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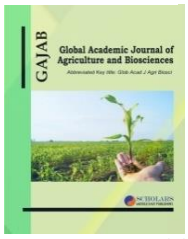

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Original Research Article

Participatory Fababean (*Vicia faba* L.) Variety Selection in East Gojam Zone, Amhara Region, Ethiopia

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Abstract: Faba bean (*Viciafaba* L.) is also referred to as broad bean, horse bean and sometimes field bean. Ethiopia is the world's second largest producer of faba bean next to China, And its share is only 6.96% of world production and 40.5% within Africa**.** Participatory variety selection has been very successful both in facilitating adoption by poor farmers in marginal environments and their selection criteria.This study was conducted with the objectives of evaluating and recommending high yielding varieties thus enabling farmers to assess the performance of improved varieties of their choice through participatory variety selection approach. The study contained six improved fababean varieties and a local check. The agronomic data were collected from mother trials and subjected to Statistical Analysis Software. The mother trial was laid out in a Randomized Complete Block Design with three replications. The mean separation analysis for seed yield showed that Tumsa produced more yield (2093.9kgha^{-1}), followed by Dosha (1978 kgha^{-1}) and Ashebeka (1977.3kgha^{-1}). The combined mean of the varieties showed discrepancy across locations (mother and baby trials).Varieties performed well at Giraram kebele followed by Enchifo and Yekegat on-station testing sites. The varieties were selected and evaluated against the set criteria's by employing pairwise ranking methods. Preferred selection criteria's' were disease resistance, number of seeds/pod, number of seeds/plant, fertile tiller capacity, earliness and stem thickness. When three locations scores summed up Dosha scored 90 and (ranked,1st) followed by Ashebeka scored 87 and Tumsa scored 85 ranked 2nd and 3rd, respectively. In conclusion, the present study has highlighted the existence of superior varieties for the yield under the study. Both varieties selected by the farmers and the mean separation analysis showed similar trend. In both cases Dosha and Ashebeka were superior to other genotypes. The information obtained about these genotypes can be exploited boosting the production and productivity of faba bean.Even though further study is important over locations and across years, Dosha and Ashebeka could be potential varieties for current use. This study has suggested that introduction, collection, and extensive hybridization of fababean in Ethiopia is a crucial task to enhance genetic variability and thereby to increase the chance for selecting and developing high yielding genotypes and hybrids through participatory approach.

Keywords: Faba bean, participatory, mother and baby trials, selection criteria's.

INTRODUCTION

Ethiopia is the world's second largest producer of faba bean next to China, its share is only 6.96% of world production and 40.5% within Africa and it is also the fourth largest faba began exporting country next to France, Australia, and the United Kingdom (FAO, 2016). Faba bean takes the largest share of area (443,966 ha) and production (848655 tones) of the pulses grown in Ethiopia (CSA, 2015).

The crop has a great economic merit in Ethiopia, providing a cheap source of protein in

human diet and animal feed, source of alternative cash income to the farmers and foreign currency to the country (Ayele and Alemu, 2006). Faba bean is also one of the most efficient fixers of atmospheric nitrogen and used as a suitable rotation crop with cereals (Gorfu and Feyisa, 2006).

The favorability of soil and climate conditions of Ethiopia for grain legume crops cultivation makes the country to be a huge producer and supplier of grain legumes in the international arena (Getachew, 2019).

The average national yield of faba bean is about 2.1 t ha^{-1} (CSA, 2018) which is very low compared to the average yield of 3.7 t ha^{-1} in major producing countries. The lower productivity of the crop in Ethiopia is attributed to yield limiting factors such as low yielding of local faba-bean cultivars which are inherently low yielding, susceptibility to biotic and abiotic stresses such as diseases, insects, weeds, moisture deficit, high soil acidity, water logging and frost (Bekele *et al*., 2006) land fragmentation and low soil fertility in the high potential areas is another problem, while fertilizer use on legume crops is usually low (Asfaw and Shiferaw, 2009).

Even though the Amhara region alone accounts for more than 34% of the area coverage and about 31% of the total volume of production of the country (CSA, 2018). The reduction in production and productivity of fababean is due to various biotic and abiotic factors.

In East Gojam Zone, most of farmers don't have any exposure and know-how about the presence of the improved varieties and have only use their own varieties, which contribute to the low production and productivity of faba bean in this zone.

