

On Farm Performance Evaluation of Faba Bean Varieties in the Highlands of Gurage and Siltie Zones

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Abstract

Faba bean is one of the important grain legumes in Ethiopia. The low yield of faba bean is partly attributed to the use of low yielding varieties. An evaluation experiment was conducted in three districts namely, Gumer, Geta (Gurage zone) and Alichowuriro (Siltie zone), Southern Ethiopia, during 2016 and 2017 main cropping seasons with the objective of obtaining high yielding and farmers' preferred variety(ies). Six faba bean varieties including one local were grown in randomized complete block design with three replications. Variety moti and gebelcho were preferred by farmers, even if were not higher yielder so, it should be expanded for the study area. Therefore, farmers to be found in the study districts are recommended to use the selected varieties to increase their faba bean production to increase income.

Keywords: Faba bean; Variety; Farmers preferred; Evaluation

Introduction

Grain legumes are an important component of agricultural and food systems in practically all over the world and serve to complement the cereal crops in several aspects. Faba bean is one of the most important cool-season food legumes grown in the highlands of Ethiopia. Faba bean is one of the important pulse crops in Ethiopia. The appropriate agro ecology for production was ranged 1800 masl-3000 masl. The crops are also served as a source of income; source of protein and high levels of carbohydrates for poor farmers at household level and to some extent contribute for the country's foreign currency earnings. Pulses are grain crops which constituted the major food crops and are the leading ones both in terms of the area coverage and volume of production in Southern Nations Nationalities People's Regional State (SNNPRS) [1]. It also plays a significant role in soil fertility restoration as a suitable rotation crop that fixes atmospheric nitrogen. In SNNPR, among the total land size of 1066825.51 hectares planted by all grain crops, pulses covered 219,502.58 hectares with a total production of

32838.99 tones. Faba bean and chickpea are the pulse crops that are cultivated in various zones and special wereda in the region, it occupies about 66590.48 and 5662.23 hectares of land annually with estimated production of 10914.12 and 938.9.3, tones respectively (CSA, 2014/2015) [2].

Crops like, faba bean with regional productivity (t ha⁻¹) of 1.64 respectively are cereals grown in different agro-ecologies of SNNPR (CSA, 2014/15). From this regional productivity list, it can be realized that the productivity of faba bean crops are too low which is less than half of the potential productivity which could be obtained through using improved crop varieties. According to Tafere, et al. farmers' exposure to evaluate and select new varieties is an advantage to exploit their potential knowledge of identifying adapted varieties that best meets their interest which further helps to include such selections in their varietal portfolio for seed production. The interaction of researchers and farmers was also help to design research objectives to overcome rejection of varieties developed by researchers alone, enhances the acceptance of varieties and reduces costs associated with variety development. Most farmers also recognized well that improved cultivars will perform better if accompanied by recommended cultural practices. Therefore, for sustainable improvement of crop productivity in selected area participatory variety adaptation and evaluation are paramount important. To alleviate the problem, participatory variety selection is the better option to fit the crop a multitude of both target environments and user preferences. It is worth mentioning that although farmer participation is often advocated on the bases of equity. Therefore, this paper was initiated to identify best performing, farmers preferred faba bean varieties [3].

Materials and Methods

Description of the study areas

The study area is located in the central part of southern nation nationalities and peoples regional state; at Gurage zone at Gumer and at Siltie zone Alichowuriro district. The Alichowuriro is located at Siltie zone and the district totally categorized as dega agro-climatic zone. The altitude ranges 2560 m.a.s.l-3262 m.a.s.l. The average annual rainfall 750 mm and the

maximum rainfall 1350 mm. Average annual temperature 19°C and temperature ranges 7.5°C-24.5°C. The district is 27 km far from Worabe, 210 km from Hawassa and about 198 km at south of Addis Ababa [4].

Treatments and design

The experiment was conducted using five improved faba bean varieties (Gebelcho, Dosha, Moti, Hachalu and Tumsa) obtained from Holetta agricultural research centre, Ethiopia and one local check. Planting was done on 15 June 2016 and in 16 June 2017 during main cropping seasons in randomized complete block design with three replications in grandmother and mother trials. The grandmother and mother trial was done in Gurage zone Gumer and Geta districts and in Siltie zone Alichowuro district. The grandmother trial was sown in a single farmer of in each districts and mother trial was sown in randomly selected three farmers in each districts. Each plot had six rows with the row length of 3 m whereas the spacing between rows, plants, plots and replications was 40 cm, 10 cm, 50 cm and 1 m, respectively [5]. Each variety was planted two seeds per hill and then thinned to one after 8 days after emergence/planting. The recommended rate of 121 kg/ha of blended NPS fertilizer was applied at planting. Hand weeding was done when required throughout the experiment. Each farmer acted as a replicate in mother trial.

