



Evaluation of Recently Released Andean Bean Varieties with the Participation of Farmers in Mid-Altitude Region of Gedeb Zuria, Gedo Zone

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

During the 2012 mehere season, a study was conducted in the income Gedeb Wereda of the Gedo zone in Ethiopia to evaluate farmers' selection criteria for beans and the performance of newly released Andean common bean varieties. The study utilised participatory variety selection (PVS) trials. The findings revealed that qualitative features were given more importance by farmers compared to quantitative traits. Among the different genotypes tested, Gegeba and Ibado emerged as the top two varieties. Farmers considered five qualitative characteristics as superior to production: seed size, marketability, maturity duration, pest and disease resistance, the ability to tolerate cool temperatures, and seed color. Gegeba, with its large, red-speckled seeds, high market demand, upright growth habit, early maturity (90 days), and reasonably high yield (>2 tonnes ha⁻¹), was the preferred choice for almost all farmers. The study suggests that future bean development efforts should focus on promoting the selected varieties and developing new ones that align with farmers' preferences, particularly in terms of adaptation to the mid-highlands, suitability for domestic consumption, local markets, and export markets.

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1. INTRODUCTION

In Ethiopia, the primary pulse crops cultivated are Faba bean, common beans, chickpeas, haricot beans, lentils, mung bean, and vetches. According to CSA [1], the common bean (*Phaseolus vulgaris* L.) holds the utmost significance as a pulse crop in terms of both area coverage and annual production volume in Ethiopia. It is extensively grown by smallholder farmers in the Southern Nation, Nationalities, and People's Region (SNNPR), making it one of the major grain legumes in the region. Legumes play a vital role in providing protein in Ethiopia, with common bean (*Phaseolus vulgaris* L.) being a prominent contributor alongside faba bean and field pea [2].

The rural areas of Sidama Zone heavily rely on the crop sector for their livelihoods. In this specific region, the primary crops cultivated are 'Enset' and maize. Enset, a perennial root crop, is unique to Ethiopia and is mainly grown in the courtyard alongside other crops like coffee, common bean, and maize. The food derived from Enset, called 'Kocho', is consumed either alone or mixed with boiled beans and maize [3-5]. Enset plays a crucial role in generating income as its straw is used as livestock feed, and it also enhances soil fertility through nitrogen fixation in the cropping system. Despite the potential yield of beans reaching up to 5 tonnes per hectare, the average yield of local bean varieties in the study area is only about 1.7 tonnes per hectare, which is significantly low. This can be attributed to various factors, such as soil conditions, climate, diseases, and pests. Moreover, the limited availability of improved varieties in different market classes and agro-ecologies, coupled with insufficient awareness [6,7].

Furthermore, farmers in different regions have shown varying levels of acceptance towards the released and high-yielding varieties. This can be attributed to the fact that these varieties were developed using conventional breeding methods, which did not take into account the preferences of farmers. According to a study conducted by Gemechu et al. [8], the adoption rate of most varieties developed through conventional breeding has been lower than expected. The researchers argue that involving farmers in the research process from the outset is crucial, as farmers have their own selection criteria that go beyond just yield potential. Another factor

contributing to the lower adoption rate is that the selected varieties may perform well in controlled research station environments but not in diverse field conditions. This is due to the influence of genotype-environment interactions, as highlighted by Ceccarelli and Grando [9].

Gemechu et al. [10] emphasised the importance of effectively utilising the unique and shared knowledge of farmers and researchers in the research process. They recognised that both farmers and professional plant breeders possess valuable knowledge and skills that can complement each other. Participatory variety selection (PVS) encompasses a range of approaches that involve various stakeholders, including scientists, breeders, farmers, and other actors, in the different stages of plant breeding. The objective of PVS is to develop varieties that not only adapt to the physical environment but also to the socio-economic conditions in which they will be utilized. According to Ashby [11], the adoption of PVS varieties by more farmers across larger areas leads to increased food production and income benefits. Additionally, PVS enhances research efficiency by generating more relevant and desirable research outcomes. Ashby [11] cited examples from different countries and crops to highlight the impact of PVS.

