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RESEARCH ARTICLE

Participatory variety selection of faba bean varieties based on farmers preferences for producing areas of South Wollo Ethiopia

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Abstract

Major production constraints of faba bean are the lack of improved high-yielding, abiotic and disease stress-tolerant varieties. Due to this most farmers are using their local variety which is very susceptible to diseases and abiotic stress. Therefore; the objective of this experiment was to evaluate and recommend the best faba bean variety in terms of high yielder and farmers' preference. The study was conducted in the south Wollo zone at Jamma, Woreilu and Legehida on the research station and farmers' site in 2020-21. The design was RCBD with three replications by using seven released varieties and local ones. The trial was executed as Mother (three replications) and Baby (a single replication) trial form. Farmers evaluated and selected the varieties depending on their criteria from the baby trial. The criteria were seed size, pod number, tillers and disease free. The result of variance showed a significant difference for the number of pods per plant, hundred seed weight, grain yield and biomass in kg per hectare. But others all traits were not statistically significant differences among the varieties. Grain yield means performance ranged between 1606kg/ha-3409.2kg/ha for Hashengie and Ashebeka varieties, respectively. Ashebeka variety scored the maximum grain yield, 3409.2kg/ha followed by Walki, 3241kg/ha and Hachalu, 3150.4kg/ha. Based on the farmers' selection process Ashebeka, Hachalu, Gora and Walki are highly preferred by farmers. Therefore, in the coming season, these demand-lead technologies should be multiplied by their seed and popularized at the tested and similar agro-ecology of faba bean-producing areas in the region.

Key words: Faba bean, selection traits, participatory variety selection, released verities, yield

Introduction

Faba bean (*Vicia faba* L.) is one of the cool-season food legume crops playing key roles in human food, incomes, animal feed and sustainable cereal production in Ethiopia. Ethiopia considers the secondary center of diversity and also one of the nine major agro-geographical production regions of faba bean (Telaye *et al.,* 1994). According to CSA (2019), it is grown on an estimated 492, 271.6ha and its production reaches 1,041, 953.5 tons with an average of productivity 2.1 tons per hectare. In Ethiopia, faba bean is a major protein source for subsistence farmers and is used to make various traditional dishes (Senayit and Asrat, 1994). It is a valuable protein supplement to cereals and other starchy food in the human diet, because of their high lysine and tryptophan contents, amino acids in which cereals are deficient. Faba bean, like other pulse crops, contributes to soil fertility improvement and source of income for producers.

Despite its many uses, the production and productivity of faba bean is declining over time due to different biotic and abiotic production factors. Of the major production constraints, which contribute to the low production and productivity of faba bean, especially in high-producing areas of the south Wollo zone, is the lack of improved high-yielding and diseases tolerant varieties. These farmers, in this zone, are still using their local variety which is very susceptible to diseases and abiotic stress. Consequently, farmers usually get very low yields with a backward production management system. To maximize production and productivity of faba bean in this area there is a need to recommend improved varieties which can withstand the prevailing biotic and abiotic stresses. Variety selection with participating farmers is one of the options to solve the problem of increasing production and productivity in terms of both target environments and users' preferences (Awol et al., 2017). Therefore, this research was conducted to select adaptable high-yielding improved faba bean varieties through farmers' participation based on their preferences criteria to major producing areas of south Wollo high producing areas.

Materials and methods

Description of experimental sites and materials

The experiment was conducted in the eastern part of Amhara National Regional State; south Wollo zone namely; Jamma, Woreilu, and Legehida district which can represent the major faba bean-producing areas of the zone. In addition to this, all of them are food-insecure districts. Seven improved faba bean varieties and one local variety, as checked, were evaluated for their adaptation and yield potential based on farmers' selection criteria during the 2020/21 main cropping season at Jamma, Woreilu, and Legehida districts. These varieties were improved and released by Holetta, Kulumsa, Alamata and Debrebrehan Agricultural Research Centers.

