

*Full Length Research Paper*

# Participatory evaluations of faba bean (*Vicia faba L.*) varieties in Wollo, Ethiopia

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The study was conducted in Wollo at Geregera, Legambo and Kutaber on station and farmers site. The objective of the trial to recommend the best performing faba bean released variety in terms of high yielder and farmers' preference. The design was RCBD with three replications by using seven nationally released varieties and local. The harvestable plot size was 4m x 1.6m(6.4m<sup>2</sup>) with four rows and one meter distance was maintained between replications at all locations. The spacing between plots, rows and plant was 1m, 40cm and 10cm, respectively. The trial executed as Mother (all the three replications are on one site) and Baby (only one replication on one site) trial form. Farmers evaluated and selected the varieties depending on their criteria's from the baby trial. The criteria's were Pod setting, Earliness free from any diseases. The analysis of variance showed significant difference ( $P<0.05$ ) for number of pods per plant, hundred seed weight in gm., seed yield and biomass in kg per hectare. But number of seeds per pod has not statistically significant difference among the varieties. The result showed that variety Walki was the best yielder with seed yield 2337kg/ha, 2697kg/ha and 4430kg/ha at Geregera, Legambo and Kutaber respectively followed by Hachalu (1975kg/ha, 2984kg/ha and 3882kg/ha). Variety Dosha and Gora were not good at Geregera and legambo but at Kutaber they scored better seed yield performance with 4342kg/ha and 3391kg/ha respectively. These two varieties also were very large seeded with hundred seed weight 78.1gm and 98.3gm. The yield advantage of Walki, Hachalu, Dosha and Gora over local variety was 86%, 64%, 69%, and 32% respectively. During farmers' selection process both female and male farmers had been incorporated so as to avoid gender bias. Variety Dosha, Walki, and Gora were selected by farmers. According to the result for seed yield Walki and Hachalu were best performed at Geregera and Legambo. Variety Dosha, Gora and Walki were well performed at Kutaber and selected by farmers in all the three locations. Variety Walki and Hachalu for Geregera and Legambo but for Kutaber all the three farmers' selected varieties (very large seeded) should be done as pre scaling up activity at the tested area and similar agro ecology to popularize.

**Keywords:** Baby and mother trial, criteria, participant farmers, released varieties and yield advantage

## INTRODUCTION

Faba bean is one of the most important cool-season food legumes grown in Ethiopia. Ethiopia consider 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). It is dominant pulse crop in Ethiopia in terms of area coverage and amount of production (CSA, 2013). 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 root and tuber foods in the human diet,

because of their high lysine and tryptophan contents, amino-acids in which cereals are deficit (Giller, 2001). In addition to this, it provides large cash for producers and foreign exchange for the country (Desta Beyene, 1988). Ethiopia is one of the largest faba bean producing countries in the world only second to China (Hebblethwaite et al., 1993). The crop is grown as field crop throughout the highlands and is most common in Woyina Dega between the altitudes 1800m.a.s.l and 2400m.a.s.l (Asfaw Telaye 1985). The crop is very important but its production and productivity 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 at Wollo is lack of improved high yielder, stress and diseases tolerant varieties. Farmers at these areas are still using their local variety and backward production management system and usually get very low production, around 0.7 ton/ha. However there is a possibility to improve the situation using improved varieties, which can give a better yield and stress tolerant than the one's widely used now.

To maximize production and productivity of faba bean at these areas there is a need to recommend improved faba bean varieties which able to withstand the prevailing biotic and abiotic stresses. Participatory variety selection proposed as an option to solve the crop problem for increasing productivity and production in terms of both target environments and users' preferences (Ceccareli et al. 1996). Therefore, this proposal was initiated to evaluate and recommend best improved faba bean varieties in terms of yield performance, stress tolerant and farmers' preference criteria to major producing areas of Wollo.