Data collection and analysis

Plant height (cm), number of pods per plant and number seeds per pod (using five random plants), as well as 100-seed weight (gm) and grain yield (kg/ha) were measured using the central four rows. The 20 farmers (11 male and 9 females) ranked varieties using the farmers' selection criteria of number of pods per plant, number of seed seeds per pod, yield, seed size and

disease resistance, pod filling/maturity, seed size and yield with the score from 1 to 6 (1=excellent, 2=very good, 3=good, 4=average 5=poor and 6=very poor) and with the score of 1 to 6 for each criterion, simple ranking method was used. The agronomic and yield data were analyzed using SAS 9.0 software [6].

Results and Discussion

Combined analyses of data from the Gurage zone (Gumer and Geta districts) and Siltie zone (Alichowuro district) shown very highly significant varietal differences ($P<0.01$) in pod per plant, yield per hectare and hundred seed weight whereas non-significant in seed per pod and plant height (Table 1). Table 1 shows mean square-values of agronomic trait across the years, location, variety, location \times variety, year \times variety and year \times location \times variety. The varieties evaluated based on yield and other agronomic traits. The varieties revealed highly significant variation in all agronomic traits recorded except number of pod per plant and seed per pod. With regard to year, locations and location \times variety most of the agronomic traits recorded shows highly significant to significant variation. Even though the year shows highly significant to significant most agronomic traits, the year \times variety and year \times location \times variety interaction shows non-significant variation for all agronomic traits. This indicates that the varieties responded similarly to the tested locations and year for all agronomic traits. Similarly Negash, et al. reported that faba bean varieties showed significant variation for these traits. Kindie and Nigusie also reported significant variation among faba bean varieties for grain yield, seed weight, plant height and pod per plant [7].

Table 1: Yield and yield components of faba bean varieties mean square values of combined over location and year.

Source of variation	Mean squares					
	DF	PP (No)	SP (No)	PH (cm)	YH (Kg)	SW (No)
Year	1	90.57**	0.717**	1452.73**	106841.94**	4.12 ^{ns}
Location	2	195.83**	0.201*	1870.87**	5899306.05**	9.30*
Replication	2	1.92 ^{ns}	0.027 ^{ns}	206.87 ^{ns}	8.82 ^{ns}	15.61**
Variety	5	125.34**	0.124 ^{ns}	205.87 ^{ns}	1212242.87**	210.01**
Location \times variety	10	55.78**	0.055 ^{ns}	213.97 ^{ns}	352431.12**	4.26*
Year \times variety	5	10.92 ^{ns}	0.027 ^{ns}	159.98 ^{ns}	4115.99 ^{ns}	1.67 ^{ns}
Year \times location \times variety	12	17.80 ^{ns}	0.030 ^{ns}	116.14 ^{ns}	1655.41 ^{ns}	1.64 ^{ns}
Error	70	9.67	0.055	111.27	3679.95	1.91
CV		15.17	7.49	8.02	1.64	1.62

LSD (0.05)		2.07	0.16	7.01	40.32	0.92
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Note: *Significance at $p \leq 0.05$, DF=Degree of Freedom, PP=Pod per Plant, PH=Plant Height, YH=Yield per Hectare and SW=Seed Weight

Number of pod per plant

The combined analysis showed that faba beans varieties were highly significantly ($P < 0.05$) affected pods per plant across all locations and years. The maximum number of pods per plant were recorded from Tumsa (25.02) followed by Dosha and Hachalu in all locations across. The minimum number of pod per plant was recorded for Gebelcho variety across all location and years' (Table 2). This result much with Wondimu who reported that Gebelcho variety was lowest number of pod per plant. Ashanafi and Makuria also reported the significant difference among faba bean varieties in number of pod per plants [8].

Number of seed per pod

The combined analysis showed that faba beans varieties were not significant difference in number of seed per pod across all locations and years. Even though non-significant different among the varieties the maximum number of seed per pod were recorded from Moti (3.29) and the minimum number of seed per pod had recorded for Gebelcho variety (3.07) in all locations across years' (Table 2) [9].

Plant height

The analysis showed that faba beans varieties were not significant difference in plant height all locations and years. Even though non-significant different among the varieties the tallest plant height was measured for Tumsa (135.4 cm) and the

shortest plant height was measured for local variety (126.6 cm) in all locations across years' (Table 2).

