



Participatory Varietal Selection and Agronomic Performance Evaluation of Common Bean (*Phaseolus vulgaris* L.) Genotypes in Metekel Zone, North Western Part of Ethiopia

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Abstract: Participatory variety selection of common bean (*Phaseolus vulgaris* L.) genotypes was conducted during 2013 main cropping season in Dibate district North western part of Ethiopia. The experiment was conducted to evaluate and recommend high yielding early maturing common bean genotypes through participatory variety selection and to assess farmers' selection criteria for improved common bean varieties for future common bean breeding program. Four common bean genotypes which were replicated over four farmers' fields were evaluated in this study. The analysis of variance revealed a highly significant difference ($p \leq 0.001$) for days to maturity and plant height, while a significant difference ($p \leq 0.01$) was observed for grain yield among the tested genotypes. Both male and female group of farmers had set almost similar selection criteria and were not directly targeting the yield only rather than selecting the yield contributing traits also. Both male and female farmers preferred the red color beans for their local dish preparation as boiled bean "Nifro" and "Shiro". Genotype SER-119 followed by SER-118 which are red in color were the leading in both female and male group selection criteria and in their agronomic performance like grain yield, number of pods per plant, number of seeds per pod and number of seeds per plant. As a result, these two genotypes are recommended for production in the tested areas and similar agro ecological Zone of Metekel and the bean breeding program should consider the farmers' criteria especially for local consumption as a target trait.

Keywords: Common bean; *Phaseolus vulgaris*; grain yield; PVS

1. Introduction

Common bean (*Phaseolus vulgaris* L.) is the most commonly consumed legume worldwide, and source of protein for small scale farmers and cash crop in many lowlands and mid-altitude areas.^[12] Common bean takes 12.73 % of the total area coverage (1,620,497.30 hectares) and 9.54% (about 30,113,480.57 quintals) of the produced grain in Ethiopia.^[4] Ethiopia had got 85% of export estimated earnings from pulses, exceeding that of other pulses such as lentils, faba bean and chickpea.^[4] Ethiopia exported 14 % (340,000 metric tons) of pulse production and generated \$ 255 million US dollars.^[5]

Common bean can grow in a wide range of agroecology of Ethiopia up to 600 meter above sea level which causes poor pod setting and a doesn't take long time to mature.^[7] Bean can be produced either as sole crop or intercrop with cereals like maize and sorghum. This helps not only securing yield but also has the advantages of restoring soil fertility. Even though, the country has huge potential and the crop has tremendous advantages, the production and productivity has been challenging by low adoption of improved technologies, drought, and lack of improved varieties, poor cultural practices, disease, and environmental degradation.^[8-10]

In addition to the above-mentioned constraints, low adoption and access to improved common bean varieties to specific growing conditions are the serious problems on the expansion of production and productivity of the crop.^[3] For this low adoption of the technologies, poor linkage of stakeholders with the breeding program take great share. Involvement of farmers before releasing a variety would facilitate the adoption and acceptance by creating awareness of the technology. This enables farmers to decide and choose which variety fits their interest.^[18]

Participatory Variety Selection (PVS) has been found very effective in addressing many of these problems mentioned above in different crops breeding program. PVS could be very useful to identify farmers-accepted varieties and thereby overcome the constraints that insist farmers to grow land races and old varieties.^[13-15] Therefore, the study was conducted with the objectives to evaluate and recommend high yielding early maturing common bean varieties through participatory variety selection and to assess farmers selection criteria for improved common bean varieties and include in the future bean breeding program.



Fig. 1. Geographical map of the study area

2. Experimental Section

A field experiment was conducted at Dibate district of Benishangul Gumuz regional state (100 39' N and 36 0 13' E) Ethiopia, at 1438 meter above sea level, during 2013 main cropping season. The location of the experimental area is located in Fig. 1 below.