To alleviate this problem Participatory Varietal Selections (PVS) has been used as an approach to provide an opportunity to the farmers a large number of varietal choices and enhances farmer's access to crop varieties and increase variety diversity. Besides, it allows varietal selection in targeted areas with less time, and this helps for easily adopt and disseminate released varieties in many areas (Mulatu and Belete, 2001; Mulatu and Zelleke, 2002). It is worth mentioning that although farmer participation is often advocated on the basis of equity, there are sound scientific and practical reasons for farmer involvement to increase the efficiency and the effectiveness of a breeding program (Ceccarelli and Grando, 2002). The present study was conducted with the objectives of evaluating and recommending high yielding varieties and enabling the farmers to assess the performance of improved varieties of their choice, through participatory variety selection approach.

MATERIALS AND METHODS

Site Description

The experiment was conducted in East Gojam Zone during the main cropping season of 2020. The mother trial was carried out at DebremarkosAgricultural Research Station, while the baby trials were also evaluated at three different locations; one on-farmers site and two on Farmers' Training Center (FTC) -site. These testing sites were Yobienechifo, Giraram and Yekegatkebeles of Aneded, Gozamen and DebreEliyas Districts, respectively. Seeds were planted during the main cropping season which is locally known as Mehir that extends from half of June to September. In all locations the dominant soil type is brown soils,Nitisol and Alisol with slightly acidic. The elevation ranges 2000-2460m.a.s.l. The annual temperature varies between 11-27°C and the growing period between 120–180 days.

Experimental Material

Six improved fababean varieties viz., Dosha, Numan, Tumsa, Ashebeka, Gora, Hachalu and a local variety; were used as experimental materials.

The treatments were laid out in Randomized Complete Block Design (RCBD) in three replications for the mother trial. The baby trials were arranged in a single plot, set side by side. Each variety, both at the mother and baby trials, was planted in 4m x 4m plot size with an intra and inter spacing of 0.1m and 0.4m, respectively. The distances between plot to plot and block to block were 1m and 1.5m, respectively. The gross plot area was 16 m^2. The net harvestable area was 12.8 m^2.

Crop Management

The experimental land was ploughed twice by tractor. Since the soil has been affected by acidity (PH=4.8), 2.3 ton ha^{-1} lime was applied a month before sowing. The experiment was planted in June 16/2020. 121 kg ha^{-1} NPS (19N:38P:7S) fertilizer was applied at planting. Hand weeding was done four times.

Data Collection

Agronomic Traits Taken On the Mother Trial

Data was collected on plot and plant basis from the mother trial. Plant height (cm), number of pods per plant, and number of seeds per plant were collected on five randomly taken plants from the middle eight rows in each plot. Seed yield (g) of the middle eight rows in each plot was harvested, measured and converted to kilogram per hectare for analysis. Disease data was scored on chocolate spot;

Aschokyta blight, Root rots and Rust during mid flowering time with 1-9 scale.

Farmers' Selection Criteria

First men and women farmers were grouped separately to avoid dominance and assimilation of attitudes.Focus group discussions held with 10 men and 10 women randomly selected farmers from each *kebele*. Each group was encouraged to add any criteria it believed to be important. Then the number of criteria was decided through the focus group discussions, and a pair-wise and direct matrix ranking used to rank the criteria. Pair-wise ranking, one kind of Participatory Rural Appraisal technique, is a structured method for ranking the selection criteria in a consensus-oriented manner to priortize.

All the selection criteria were tabulated in a matrix scoring table, and each selection criterion had been compared with each of the others in a pair-wise fashion. Then the farmers evaluated each variety against the selected criteria's set using pair wise ranking method again. The selection criteria from 1 to 5 (5 = very good, 4 = good, 3 = average, 2 = poor and 1 = very poor) for each variety.

Generally, Farmers' evaluation and preference data was collected on plot basis from the three baby trials of each site and it was carried out at physiological maturing stage. Six Agricultural development agents were also participated in the selection processes. A total of 60 farmers participated in variety selection across locations, of which 30 were men farmers and the remaining 30 were women farmers.

Data Analysis

The recorded agronomic data was subjected to the analysis of variance (ANOVA) using Statistical Analysis System (SAS, 9.4) and mean separation was carried out using Least Significant Difference (LSD) test at 5% probability level. Farmers' selection data were analyzed using the pair wise ranking method.

RESULT AND DISCUSSION

Agronomic traits of the mother trials

As indicated below in table 1, the analysis of variance (ANOVA) showed that there is a significant difference ($p<5\%$) among the genotypes. The genotypes did not show any significance difference for Chocolate spot, root rot, rust, Aschochyta blight, plant height, pods/plant and seeds/plant.