## LITERATURE REVIEW

### History, Origin and Distribution of Faba bean

Faba bean (*Vicia faba*) was not among the first domesticated crops. It was probably introduced in to agriculture only in the Neolithic period (Korber – Grohne, 1987). Cubero (1974) concluded that the center of origin was in the Near East, Iraq and Iran, and secondary centers evolved latter on in Afghanistan and Ethiopia. Before 1000 BC the culture of faba beans was already very established in Europe, including Britain. Large seeded types are of recent origin and they were probably developed only 1000 - 1200 years ago in East Iraq, and from there spread to Asia, across North Africa to Europe, and eventually to America. In China, the crop seems to have arrived only after 1200 AD. The faba bean reached Mexico and South America by the Spaniards.

### Economic Importance of faba bean

World Development Report (2008), at the world wide scale, faba bean occupies about 2.6 million ha, which in 2005 represented 4% of the total area dedicated to pulses. From the world wide area occupied by faba bean, 41% was concentrated in Asia, 33% in Africa, only 12% Europe and 7% in Oceania as well as in America. China is the largest grower of faba bean in the world ide with 39% of the World wide area. In Africa, Faba bean is mostly concentrated in Ethiopia (15% of the World wide faba bean area)

### Research Output of Faba Bean Varieties

Agricultural Research centers, especially Holeta and Kulumsa, in Ethiopia are doing with their best efforts to improve faba bean breeding system and outputs due to this they released many improved varieties within 35 years. In all this time, selection of faba bean varieties by formal plant breeders in Ethiopia has been based mainly on grain yield and yield related traits. Different breeding lines have been developed and their performance evaluated at diverse research-controlled sites to identify the highest yielding varieties for final release. The evaluation and selection activity is dominated by plant breeders and takes eight to ten years from first nurseries to final release (Assefa et al. 2005, 2006). Not only is the speed of the variety development and release lengthy (Assefa et al. 2006) but farmer acceptance of the released varieties has been relatively limited. Due to this most of the released varieties were shelved without popularizing to end users (table 1).

### Participatory Varietal Evaluation

In participatory varietal evaluation farmers select among the fixed varieties or the finished products of plant breeding under their own management (Witcombe et al., 1996). The participatory varietal selection approach has provided primary information to feedback into the varietal development program. Secondly, it also provides direct information into the technology transfer process by highlighting promising varieties that address the needs of local communities. A very important advantage of participatory variety selection is that the adoption of new cultivars is much faster than under the formal system, in which farmers are confronted with only a very restricted range of new cultivars. Also the spread from farmer-to-farmer through the local seed system can be very fast, thus guaranteeing a further good adoption (Bellon and Reeves, 2002). According to Witcombe et al. (1996), it simply not re-labeling of the existing on-farm adaptive research.. There are a number of important reasons that differentiate the traditional on-farm adaptive research from the more participatory varietal selection approach. Traditional on-farm methods relied on released or recommended varieties but participatory variety selection includes varieties irrespective whether they are non-recommended or non-released varieties or are at pre released stage if they meet farmers' criteria. Results from many participatory variety selection program in many countries and crops provide overwhelming evidence that farmers identified non recommended, non-released varieties, and these varieties spread rapidly from farmer-to farmer (Fetien and Bjornstad, 2008; Monty et al., 2000). Such a result is not possible with traditional approach which misses this opportunity (Monty et al., 2000). The participatory variety

**Table 1:** Faba bean cultivars character used during adaptation trials in Holeta Research Centre.

Varieties	Year of released	Date of maturity	Production per ha	
			On research field	On farmers field
CS20DK	1977	145 – 160	20 – 40	15 - 30
Kusie 2-27-33	1978	135 - 150	20 – 35	15 - 25
NC – 58	1978	118 – 132	20 - 40	15 – 35
Kasa	1980	120 – 135	20 – 45	15 - 30
Bulga 70	1994	143 – 150	20 - 50	15 – 35
Tesfa	1995	125 – 135	20 – 40	15 - 35
Mesay	1995	120 – 135	20 - 45	15 – 30
Holeta -2	2001	140 – 150	20 – 50	15 - 35
Selalae - Kasim	2001	95 – 153	18 - 32	10 – 23
Wayu	2001	98 – 155	22 – 33	10 - 23
Degaga	2002	116 - 135	25 - 50	20 – 45
Moti	2006	108 – 165	28 – 51	23 - 35
Gebelcho	2006	103 – 167	25 - 44	21 – 36
Obse	2007	87 – 166	25 – 61	21 - 35
Walki	2008	133 – 146	24 - 52	20 – 42
Dosha	2009	120 – 130	28 - 62	23 - 39
Hachalu	2010	120 – 130	20 - 45	18 - 40
Gora	2012			

**Source:** Holeta, Kulumsa and Debrebirhan Agricultural Research Centers

selection follows a parallel model of extension than the conventional model linear model of extension.