Four common bean genotypes (three recently advanced and good performing genotypes for the area and one released variety) were planted in a randomized complete block design with four replications. The trial was replicated on four farmer's field. Each genotype was planted in a plot size of 10m by 10 m. A spacing of 40 cm between rows and 10 cm between plants were used. A seed rate of 100 kg/ha and fertilizer rate of 100 kg P₂O₅ and 100 kg urea fertilizers were used respectively. All other agronomic practices were done accordingly. Fig. 2 shows the materials used for evaluation (Common bean genotypes).

2.1. Data collection and analysis

Agronomic data were collected on five randomly selected plants from the middle rows for plant height, number of pods per plant, number of seeds per pod, number of seeds per plant while a plot-based data was taken for days to maturity. Hundred seed weight and grain yield were recoded after harvest from the middle rows. The visual evaluation and selection of the varieties by farmer was done when the crop reaches to physiological maturity stage by involving 10 females and 10 males common bean producing farmers. The farmers were selected in collaboration with Kebele developmental agents. A clear briefing was given for the farmers and then grouped separately (male group and female group) and discussed on the common bean variety selection criteria. After the two groups set their variety selection criteria, they gave scores for each selection criteria as (1= Very good, 2= Good, 3= Medium, 4= Poor, 5= Very Poor). Table 1. Description of experimental materials used for the

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Genotypes	Seed color	Source
SER-119	Red	MARC
SER-118	Red	MARC
Nassir	Red	MARC
ICN Bunsu x S x B 405	Red	MARC

Note: - MARC= Melkasa Agricultural Research Center

study. GenStat software (VSN International, 2012) was used to analyze the agronomic data with the following linear equation. The linear model used for the analysis was as follows:

$$y_{ij} = \mu + g_i + r_j + e_{ij}$$

Where, μ = Overall mean,

Y_{ij} = phenotypic observation in the i^{th} treatment and j^{th} replication,

g_i = effect of i^{th} treatment,

r_j = effect of j^{th} replication,

e_{ij} = Random error associated with i^{th} treatment and j^{th} replication.

3. Results and Discussions

The analysis of variance revealed a highly significant difference ($p \leq 0.001$) among genotypes for days to maturity and plant height while a significant difference ($p \leq 0.01$) was recorded for grain yield and seed per pods ($p \leq 0.05$). On the other hand, seeds per plant and hundred seed weight were non-significant for the tested genotypes as presented in Table 2. This result is in line with the findings of different scholars. Common bean genotypes exhibited a significant variation for yield and yield related traits like plant height, number of nodes, biological yield, pods per plant, harvest index and hundred seed weight.^[16,9,14,14]

The average days to maturity ranged from 75 to 94 days; the variety Nassir matured earliest than the others while ICN Bunsu x S x B 405 was matured late. Variety Nassir was the earliest genotype for days to flowering among the tested genotypes.^[14] The average plant height was ranged from 35 cm to 73.8 cm; Nassir has the shortest plant height and ICN Bunsu x S x B 405 had the longest height. High number of pods per plant was recorded on genotypes SER-119 (10.6) followed by Ser -118 (8.9) respectively. On the other hand, genotypes had responded differently for seeds per pod, seeds per plant, hundred seed weight and grain yield. As a result, among the tested genotypes, SER-119 was the best adopted genotype followed by SER-118 for number of pods per plant (10.6), number of seeds per pod (5.3), number of seeds per plant (42.7), hundred seed weight (17.5 gm) and grain yield (1794.4 kg/ha). A high genetic variability among



Fig. 2. Materials used for evaluation (Common bean genotypes).

Table 2. Mean grain yield and yield components of four common bean genotypes evaluated in 2013 cropping seasons in North part of Ethiopia

Genotypes	DM	PH	PPP	SPP	SPPt	HSW	GY
SER-119	88	35.0	10.6	5.3	42.7	17.5	1794.4
SER -118	85	36.3	8.9	4.7	31.2	16.8	1616.2
ICN Bunsu x S x B 405	94	73.8	8.8	5.1	32.8	15.5	1229.4
Nassir	75	63.7	7.8	5.3	30.4	17.3	1498.8
Mean	85	52.2	9.0	5.1	34.3	16.8	1534.7
CV	2.7	14.2	22.9	6.2	22.2	17.7	15.0
LSD	3.694	11.9	3.3	0.5	12.1	4.8	355.2
Sign (5%)	***	***	NS	*	NS	NS	**

