Participatory variety selection of Faba Bean for yield components and yield at highlands of West Hararghe, Eastern Ethiopia

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Faba bean is one of the major highland grain food legumes contributing an enormous amount of protein to the human diet in Ethiopia. Though a lot of improved varieties were released by research centers farmers depend on low yield and local varieties. Participatory variety selection is one of the methods used to evaluate varieties through involvement of users. The participatory faba bean variety selection was conducted during 2014 cropping season at Chiro and Gemachis districts on two farmers training center and three farmers field. Eight released varieties with one local check were laid out in Randomized complete block design in three replications on Farmers training center and single plot on farmer’s field. Agronomic and farmer selection data were collected and analyzed. From all the tested varieties, variety Hachalu was superior in grain yield (1437 kg ha\(^{-1}\)) and (808 kg ha\(^{-1}\)) while Wayu variety was yielded (719 kg ha\(^{-1}\)) and 796 (kg ha\(^{-1}\)) at Chiro and Gamachis respectively. The lowest grain yield was obtained from Obse (215 kg ha\(^{-1}\)) variety at Chiro and Local variety (581 kg ha\(^{-1}\)) at Gemachis respectively. In case of farmer preference Hachalu score higher mean value (3.8) followed by Tumsa (3.6) and least mean value was recorded from variety local (2.2). Therefore, the varieties selected by researcher and farmer data Hachalu, Wayu and Tumsa were recommended for further production in these areas.

Key words: Faba bean, Varieties, Farmers training center, Legumes, productivity

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 (Graham and Vance, 2003). First in terms of human nutrition, legumes supply a higher percent of protein while cereals are the primary source of calories. The amino acid profile of legume protein tends to complement that of cereals, adding lysine to the diet while cereals better source of sulfur containing amino acids. Furthermore, legumes are better source of minerals, presenting two or more times the levels found in most cereals (Wang et al., 2003).

Within the group of leguminous having edible seeds, faba bean is one of the most important. It is originated in the near East and is one of the earliest domesticated legumes after chick pea and pea. Ethiopia is considered 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). Ethiopia is one of the largest faba bean producing countries in the world only second to China (Heblethwaite et al., 1993). At present faba bean is the third most important cool-season food legume in the world (Torres et al.,2006).It is grown as field crops throughout the highlands and is most common in woina dega between the altitudes 1800 m.a.s.l and 3000m.a.s.l (Asfaw Telaye ,1985).

In Ethiopia, faba bean is the leading protein source for the rural people and used to make various traditional
dishes. Moreover, it can improve soil fertility through fixing atmospheric nitrogen and provides large cash for producers and foreign exchange for the country (Desta Beyene, 1988).

In Ethiopia, the productivity of faba bean is far below its potential due to a number of factors, the biological limitations include inherently low grain yielding potential of the indigenous cultivars and susceptibility to biotic and abiotic stresses (Mussa et al., 2008). The productivity of faba bean in Ethiopia is quite lower (19.53 qt/ha) (CSA, 2013). Local varieties are low yielding and susceptible to both biotic and abiotic factors.

Even though faba bean is important crop as national and internationally, the production and productivity of faba bean in western hararghe is low 1.59 t/ha (CSA, 2015) due to unavailability of improved varieties in the area. Tullo, Mesela, Chiro, Gemechis, Oda Bultum, and Guba Koricha are the districts where faba bean is produced and farmers in the area are highly demanding better yielding varieties in order to maximize their production and productivity (ZoA, 2013).

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, 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). Therefore, this activity was initiated to evaluate and select faba bean varieties for high yields and superior agronomic traits through farmers participation through selection.

MATERIAL AND METHODS

Site Description

The experiment was conducted at Waliargi and Arbarakate FTC in Gemechis and Chiro districts suitable for highland pulses production during 2014 cropping season. The soil structure of Arbarakate was black clay and of waliargi was loam. The area is at an altitude of 1800 m above sea level. The total annual rainfall is 900mm and erratic in distribution. The mean maximum, minimum and average air temperature is 23, 12, and 17.5°C, respectively (ZoA, 2013).

Experimental Material

Nine Faba bean varieties Tumsa, Hachalu, Dosha, Walki, Obse, Moti, Gabelcho, and Wayu released from Holetta and Kulumsa agricultural research center and local cultivar were used as experimental material. The treatments were laid out in randomized complete block design in three replications as grandmother trial. On farmers field single plot set side by side on 3 m x 3.2 m. Each varieties was planted in 6 rows with 3 m x 3.2 m row length, 0.4 m spacing between rows, 0.5 m distance between blocks and 1 m between plots. The gross plot area 9.6 m². The land was prepared and ploughed by oxen two times. DAP fertilizer was applied as rate of 100 kg ha⁻¹ during sowing.

Data collected

Agronomic data, days to flowering, days to maturity, plant height (cm) and yield and yield components were taken from grandmother trial on plot basis. Farmers evaluation and selection was collected from single plot observation on farmers field. Farmers perception on plant establishment, overall performance, stem strength, number of branches, seed size were taken as the rate of 5= very good, 4= good, 3= average, 2= poor and 1 = very poor.

Data Analysis

The collected data were analyzed using GenStat 13 statistical software (GenStat Thirteenth Edition, 2010). Mean separation was carried out using Least Significant Difference (LSD) test at 5 % probability level (Steel and Torrie, 1980). Farmer’s selection data were analyzed using simple ranking method in accordance with the given value (De Boef and Thijsen, 2007).