Table 1: Geographical description of study areas

Locations	Altitude	Longitude	Latitude
Jamma	2630	39^0 16' E	10^0 27ˆN
Woreilu	2662	39^0 26' 19'E	10^0 40 60ˆN
Legehida	2796	51^0 06 56'E	11^0 64 50ˆN

Experimental design, data collection and analysis

The activity was done based on the mother and baby trial form. The mother trial is a researcher-managed trial that is executed at research stations or farmers' training centers. The baby trial is farmers managed and done on their farm (unpublished ARARI PVS Protocol 2018). Randomized Complete Block Design (RCBD) with three replications was the design to execute the experiment. The area of each plot was 4m x 2.4m with spacing of 40 cm and 10 cm between rows and plants respectively. For each baby trial plot used 30m2. 121 kg of NPS fertilizer was added for each variety. Agronomic data were collected on a plant and plot basis from the mother trial. All data like, the number of pods per plant and seeds per pod, seed weight and plant height were taken from randomly selected five plants. And others data like, biomass and seed yield were collected from the harvestable plot area of the plot. In addition to these disease data and days to maturity are also taken and analyzed.

Farmers evaluated and selected the varieties depending on their criteria from the baby trial. The selection criteria were seed size, pod number, tiller and diseases tolerant/resistant. Farmers were given the accidental to rank each variety based on the attributes listed by them. During the selection process, both female and male farmers participated to avoid gender bias. A total of 76 (19 females) farmers, 3 development agents and 3 researchers were participating in faba bean variety selection process (Table 2).

The agronomic data were subjected to the analysis of variance by using SAS software version 9.0 from the mother trial. Farmers' selection data, seed size, pod number, tiller and diseases tolerant/resistant, were analyzed using the simple ranking method by the given value (Awol *et al.,* 2017). Simple ranking is a tool often used to identify the best varieties based on farmers' preferences.

Result and discussions

According to the analysis of variance (ANOVA) and farmers selection criteria the best variety was identified at the Jamma location. There were significant differences between the varieties for grain yield, hundred seed weight and number of pods per plant but the other analyzed traits were not significant. The analysis showed Walki variety was a high yielder with a grain yield of 3302kg/ha followed by Ashebeka (3278.7kg/ha) and Hachalu (3264.3kg/ha) at Jamma.. The same result was recorded by Awol et al., 2017 and (Wondimu, 2016). Seed size trait was one of the farmers' criteria to select the best variety. For this trait, Ashebeka was the boldest seeded variety with 106gm of hundred seed weight, more than two times that of the local variety (42.7gm). The faba bean gal disease and chocolate spot were not seen at Jamma.

At the Woreilu location, except for days to maturity, all other traits were significant differences between the varieties. Analysis showed the Ashebeka variety was a high yielder with a grain yield of 2174.4kg/ha followed by Dosha (1718kg/ha) and Hachalu (1486kg/ha). Ashebeka was the boldest seeded variety also on this location with 99gm of hundred seed weight. The diseases, faba bean gal and chocolate spot, and frost were the major problems at Woreilu. The Ashebeka variety was free from chocolate spots and also it scored the least for faba bean gal compared to other evaluated varieties. The local variety was the most At the Woreilu location, except for days to maturity, all other traits were significant differences between the varieties. Analysis showed the Ashebeka variety was a high yielder with a grain yield of 2174.4kg/ha followed by Dosha (1718kg/ha) and Hachalu (1486kg/ha). Ashebeka was the boldest seeded variety also on this location with 99gm of hundred seed weight. The diseases, faba bean gal and chocolate spot, and frost were the major problems at Woreilu. The Ashebeka variety was free from chocolate spots and also it scored the least for faba bean gal compared to other evaluated varieties. The local variety was the most susceptible to all biotic and abiotic factors. Due to biotic and abiotic factors overall performance of the varieties at this location was so poor compared to other locations, Jamma and Legehida.

At the Legehida location also, there was a significant difference between the varieties for all traits except plant height and number of seeds. At this location the variety's performance highly expressed themselves compare to the other two locations. The analysis of results showed Walki variety was a high yielder with a grain yield of 3941.2kg/ha followed by Ashebeka (3775.3kg/ha) and Hachalu (3700kg/ha) (Table 5). The range of seed size, mentioned by hundred seed weight, was 112.2 – 46.9gm. Ashebeka scored the maximum seed size with 112.2gm of hundred seed weight whereas the Dagim variety scored 46.9gm next to the local variety which scored 49.7gm. The faba bean gal disease and chocolate spot were not seen at Legehida.