Participatory variety selection (PVS) is becoming increasingly popular in African countries as a way to discover and promote new crop breeding materials. This method involves farmers selecting new varieties from predetermined lines in different target environments. Participatory variety selection encompasses a wide range of approaches in plant breeding, engaging scientists, breeders, farmers, and other stakeholders.

The common bean is commonly cultivated in low-altitude and hot environments in Ethiopia [12]. Nevertheless, specific Andean bean genotypes possess the capability to adjust to mid-altitude regions with cooler climates because of their phylogenetic and gene pool origins. Consequently, this study represents one of the few pioneering experiments carried out at a moderate elevation to introduce the adaptation of Andean beans in both Ethiopia and the southern region.

Moreover, we can credit the discovery of this bean to the unique climatic conditions found in this area.

Therefore, the objectives of this study were to:

The objective is to assess and choose the most successful Andean common bean varieties that are suitable for adaptation in the mid-highland region.

Additionally, the aim is to evaluate the selection criteria used by farmers in choosing common bean varieties in the mid-highland, with active participation from the farmers.

Furthermore, it is crucial to identify the key criteria that will guide future improvements in bean cultivation in the region and surrounding areas.

2. MATERIALS AND METHODS

The study was conducted in the Gedeb district, Gedio Zone, SNNPR Region. Situated at an elevation of 2200 m.a.s.l., the region receives an annual rainfall of 1200 mm. The soil in this area is characterised by a sandy-loam texture. Ensete, maize, barley, wheat, potato, faba bean, and field pea are the main crops cultivated in this predominantly agricultural region. Additionally, the region experiences bi-modal rainfall, allowing for the cultivation of grain crops during both the Meher and Belg seasons.

The initial phase of the experiment took place in Gedio Zone, Gedeb Wereda. The experiment involved seven different Andean bean varieties, namely Ibado, Gegeba, Tatu, Remeda, Wajo, Awash-2, and Batu. To ensure accuracy, a randomized complete block design (RCBD) was implemented. Each plot had a size of 12.8 m²,

consisting of four rows measuring two metres in length. The spacing between rows was 40cm, while within a row it was 10cm. A total of 100 kg of NPS/ha fertilizer was applied. All recommended agronomic practices, including weeding and cultivation, were diligently carried out. Detailed observations were made on phenological, agronomic, and yield traits. Additionally, for the secondary trials, twenty farmers from the surrounding area were selected. Each farmer received one kilogramme of two bean varieties based on their personal preferences, and they were responsible for managing their own plots. The experiment was initiated in 2012, and the harvest took place in July of the same year.

3. RESULTS AND DISCUSSION

3.1 Researcher's Evaluation

The PVS trial for the common bean in the Gedeb district was evaluated by the researchers, with a specific focus on grain yield (Table 1). The different varieties showed a significant range in grain yield, with Gegeba achieving the highest yield of 2500 kg/ha and Batu having a lower yield of 1300 kg/ha. The analysis of the PVS trial indicated a noticeable difference in grain yield among the varieties in Gedeb during the 2012–2013 period (Table 1). Ibado and Gegeba were selected for the initial trial based on factors such as seed size, earliness, pod length, disease resistance, and overall yield, as determined by both male and female farmers. These chosen varieties are characterized by early maturation and are well-suited for double cropping, especially during the Belg season. While faba bean and field pea are the primary legumes in the mid-highland areas, common bean can also be considered a viable alternative legume crop.

