220.0	2990.0	650.0	27.8	225.4
	Nasir (Control)	2120.0	2560.0	2340.0	-	-	204.6
Shalla	SER 125	2560.0	2900.0	2730.0	600.0	28.2	371.1
	SER 119	2680.0	3120.0	2900.0	770.0	36.2	335.1
	Nasir (Control)	2100.0	2160.0	2130.0	-	-	146.6

Source: On-farm demonstration fields

3.3. Financial Benefits

Assessment of the profitability of common bean cultivation was calculated for every treatment using the following formula:

The profitability of common bean cultivation with the utilization of improved varieties and farmers' practices has been presented in Table 3. The utilization of improved varieties under on-farm demonstration recorded higher average gross returns (22382 birr/ha) and net returns (12923 birr/ha) compared to control plot average gross returns (16986 birr/ha) and net returns (8733 birr/ha). These results are in conformity with the study conducted by Ndakidemi et.al., (2006) on common bean and Birhanu et.al., (2018); Afewerk and Adam, (2018) on soybeans.

Table3. Financial benefits of the improved varieties in farmers income

Cost of cultivation			Gross return			Net return			Benefit cost ratio		
Nasir	SER-125	SER-119	Nasir	SER-125	SER-119	Nasir	SER-125	SER-119	Nasir	SER-125	SER-119
8253	9459	9459	16986	20634	22382	8733	11175	12923	1:23	2:18	2:37

NB: The sale price of common bean is 760 birr/kg for the year 2017-18

The improved variety and control plots have a positive outcome (Table 3). Being the improved varieties have positive outcomes, the farmers will be at the high-profit level if they cultivate any of the newly promoted improved varieties along with recommended agronomic practices than the control (Nasir). However, farmers will have a higher return on the amount invested in common bean farming with SER-119 variety.

4. CONCLUSION AND RECOMMENDATION

The study showed that the improved common bean varieties (SER-119 and SER-125) had shown better performance in grain yield than the Nasir (control). Thus, the cultivation of common bean with improved varieties has been found more productive and the yield capacity can be increased up to 36.15 percent. Replacement of Nasir variety with a newly released variety (SER-125 and SER-119) of common bean will increase the production and net income. The existing Nasir variety of common bean should be replaced with newly released common bean varieties (SER-119 and SER-125) because of higher productivity and income. SER-119 and SER-125 varieties were found to be suitable in both study locations since they fit well to the existing farming situation and also it had been appreciated by the farmers. Hence, the office of agriculture of the respective districts should further popularize to a large number of farmers in similar areas. Seed producer enterprise, cooperatives or organized seed producer farmers groups should continuously and consistently multiply and supply the seeds of this variety so that there is sustainable seed supply for SER-119 and SER-125 varieties in the area.

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