The yield performance of the varieties ranged 1215.1 (local check)-2093.9 (Tumsa) kg/ha. The highest yield was registered from Tumsa (2093.9 kg/ha) followed by Dosha (1978 kg/ha) and Ashebeka (1977.3 kg/ha), but the local check yielded the lowest (1215.1kg/ha). The yield of Tumsa, Dosha, Ashebeka, and Numan were superior to the mean yield (1762.3 kg/ha). Except the rank of the varieties this result agreed with the authors (Mastewal and Melkamu, 2018). These authors have found that Dosha was the first followed by Tumsa, and Hachalu, respectively. These varieties performed well at Gozamin, Senan and DebayTelatgen stably. Thus, Tumsa and Dosha were the best varieties in the two separate studies.

The yields of Hachalu (1651.4 kg/ha), Gora (1473.4 kg/ha) and the local check (1215.1kg/ha) were below the mean yield (1762.26kg/ha). The yield advantage of the highest yielder (Tumsa) was 72.3% over local check.

Table 1: Mean and ANOVA values agronomic traits for mother trial at Debremarkos Agricultural Research Station

Genotype	DF	DM	CS	RR	Rust	AB	Ph(cm)	Pop	Spp	Yld(kg/ha)
Ashebeka	65.33a	148.33ba	1.67b	0.33b	0.33a	0b	124.87a	14.53ba	33.07a	1977.3a
Dosha	65.00a	147ba	3a	0.67ba	1a	0.33ba	111.67ba	12.8ba	25.88a	1978a
Gora	67.00a	147.33ba	3.67a	0.67ba	0a	1.67a	108.27ba	9.73b	24.33a	1473.4ba
Hachalu	65.33a	145ba	3.67a	0.33b	0.67a	0.67ba	107.27ba	12.73ba	27.87a	1651.4ba
Local	65.33a	143.33b	3.67a	1.67a	0a	0.33ba	102.93b	15a	35.87a	1215.1b
Numan	65.00a	150.33a	3a	0.67a	0.33a	0.67ba	112.27ba	12.53ba	27.2a	1946.6ba
Tumsa	65.33a	149.33a	1b	1a	0.33a	1.67a	116.68ba	12.13ba	23.27a	2093.9a
Mean	65.48	147.24	2.8	0.76	0.38	0.76	111.99	12.78	28.21	1762.26
CV(%)	1.8	2.12	11	76.70	164.57	81.2	10.11	22.7	27.46	24
LSD(0.05)	2.05	5.54	1.1	1.19	1.29	1.44	20.15	5.14	13.78	753.81
R-square	0.63	0.54	0.88	0.39	0.43	0.55	0.41	0.48	0.48	0.52

DF= days to flowering, DM= days to maturity, RR=Root Rot, AB= Aschocayta blight, Ph=plant height (cm), Pop=pod per plant, Spp=seed per plant, yld=yield (kg/ha), CV=Coefficient of Variation, LSD=Least Significant Difference, ns= non-significant,*=Significant at 0.05 probability level

Average yield performance of the genotypes across the experimental sites

As depicted in table below, there was discrepancy among genotypes performance across the testing sites. This indicated that the genotypes responded differently to varied environments. Although, there was yield variation at on-station and Giraram kebeles, the genotypes performed stably. This might indicate the two testing sites have similar agro ecology. In the meantime the genotypes had showed stable performance at Yobienechifo and Yekegat experimental sites. There was no any crossing over effect at the two locations.

The genotypes had nearly expressed their potential at Giraram than any other testing sites. It ranged 3359.77 (Gora) -4365.63kgha^{-1} (Ashebeka). The genotypes were not good at Yekegat testing site compared to other testing sites. The mean yield varied between 649.61 (Hachalu) to 1369.53 kgha^{-1} (local check). Since the overall performance of the genotypes at this location was not good as a result no field day was organized.

Table 2: Average yield performance of genotypes across the testing locations

Genotypes	Yield kg/ha					
	On-station	YobiEnechifo	Giraram	Yekegat	Combined mean	
Ashebeka	1977.3	1927.34	4365.63	1036.72	2326.75	
Dosha	1978	2069.92	4141.02	1163.28	2338.06	
Gora	1473.4	1077.73	3359.77	742.66	1663.39	
Hachalu	1651.4	1677.34	3522.66	649.61	1875.25	
Local	1215.1	1912.50	3888.67	1369.53	2096.45	
Numan	1946.6	1596.88	3932.81	1141.80	2154.52	
Tumsa	2093.9	1405.08	4345.70	395.70	2060.10	

Farmers' variety selection and Evaluation

Table 3: Farmer selection criteria and mean of the given value at all locations (30 men+ 30 female farmers participated)