DM= Number of days to maturity, PH= Plant height, PPP= Number of pods per plant, SPP= Number of seed per pod, SPPT= Number of seed per plant, HSW= 100 seed weight (gm), and GY=Grain yield(kg/ha)

Table 3. Female farmers' variety selection criteria, scores and ranks of four common bean genotypes in Dibate district

Genotypes	Grain yield	Seeds/pod	Pods /plant	Branching habit	Seed color	Total	Average	Rank
SER-119	1	1	3	1	1	7	1.4	1
SER -118	1	3	2	1	3	10	2	2
Nassir	2	3	3	1	2	11	2.2	3
ICN Bunsu x S x B 405	2	2	3	3	3	13	2.6	4

Table 4. Male farmers' variety selection criteria, scores and ranks of four common bean genotypes in Dibate district

Genotypes	Grain yield	Pods/ plant	Seeds/pod	Disease resistance	Total	Average	Rank
SER-119	1	1	1	1	4	0.8	1
SER -118	2	1	1	1	5	1.0	2
Nassir	2	1	3	1	7	1.4	3
ICN Bunsu x S x B 405	3	2	2	1	8	1.6	4

the tested common bean genotypes for days to flowering, days to maturity, pods per plant, seeds per pod and hundred seed weight among twenty bush type genotypes.^[2,10] A highly significant difference ($P < 0.01$) for seed per pod, 100 seed weight and grain yield among the twelve released genotypes.^[1]

The visual observation and selection of common bean genotypes were done for female and male groups independently as presented in Table 3 and Table 4. The female farmers selected grain yield, number of seeds per pod, number of pods per plant, branching habit and seed color as a criterion for common bean variety selection. Whereas the male group were used grain yield, number of pods per plant, seeds per pod, disease resistance. The above listed criteria were ranked according to their level of importance in both groups. From both groups the primary selection criteria was grain yield. The farmers' criteria were also the targets of the researcher for better variety selection. This indicates that the research targets the traits that the client needs.

Researchers and farmers have their own unique and common experience, which should be effectively exploited in the research process. This is an indication that clients and researchers should complement each other on variety development and help for the rapid adoption of the variety in the development system.^[6] From the two groups varieties were ranked in similar manner that SER-119 was selected as preferred genotypes followed by SER-118, Nassir and ICN Bunsu x S x B 405. This indicated that farmers had come with the similar evaluation and level of understanding from both groups and would help to assess the understanding of different groups of farmers and will direct the future expansion of the technology in the target areas and similar areas. A similar study was conducted using at Hawassa zuria, Meskan and East Badawacho districts of SNNPR in 2013 cropping season and found that SER-119 was the leading among the tested genotypes and selected by farmers. As a result, it was recommended for further scaling up for the tested and similar agroecology.

4. Recommendation

Genotype SER-119 followed by SER-118 which are red in color were the primary choice of both female and male group of farmers and good in their agronomic performance like grain yield, number of pods per plant, number of seeds per pod and number of seeds per plant. As a result, genotype SER-119 and SER-118 are recommended and used for production in the tested areas and similar agro ecological Zone of Metekel. Bean research program should consider the farmers' criteria especially color for local consumption in the tested area as a target trait in the future breeding program.

5. Conclusions

Participatory variety selection is a better option to create a common understanding between researchers and different clients by considering traits that meet their interest. This makes the breeding program more successful and users can easily adopt the technology after release. In this study, male and female group of farmers had set grain yield, pods per plant, seeds per pod and resistance to different disease as primary selection criteria for common bean. In addition to this the female group had also included grain color and branching habit in their selection criteria. Female farmers preferred the red color beans for their local consumptions as boiled bean "Nifro" and "Shiro".

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Conflicts of Interest

The authors declare no conflict of interest

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