Farmers being the end-users of agricultural technologies are the primary beneficiaries in a participatory variety selection program. Benefits to farmers include: access to seed of a range of new varieties that are pre selected to meet farmers' needs; new varieties may allow a farmer new options to make alternative and profitable cropping patterns. For instance, access to early maturing or drought resistant varieties may allow additional crops; new seeds may increase grain yield and offer a range of associated benefits such as superior cooking quality or more market price, higher fodder yield and better resistance to drought and insect-pests; farmers receive new seeds free for experimentations that they may be constrained to find themselves; and farmers get the seed of potential varieties earlier in the process of varietal development. This reduces the delivery gap between release and dissemination to farmers. The researchers benefit from the PVS process in the form of a feedback that helps them to re-orient their research program to better meet farmers' needs. In participatory variety selection, farmers conduct three types of trials. The first one is mother trials, single replicate, all varieties trials and the trials are researcher-designed but farmer managed. The second is baby trials, single variety trials where new variety and local check are grown alongside under farmer management. The third is informal research and development, farmers evaluate new varieties in comparison to their local cultivars with little intervention from scientists, the evaluation is mainly by anecdotal means and adoption trends, this is very cost effective and an efficient means of dissemination of varieties

since farmers are encouraged to keep and exchange seed of preferred varieties (Virk et al. 2003).

## MATERIAL AND METHODS

### Description of Experimental Sites

The experiment was conducted in the northeast part of Amhara National Regional State; North and South Wollo namely; Geregera, Legambo, and Kutaber district. These three locations represent various agro – ecology of the two Zones of Wollo where faba bean is widely grown and moisture deficit area. In addition to this all three areas are food insecure districts. The experiment site was located at about 220km northeast, 580km southeast and 505km southeast of Bahir Dar, the main city of the region.

### Experimental materials

Seven improved faba bean varieties (Dosha, Gora, Hachalu, Moti, Tumsa and Walki) including the local variety (check) were evaluated for their adaptation and yield during 2014 main cropping season across Geregera, Legambo, and Kutaber district. These varieties were improved and released by Holetta and Kulumsa Agricultural Research Centres.

### Experimental Design

The experiment was laid out on Randomized Complete Block Design (RCBD) with three replications.

Each experimental plot had six rows of four meter length. Each plot consisted of six rows with 40cm x 4m long. The harvestable plot size was 4m x 1.6m(6.4m<sup>2</sup>) with four rows and one meter distance was maintained between replications at all locations. The spacing between plots, rows and plant was 1m, 40cm and 10cm, respectively. The trial had executed as Mother (all the three replications are on one site) and Baby (only one replication on one site) trial form. DAP fertilizer was applied at the recommended rate of 100kg/per hectare.

### Data Collected

Agronomic data were collected on plant and plot basis from mother trial. The data of number of pods per plant, number of seeds per pod, hundred seed weight (gm) and Plant height (cm) were taken and evaluated on five plants from the middle four rows of each plot. And biological data like biomass yield (gm) and seed yield (gm) were collected from harvestable plot area of mother trial plot. In addition to these disease data also scored.

### Data Analysis

The researchers' recorded agronomic data were subjected to the analysis of variance (Gomez and Gomez, 1984) using Gen stat software from mother trial. Farmers' selection data were analyzed using simple ranking method in accordance with the given value (De Boef and Thijssen, 2007). Simple ranking is a tool often used to identify best varieties based on farmers' preference.