Genotypes	Farmers' selection criteria								
	Disease resistance	Number of seeds /Pod	Number of Pods /Plant	Fertile Tiller capacity	Earliness	Stem thickness	Total score	Mean	Rank
Ashebeka	24	8	18	16	6	15	87	14.5	2
Dosha	23	9	26	6	16	10	90	15.0	1
Gora	15	2	2	6	9	10	44	7.3	6
Hachalu	12	6	12	4	20	4	58	9.7	5
Local Check	1	3	10	6	20	1	41	6.8	7
Numan	27	7	15	11	5	11	76	12.7	4
Tumsa	24	6	22	14	7	12	85	14.2	3

Note: The varieties score was summed up from the three locations

A field day was organized to select varieties through Participatory Variety Selection based on criteria set. Disease resistance was one of the selection criteria and the highest score was given for the variety Numan (27). The lowest score was given for local check (1). The three varieties that had obtained the highest score for that section criterion were Numan, Ashebeka and Tumsa. In case of the number of seeds per pod, Dosha had super scored. The lowest score was recorded for Gora. Dosha had many seeds/pod while Gora had few. The number of pods /plant was the highest for Dosha while the lowest was for Gora. Ashebeka had the highest fertile tillering capacity, but Hachalu had lowest. Hachalu and the local check were the first two varieties having similarity in maturing earlier than others. Ashebekawere late maturing (Table 3). Ashebeka was superior in stem thickness score while the local check was the inferior. The mean score for varieties against the selection criteria's at three locations combined together ranged from 6.8(local check)-15.0(Dosha). Dosha, Ashebeka and Tumsa had the highest mean score and ranked 1st, 2nd and 3rd.Generally, these varieties were evaluated and selected by 30 men farmers, 30 women farmers and 6 Development Agents (DA) wisely. Farmers demanded seeds of these varieties to grow.

Table 4: Mean of farmers' preference criteria on faba bean variety selection at Debremarkos research station

Genotypes	Farmers' selection criteria							
	Disease resistant	Number of seeds/pod	Number of pods/plant	Fertile tiller capacity	Earliness	Total score	Mean	Rank
Ashebeka	7	6	7	12	3	35	7	2
Dosha	8	3	10	6	4	31	6.2	3
Gora	3	2	1	2	2	10	2	6
Hachalu	3	1	4	3	5	16	3.2	5
Localcheck	0	0	1	1	6	8	1.6	7
Numan	10	3	7	8	0	28	5.6	4
Tumsa	11	5	12	10	1	39	7.8	1

Table 5: Mean of farmers' preference criteria on faba bean variety selection at Yobienechifokebele

Genotypes	Farmers' section criteria								
	Disease resistant	Overall performance	Number of seeds /pod	Number of pods /plant	Earliness	Stem thickness	Total score	Mean	Rank
Ashebeka	7	3	2	6	2	4	24	4	4
Dosha	11	5	6	12	2	6	42	7	1
Gora	6	0	0	0	1	5	12	2	6
Hachalu	5	5	5	8	4	2	29	4.8	2
Local heck	1	2	3	7	6	0	19	3.2	5
Numan	11	4	4	5	1	3	28	4.7	3
Tumsa	1	1	1	4	5	1	13	2.2	6

Table 6: Mean of farmers' preference criteria on faba bean variety selection at Giraramkebele

Genotypes	Farmers' selection criteria								
	Overall performance	Number pods/plant	Disease resistant	Stem thickness	Earliness	Fertile tiller capacity	Total score	Mean	Rank
Ashebeka	9	5	10	11	1	4	40	6.67	2
Dosha	3	4	4	4	10	0	25	4.17	5
Gora	6	1	6	5	6	4	28	4.67	4
Hachalu	5	0	4	2	11	1	23	3.83	6
Local check	5	2	0	1	8	5	21	3.5	7
Numan	4	3	6	8	4	3	28	4.67	3
Tumsa	10	6	12	11	1	4	44	7.33	1

CONCLUSION AND RECOMMENDATION

In conclusion, the present study has highlighted the existence of superior genotypes for the yield under the study. Both genotypes selected by the farmers and the genotypes mean separation analysis showed similar trend. In both cases Dosha and Ashebeka genotypes were superior to other genotypes. .The information obtained about these genotypes can be exploited to boost the production and productivity of faba bean.

Even though further study is important over locations and across years, Dosha and Ashebeka varieties could be potential genotypes for current use. This study has suggested that introduction, collection, and extensive hybridization of fababean in Ethiopia is a crucial task to enhance genetic variability. This will help to increase genetic variability and to increase the chance for selecting and developing high yielding genotypes, and hybrids. Acid tolerant and disease resistant genotypes should be developed since acidity and disease pressure are the main prevailed factors of faba bean growing areas of East Gojam Zone. Extensive screening of genotypes for acidity and disease should be worked out in this study area. The national fababean breeding program should use marker assisted selection to quickly and effectively address the above mentioned constraints.

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