RESULT AND DISCUSSION

Agronomic traits of grandmother trial

The agronomic traits viz., plant height(cm) , days to flowering, days to maturity, number of pods per plant and grain yield showed significant difference (p<0.05) (Tables 1 and 2). The varieties significantly (P<0.05) varied for plant height, number of pod per plant and grain yield at Chiro district while at Gemechis the varieties were significantly difference only in days to maturity (Table 2).

A significant difference (p<0.05) was observed among faba bean varieties in days to maturity. Variety Gabalcho (118 and 117) and Wayu (118.7 and 117 days ) were took longer days to mature after planting while local variety was early mature (111 and 110 days ) than other varieties at Chiro and Gemechis districts respectively. This result indicates that varieties like Gabalcho and wayu are late maturing varieties, while local is early maturing variety at both locations (Tables 1 and 2). Tafere et al. (2012) reported that Moti is early maturing
variety while Gebelcho is late maturing. The result disagree with the finding of Ashanafi and Makuria (2015) that variety Hachalu was took longer maturity date than Gabalcho. The variation may be due to climate condition during growth period under different agro ecologies. The plant height was significantly different (p<0.05) at Chiro as variety Wayu 132.8cm and shortest variety was variety Obse 47.8 cm (Table 1). Though the plant height at gamachis was not statistically significant different tallest variety was Tumsa 89.1cm as wayu variety was recorded as shortest ( Table 2). The variation in plant height across location and genotypes may be due to the difference in soil type on which varieties we re grown. Talal and Munqez (2013) reported that plant height was significant affected by faba bean accessions. Della (1988) found that plant height of faba bean genotypes varied significantly under rain fed conditions.

Number of pod per plant were significantly affected by varieties (p<0.05) at Chiro district not significant from means at Gemachis district. Highest number of pod per plant were recorded from variety Wayu (44.8) and lowest pod per plant from variety Obse (5.1) at Chiro district. At Gemachis though the result showed not significant from means highest number of pod per plant was from local variety and lowest pod per plant from variety Gabalcho, 11.07 and 6.07 respectively (Table 1 and 2). Ashanafi and Makuria (2015) also reported the significant difference among faba bean varieties in number of pod per plants.

Analysis of variance showed that at Chiro district varieties were significantly superior in grain yield. Accordingly, higher yield recorded by Hachalu (1437 kg ha⁻¹), Walki (805kg ha⁻¹) and Wayu (719 kg ha⁻¹) while lowest grain yield was recorded from Obse 215 kg ha⁻¹. The soil condition of the area was black soil and have a water
logging problem. Similarly, at Gemachis district highest grain yield were recorded from Hachalu (808 kg ha\(^{-1}\)), Gebalcho (804 kg ha\(^{-1}\)) and Wayu 796 (kg ha\(^{-1}\)). At Gamachis the soil loamy and has lower water holding capacity. Tafere et al., (2012) reported that highest grain yield was recorded from variety Wayu and lowest yield from Moti and Gebalcho varieties. Tewodros et al., (2015) also found that Hachalu and Tumsa varieties were superior in grain yield while variety Obse and Moti was the lowest in grain yield. The variation in yield at these two locations may be due to the fact that there was difference in rain fall and soil type.

**Farmers Variety Evaluation and Selection**

A field day was organized to select varieties through participatory variety selection based on criteria set. The mean scores for five farmers’ selection criteria ranged from 2.2 (local variety) to 3.8 (variety Hachalu). The highest score (4) for plant establishment was obtained for Hachalu and Tumsa as lowest score (2) was for variety Obse. Highest score for stem strength (tolerant to lodging) were (5) for Hachalu followed by Tumsa (4) and lowest score (2) was for Dosha and Walki varieties. Highest score for number of branching (4) for variety Tumsa and Walki and least score (2) for Local. Higher tiller number is reduce the seed rate. For seed size high score (4) were for larger seed varieties Moti and Dosha as the least score was for small seeded local variety. According to farmers selection criteria Variety Hachalu score high mean value (3.8) followed by Tumsa (3.6) and least mean value was recorded from Local variety (2.2) (Table 3).

<table>
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<tr>
<th>Varieties</th>
<th>PES</th>
<th>OAP</th>
<th>STS</th>
<th>SS</th>
<th>NOB</th>
<th>Total</th>
<th>Mean</th>
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<td>2</td>
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<td>16</td>
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<td>2</td>
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<td>4</td>
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<td>3.6</td>
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</table>

PES=Plant establishment, OAP=Overall performance, STS=stem strength, NOB= number of branches, SS =seed size; rating 1= very poor, 2= poor and 3= average, 4= good, 5= very good.

CONCLUSION

From agronomic data at Chiro and Gemachis districts in participation of farmers, Hachalu, Wayu and Tumsa faba bean varieties were superior in grain yield. Though the yield obtained during this season seems low as compared to the potential of each varieties due to moisture stress during growth stage, the new varieties were superior to local check. From farmer preferences these faba bean were scored higher mean value and selected for good performance, tolerance to lodging, medium seed size. Therefore, Hachalu, Wayu and Tumsa which have good agronomic traits and selected by farmers are recommended for Chiro and Gemachis districts western Hararge and similar agroecology.

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