

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 lack of improved high yielding, abiotic and diseases stress tolerant varieties. Due to these most of farmers are using their local variety which is very susceptible for 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 south Wollo zone at Jamma, Woreilu and Legehida on research station and farmers' site 2020/21. The design was RCBD with three replications by using seven released varieties and local. The trial 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 significant difference ($P < 0.05$) for number of pods per plant, hundred seed weight in gm., grain yield and biomass in kg per hectare. But others all traits were not statistically significant difference among the varieties. Grain yield mean performance ranged between 1606kg/ha – 3409.2kg/ha for Hashengie and Ashebeka variety, respectively. Ashebeka variety scored the maximum grain yield, 3409.2kg/ha followed by Walki, 3241kg/ha and Hachalu, 3150.4kg/ha. Based on 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 their seed and popularized at the tested and similar agro-ecology of faba bean producing areas in the region.

Keywords: Mother and baby trial, farmers' selection traits, participatory variety selection and released varieties.

INTRODUCTION

Faba bean (*Vicia faba* L.) is one of the cool-season food legume crops playing key roles for human food, incomes, animal feed and sustainable cereal production in the Ethiopia. Ethiopia considers as the secondary center of diversity and also one of the nine major agro-geographical production regions of faba bean (Asfaw 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 major protein source for the subsistence farmers and 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 deficit. Faba bean, like other pulse crops, contributes for soil fertility improvement and source of income for producers.

In spite of its many uses, production and productivity of faba bean is declining through time due to different biotic and abiotic production factors. Of the major production constraints, which contribute for low production and productivity of faba bean, especially high producing areas of south Wollo zone, is lack of improved high yielding and diseases tolerant varieties. Due to these farmers, at

this zone, are still using their local variety which is very susceptible for diseases and abiotic stress. Consequences this, farmers usually get very low yield with backward production management system. To maximize production and productivity of faba bean at 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 options to solve the problem for increasing production and productivity in terms of both target environments and users' preferences (Awol, *et al.*, 2017). Therefore, this activity was conducted with the objective of selecting adaptable high yielding improved faba bean varieties through farmer's participation based on their preferences criteria to major producing areas of south Wollo high producing areas.

MATERIAL AND METHODS

Description of Experimental Sites

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.

Table 1: Geographical description of study areas

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

Experimental Materials

Seven improved faba bean varieties with local variety, as check, were evaluated for their adaptation and yield potential based on farmers selection criteria during 2020/21 main cropping season at Jamma, Woreilu, and Legehida districts. These varieties were improved and released by Holetta, Kulumsa, Alamata and Debretrehan Agricultural Research Centers.

Experimental Design

The activity was done based on mother and baby trial form. The mother trial is a researcher-managed trial which is executed on research station or farmers training centers. The baby trial is farmers managed and done on their own farm (unpublished ARARI PVS Protocol 2018). Randomized Complete Block Design (RCBD) with three replications was the design to execute the experiment. Area of each plot was 4m x 2.4m with a 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.

Data Collected

Agronomic data were collected on plant and plot basis from mother trial. All data like, 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 harvestable plot area of plot. In addition to these disease data and days to maturity also taken and analyzed. Farmers evaluated and selected the varieties depending on their own criteria from 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 selection process both female and male farmers were participated to avoid gender bias. The total of 76 (19 females) farmers, 3 development agents and 3 researchers were participating during faba bean variety selection process (Table 2).

Data Analysis

The agronomic data were subjected to the analysis of variance by using SAS software version 9.0

from mother trial. Farmers' selection data, seed size, pod number, tiller and diseases tolerant/resistant, were analyzed using simple ranking method in accordance with the given value (Awol, *et al.*, 2017). Simple ranking is a tool often used to identify best varieties based on farmers' preferences.

RESULT AND DISCUSSIONS

Biological Data Analysis Results

According to the analysis of variance (ANOVA) and farmers selection criteria the best variety identified at Jamma location. There were significant differences between the varieties for grain yield, hundred seed weight and number of pods per plant but the other all analyzed traits were not significant. The analysis showed Walki variety was high yielder with grain yield 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 farmers' criteria to select best variety. For this trait Ashebeka was the boldest seeded variety with 106gm of hundred seed weight, more than two times that of local variety (42.7gm). The faba bean gal disease and chocolate spot were not seen at Jamma.

At Woreilu location, except days to maturity all other traits were significant difference between the varieties. Analysis showed Ashebeka variety was high yielder with grain yield 2174.4kg/ha followed by Dosh (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 problem at Woreilu. Ashebeka variety was free from chocolate spot and also it scored the least for faba bean gal compare to other evaluated varieties. The local variety was the most susceptible for all biotic and abiotic factors. Due to biotic and abiotic factors overall performance of the varieties at this location was so poor compare to other locations, Jamma and Legehida.

At Legehida location also, there was significant difference between the varieties for all traits except plant height and number of seeds. At this location

the varieties performance highly expressed themselves compare to other two locations. The analysis of results showed Walki variety was high yielder with grain yield 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 environmental contribution for the variability between the varieties was highly significant. Over all location grain yield mean performance ranged between

1606kg/ha – 2960kg/ha for Hashengie and Ashebeka variety, respectively (Table 6). 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 showed by the range between 105.3 – 45gm hundred seed weight. According to the results 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 6). Number of tillers was one of grain yield related and farmers preference trait to evaluate the varieties. Based on this, Hachalu variety scored the maximum number of tillers (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 | DM | PH | NT | NPP | NSP | HSW | GYKH | BMKH | HI |
|-----------|-----|------|------|--------|-----|--------|----------|----------|--------|
| 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 |

Farmers' Preference Analysis

Based on farmers preferences, four traits identified for faba bean to select best variety. The traits were seed size, pod number, tiller and disease resistance. According to pair-wise ranking of the criteria, the traits ordered as disease resistance, seed size, pod number and tiller (Table 7). The result of farmers' preference analysis showed that only one variety selected 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 Esrael (2018) especially 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 (Table 9).

Table 9: Rank of total acceptance from 15 farmers at Wereilu district (N=15)

| Variety | Criteria with their weights | | | | Total | Rank |
|-----------|-----------------------------|--------|-------|--------|-------|------|
| | Ss (2) | Pn (3) | T (4) | Dr (1) | | |
| Ashebeka | 2 | 3 | 4 | 1 | 10 | 1 |
| Dosha | 14 | 24 | 24 | 6 | 68 | 6 |
| Hashengie | 16 | 21 | 28 | 7 | 72 | 7 |
| Hachalu | 8 | 9 | 20 | 4 | 41 | 4 |
| Gora | 4 | 6 | 8 | 2 | 20 | 2 |
| Dagm | 10 | 15 | 8 | 4 | 37 | 3 |
| Wolki | 6 | 12 | 16 | 3 | 37 | 3 |
| Local | 12 | 18 | 12 | 5 | 47 | 5 |

N.B Ss=seed size, Pn=pod number, T=tiller and Dr=disease resistance

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 advantage over local, farmers variety (Tabel 6).

After selecting the variety by farmers, we tried to popularize one of the selected variety, Gora, in Woreilu and Legehida districts. Totally, eleven hectares of land covered by this variety after giving training on faba bean production package to 41 participant farmers.

CONCLUSION AND RECOMMENDATION

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 fulfill 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. Therefor 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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Data Statement Availability

Data availability in this manuscript is only the authors who are mentioned in this manuscript.

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