Yield per hectare

The combined analysis showed that faba beans varieties were highly significantly ($P < 0.05$) affected yield per hectare across all locations and years. The maximum yield per hectare was measured from Tumsa (4.18 t ha⁻¹) followed by local (3.73 t ha⁻¹) and Moti (3.69 t ha⁻¹) in all locations across year. The minimum yield per hectare was measured for Gebelcho (3.46 t ha⁻¹) variety across all location and years' (Table 2) [10]. This result was in line with Ashanafi and Mekuria. Similarly (Goa Y,) 2017 reported that significance variation of faba bean varieties for seed yield in different location.

Hundred seed weight

The combined analysis showed that faba beans varieties were highly significantly ($P < 0.05$) affected yield per hectare across all locations and years. The maximum yield per hectare was measured from Gebelcho (88.78 gram) followed by Tumsa (88.04 gram) and local (85.10 gram) in all locations across year. The minimum hundred seed weight was measured for Dosha (81.5 gram) and Hachalu (81.9 gram) variety across all location and years' Table 2 [11].

Table 2: Average values of yield and yield related attributes of faba bean varieties across location and year.

Varieties	PP (No)	SP (No)	PH (cm)	YH (t ha ⁻¹)	SW (No)
Tumsa	25.02	3.16	135.4	4.18	88.04
Dosha	21.93	3.07	131.2	3.52	81.50
Hachalu	20.43	3.15	132.4	3.58	81.90
Local	19.02	3.08	126.6	3.73	85.10
Moti	18.78	3.29	134.7	3.69	82.91
Gebelcho	17.83	3.07	128.8	3.46	88.78
LSD	2.07**	0.16 ^{ns}	7.01 ^{ns}	40.32**	0.92**
CV	15.17	7.49	8.02	1.64	1.62

Farmer's selection

Selection was carried out at three different growth stages by organizing a field day at each stage *i.e.* at vegetative, physiological maturity and after threshing. The evaluations of overall score value for each variety ranged from 7 to 27. Tumsa

scored the highest value followed by local variety and the lowest was scored by Dosha and Moti. The best varieties namely Tumsa followed by local were selected as top ranking in all groups as final selections or adapted varieties at Gumer district [12]. The evaluations overall score value for each variety ranged from 8 to 28. Tumsa scored the highest value followed by Gebelcho variety

and the lowest was scored by Dosha. The best varieties namely Tumsa followed by Gebelcho were selected as top ranking in all groups as final selections or adapted varieties at Geta Wereda. The evaluations overall score value for each variety ranged from 8 to 28. Moti scored the highest value followed by Gebelcho variety and the lowest was scored by Dosha.

The best varieties namely Moti followed by Gebelcho were selected as top ranking in all groups as final selections or adapted varieties at Alichowuriro district (Table 3) [13].

Table 3: Farmer's preference criteria on faba bean varieties selection at three locations district.

Gumer								Geta								Alichu							
Variety	PP	SPP	Yld	SS	DO	Overall sum	Overall rank	PP	SP	Yld	SS	DO	Overall sum	Overall rank	PP	SP	Yld	SS	DO	Overall sum	Overall rank		
Dosha	6	5	6	5	5	27	5	6	5	6	6	5	28	6	6	6	6	5	5	28	6		
Hachalu	5	3	4	5	5	22	4	4	5	3	2	3	17	4	3	4	3	4	4	18	4		
Moti	5	6	6	5	5	27	5	3	3	4	4	2	16	3	1	1	1	1	2	8	1		
Gebelcho	3	2	3	3	2	14	3	3	2	2	2	2	11	2	2	2	2	3	2	11	2		
Tumsa	1	2	1	1	2	7	1	2	2	1	1	2	8	1	5	6	5	5	4	25	5		
Local	2	2	2	3	3	12	2	6	5	5	6	5	27	5	4	3	4	3	3	17	3		
Note: PP=Pod per Plant, SP=Seed per Pod, Yld=Yield, SS=Seed Size and DO=Disease Occurrence																							

Conclusion

Participatory variety selection is an important tool to evaluate the adaptability of varieties and to upgrade the skill and knowledge of farmers. According to the preference of farmers at Gumer district, variety Tumsa and local were preferred by farmers and were relatively have good yield so, whereas, at Geta district Tumsa and Gebelcho varieties were preferred by farmers and higher yielded so, it should be expanded for the study area. Moti and Gebelcho were preferred by farmers, even if Gebelcho variety not higher yielder so, it should be expanded for the study area. According to the combined analysis of variance result variety Tumsa had shown highest yield per hectare followed by local and moti varieties across location and year. Therefore, based on farmers preference and combined analysis of variance result Tumsa, local and Moti varieties must be recommended for these location to increase their faba bean production as well as income.

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