Table 1. Mean yield (Qt /ha) with farmers preference rank at Gedeb 2012/13

No.	Varity	Market class	Yield kg/ha	Farmers Preference	
				Male (15)	Female (5)
1	Ibado	Large Red mottled	2000	2	1
2	Tatu	Large Red mottled	2300	3	4
3	Batu	Large White	1700	6	6
4	Gegeba	Large Red mottled	2500	1	2
5	Awash-2	Large White	1900	7	7
6	Wajo	Large White	2000	5	5
7	Remeda	Red Kidney	2200	4	3
Cv (%)			24		

Table 2. Trait (selection criteria) used by farmers with preference rank at Gedeb 2012/13

Trait (Selection criteria)	Remeda	Ibado	Gegeba	Batu	Awash-2	Wajo	Tatu
Number pods/plant	4	6	5	2	5	1	3
Time of maturity (Earliness)	4	6	5	2	1	3	5
Grain harvested	5	6	5	1	3	1	3
Grain shape	3	6	4	2	3	3	2
Largeness of Seed	2	6	5	2	5	2	1
Red and Red Mottled color	3	2	5	3	3	2	6
Demand by the market	4	3	6	1	4	1	4
Largeness of Seed	4	6	6	1	5	1	4
Growth period	3	4	6	1	2	1	3
Disease Tolerance	6	5	2	1	4	1	1
Insect Tolerance	5	6	4	1	3	1	1
Brightness of Seed	1	5	6	2	3	1	1
Stay green	6	1	5	1	3	1	4
Mean Preference rating	3.85	4.77	4.92	1.54	3.38	1.46	2.92
Rank	3	2	1	6	4	7	5

Table 3. Rank of the best preferred criteria used by men and women farmers at Gedeb, 2012/13

Selection criteria	Men	Women
Pods/plant	4	3
Number of seed/pod	5	6
Pod filling	8	7
Diseases and Insect tolerance	6	5
Seed size & pod length	7	8
Seed color (speckled or uniform color)	3	4
Growth period	2	2
Erectness or climbing growth habit	8	8
Yield	1	1

3.2 Farmers Evaluation

In the study area, farmers engaged in participatory variety evaluation and selection. They assessed various criteria to determine their acceptance or rejection of bean varieties. These criteria encompassed pod load, earliness, yield, seed size, red colour, market value, seed shape, maturity period, disease resistance, insect resistance, pod appearance, and green leaf. Out of the fourteen different traits, farmers selected the ones they frequently utilized when evaluating common bean genotypes for adoption. This indicates that although farmers take into account multiple traits, there are only a few that they commonly rely on, and it is crucial to identify these traits. Similar findings have been observed in previous studies conducted by Gurumu (2013) and Wondimu (2016) on common beans, where farmers utilized a combination of a few traits when evaluating new genotypes.

4. CONCLUSION

The most preferred genotypes identified by the farmer's discussion through PVS and the researchers' analysis results were Gegeba and Ibado. These genotypes need to be demonstrated on large plots in a pre-extension demonstration (PED), and finally, the varieties need to be upscaled through participatory seed production. The first two varieties (Gegeba and Ibado) were also identified by researchers as the most preferred varieties for yield and other desirable traits. The study indicates that to assure the quality and quantity of data, enough resources have to be made available.

Gegeba and Ibado have been identified as the most favored genotypes through the farmers' discussion and the researchers' analysis. To showcase these genotypes effectively, they should be grown on extensive plots in a pre-

extension demonstration (PED). Furthermore, participatory seed production should be employed to expand the cultivation of these varieties. The researchers have also recognised Gegeba and Ibado as the top selections for yield and other desirable traits. The study highlights the significance of allocating ample resources to guarantee the quality and quantity of data.

5. RECOMMENDATIONS

According to the findings, it is imperative to carry out the following measures:

- Encourage the adoption of specific cultivars and their associated farming techniques in the experimental locations where they have been implemented.
- Formulate plans for the multiplication and distribution of seeds to ensure the continued availability of these cultivars for farmers in the long term.
- Begin the development of new cultivars suitable for the mid-highland region, using Andean genotypes, with the goal of introducing improved alternatives for the area.

ETHICAL APPROVAL

The present study followed, national, Regional and/or institutional guidelines for Crop Science Research and complied with relevant legislation from *Southern Agricultural Research Institutional Review or Hawassa Research Center Guideline*.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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