The combined analysis results showed significant differences for pods per plant, grain yield, biomass and harvest index. This indicates the environmental contribution to the variability between the varieties was highly significant. Overall location grain yield means performance ranged between 1606kg/ha – 2960kg/ha for Hashengie and Ashebeka varieties, respectively. Ashebeka variety scored the maximum grain yield (2960kg/ha) followed by Walki (2907kg/ha) and Hachalu (2842.2kg/ha). Seed size was the key trait for farmers to select the varieties. The variability for seed size between the varieties was shown by the range between 105.3 – 45gm hundred seed weight. According to the results, the Ashebeka variety scored the maximum hundred seed size (105.3gm) followed by Gora (99.1gm) and Hashengie (86.5gm). The local variety scored the least seed hundred seed weight, 45gm the same result reported by Awol et al., (2017) (Table 2). The number of tillers was one of the grain yield related and farmers' preference traits to evaluate the varieties. Based on this, the Hachalu variety scored the maximum number of tilers (4) followed by Ashebeka (3.1) and Dagim (3.1) (Table 2).

Table 2: Combined means of yield and yield characters of faba bean varieties at 3 locations

Varieties	Days to maturity	Plant height	Number of tillers	Numbeer of pods per plant	Number of seeds per pod	100 seed weight	Grain yield (kg/ha)	Biomass	Harvest index
Ashebeka	138	87	3.2	24.1c	3	105.3a	2960.9a	6433.8a	47.2ab
Dosha	135	83	2.6	23.3c	3.1	82.6cd	2456.8bc	5931.6bc	42cd
Hashengie	138	81	2.7	16.5d	3	86.5c	1606d	4780.3f	39.6d
Hachalu	135	88	3.1	28.7a	2.9	79.4d	2842.2a	6201.5ab	44.6bc
Gora	136	92	2.5	17.9d	2.8	99.1b	2352.2c	5347.4de	42.7cd
Dagim	134	77	3.3	28.4a	2.9	46.8e	2341.7c	5030.2ef	44.2bc
Walki	136	86	2.9	27.6ab	3	81.2d	2907.6a	5672.6cd	50.2a
Local	133	75	2.8	31.1a	2.9	45e	2587.8b	5524.4d	43.9bc
Treat	*	**	NS	**	NS	**	**	**	**
Location	**	**	**	**	**	**	**	**	**
Treat*Loc	NS	NS	NS	*	NS	NS	**	**	**
GM	135	83.4	2.9	24.7	2.9	78.2	2544	5615.2	44.3
CV	4.5	8.4	16.4	18.1	8	6.4	6.7	7	8.4

Based on farmers' preferences, four traits were identified for faba bean to select the best variety. The traits were seed size, pod number, tiller and disease resistance. According to the pair-wise ranking of the criteria, the traits ordered as disease resistance, seed size, pod number and tiller . The result of the farmers' preference analysis showed that only one variety selected the first level at all locations, Ashebeka. At Jamma and Legehida locations, farmers selected the top three varieties based on their preference criteria, Ashebeka, Hachalu and Wolki ranks 1st, 2nd and 3rd, respectively the same result was reported by Yasin and Israel (2018) especially the Walki variety selected while at Woreilu location, the results of farmers' preference analysis showed that the top three varieties that were preferred by farmers are Ashebeka, Gora and Hachalu ranks 1st, 2nd and 3rd. In general, biological and farmers' selection results showed the same varieties identified, Ashebeka, Hachalu and Walki. These varieties have 14.4%, 12.4% and 10% grain yield advantages over local, farmers' varieties (Table 2).

Hence, in conclusion farmers' participation to evaluate in selecting new varieties is an advantage to exploit their potential knowledge of identifying adapted varieties which can support the researchers to decide and select the best one which fulfills the requirements of objectives. According to biological data and farmers' selection traits Ashebeka, Walki and Hachalu are best-performed varieties. In general, farmers' selection process Ashebeka, Hachalu, Gora and Walki are highly preferred by farmers in the districts. Therefore in the coming season, these demand-lead technologies should be multiplied their seed and popularized at the tested and similar agro-ecology of faba bean producing areas.

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