## RESULTS AND DISCUSSION

According to the analysis of variance (ANOVA) and farmers selection criteria the best variety identified. The analysis of variance showed significant difference ( $P < 0.05$ ) for number of pods per plant, hundred seed weight in gm., seed yield and biomass in kg per hectare. But number of seeds per pod has not statistically significant difference among the varieties. The analysis showed variety Walkiwas the best yielder with seed yield

**Table 2:** List of faba bean varieties tested

NO	VARIETIES
1	DOSHA
2	GORA
3	HACHALU
4	MOTI
5	TUMSA
6	WALKI
7	LOCAL

2337kg/ha, 2697kg/ha and 4430kg/ha at Geregera, Legambo and Kutaber respectively followed by Hachalu (1975kg/ha, 2984kg/ha and 3882kg/ha) (table 2, 3 and 4). Variety Dosh and Gora were not good at Geregera and legambo but at Kutaber they scored better seed yield performance with 4342kg/ha and 3391kg/ha respectively. These two varieties also were very large seeded with hundred seed weight 78.1gm and 98.3gm. The Local variety scored the least for hundred seed weight (37.5gm, 52.3gm and 46gm). The yield advantage of Walki, Hachalu, Dosh and Gora over local variety was 86%, 64%, 69%, and 32% respectively (table 8). Variety Dosh, Walki, and Gora were selected by farmers (table 6 and 7). Local variety is so early compare to any evaluated varieties. But it is highly attacked by chocolate spot and faba bean gal disease at Geregera (table 5). The new disease was not major problem at Legambo but chocolate spot more seen on local variety.

### Farmer's Selection

Farmers evaluated and selected the varieties depending on their criteria's from the baby trial. The criteria's were Pod setting, Earliness and free from any diseases. The ranking procedure was explained for participant farmers and each selection criterion was ranked from 1 to 5 (1= very poor, 2= poor, 3= average, 4=good and 5= very good). Then farmers were given the chance to rank each variety based on the attributes listed by them. During selection process both female and male farmers had been incorporated so as to avoid gender bias. In general 38 (5 females) farmers participate for doing activities and selection process. According to farmers' selection process variety Walki, Dasha and Gora was selected (table 7 and 8).

**Table 3:** means of yield and yield components faba bean PVS at Geregera

VARIETIES	NPP	NSP	PH	HSW(GM.)	ASY(KG/HA)	BM T/HA
DOSHA	11.9BC	2.7	90.60AB	78.60B	1838AB	3.5
GORA	8.9E	2.8	86.53BC	94.37A	1068C	2.2
HACHALU	10.7D	1.9	97.73A	73.23BC	1975A	4.6
MOTI	12.5B	2.7	97.27A	80.10B	1518BC	3.3
TUMSA	9.4E	2.5	98.30A	74.17BC	1484BC	3.2
WALKI	10.7C	2.5	91.43AB	68.63D	2237A	4.3
LOCAL	21A	2.9	81.13C	37.50C	1200C	2.7
GM	12.6	2.56	91.9	72.4	1617.2	3.4
CV	5.4	14	5.5	6.6	14.6	21
DMRT(0.05)	*	NS	*	**	**	NS

**Keywords:** NPP= Number of pods/plant; NSP= Number of seeds/pod; PH= Plant height; HSW= Hundred seed weight; ASY= Adjusted Seed yield; BM= Biomass

**Table 4:** means of yield and yield components faba bean PVS at Legambo.

VARIETIES	NPP	NSP	PH	HSW(GM.)	ASY( KG/HA)	BM T/HA
DOSHA	10.1BC	3.8	95	86.23B	1993A	5.1
GORA	8.2BC	3.3	105.7	107.10A	2191A	5.9
HACHALU	11.7AB	4.1	108.3	79.23B	2984A	6.7
MOTI	8.2BC	3.5	101.3	84.63B	2160A	4.9
TUMSA	6.7C	2.8	84.8	78.20B	1008B	3.7
WALKI	11.5AB	2.9	106.3	74.40B	2697A	6.2
LOCAL	14.5A	3.0	101.5	52.53C	2349A	5.2
GM	10.2	3.3	100.4	80.3	2197.4	5.4
CV	21.7	28.4	10	8.3	24.4	20
DMRT(0.05)	*	NS	NS	**	*	NS

**Keywords:** NPP= Number of pods/plant; NSP= Number of seeds/pod; PH= Plant height; HSW= Hundred seed weight; ASY= Adjusted Seed yield; BM= Biomass

**Table 5:** means of yield and yield components faba bean PVS at Kutaber.

VARIETIES	NPP	NSP	PH	HSW(GM.)	ASY( KG/HA)	BM T/HA
DOSHA	15.3B	2.9	76.13B	4342AB	15.3B	10.7BC
GORA	10.1C	2.9	98.33A	3391BCD	10.1C	11.3BC
HACHALU	15.1B	3.1	74.4B	3882ABC	15.1B	16.9AB
MOTI	11.3C	3.2	71.17B	3126CD	11.3C	11.9BC
TUMSA	12.4C	2.4	78.77B	1951E	12.4C	11.3BC
WALKI	16.5B	2.7	68.07B	4430A	16.5B	18.8A
LOCAL	21.2A	2.3	46.07C	2571DE	21.2A	8.1C
GM	16.5	2.93	73.3	3384.6	16.5	12.69
CV	6.3	5.3	10.7	15.3	6.3	19.4
DMRT(0.05)	**	NS	**	**	**	*

**Keywords:** NPP= Number of pods/plant; NSP= Number of seeds/pod; PH= Plant height; HSW= Hundred seed weight; ASY= Adjusted Seed yield; BM= Biomass

**Table 6:** Diseases Severity Score at Geregera

VARIETIES	FABA BEAN GALL DISEAS (0 – 5)	CHOCOLATE SPOT(0 – 5)
DOSHA	0	1
GORA	0	1
HACHALU	0	1
MOTI	1	2
TUMSA	1	2
WALKI	0	1
LOCAL	6	6

**Table 7:** farmers' selection of faba bean at Legambo and Geregera

SN	VARIETY	NPP(0.2)	ER(0.2)	DR(0.6)	TOTAL	RANK
1	DOSHA	2.6	3	12	17.6	1
2	GORA	1.8	2.4	12	16.2	3
3	HACHALU	1.8	1.6	12	15.4	5
4	MOTI	1.6	1.2	12	14.8	6
5	TUMSA	2.4	1.2	12	15.6	4
6	WALKI	4	0.8	12	16.8	2
7	LOCAL	0.8	4	2.4	7.2	7

DR= diseases resistance (0.6), ER= Earliness (0.2), NPP= Number of pods per plant (0.2).

**Table 8:** farmers' selection of faba bean at Kutaber

SN	VARIETY	NPP(0.2)	ER(0.2)	DR(0.6)	TOTAL	RANK
1	DOSHA	1.8	2.2	9	13	1
2	GORA	1.6	2	9	12.6	2
3	HACHALU	1.6	1.4	9	12	4
4	MOTI	1.2	1.4	9	11.8	5
5	TUMSA	1.8	1	9	11.8	5
6	WALKI	2.2	1	9	12.2	3
7	LOCAL	0.6	3	1.8	5.4	7

DR= diseases resistance (0.6), ER= Earliness (0.2), NPP= Number of pods per plant (0.2)

**Table 9:** Yield advantage of the varieties over Local (in %)

VARIETIES	GEREGERA	LEGAMBO	KUTABER
DOSHA	53	-15	69
GORA	-11	-7	32
HACHALU	64	27	50
MOTI	26	-8	45
TUMSA	24	-57	-24
WALKI	86	15	72

## CONCLUSION AND RECOMMENDATION

Farmers' exposure to evaluate and select new varieties is an advantage to exploit their potential knowledge of identifying adapted varieties (Mulalem et al., 2012) which can support the researchers to decide and select the best variety which can meet the objective. According to the biological data analysis Walki and

Hachalu were best performed at Geregera and Legambo. Dosh, Gora and Walki were well performed at Kutaber and also selected by farmers in all the three locations. From this result Walki and Hachalu for Geregera and Legambo but for Kutaber all the three farmers' selected varieties should be done as pre scaling up activity at the tested and similar agro ecology area.

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