

Registration of “Mi’oftu” Speckled Common Bean (*Phaseolus vulgaris* L.) Variety

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Abstract

Background: Common bean is an important food and export crop widely grown in Ethiopia. Limitation of high yielding and disease resistant speckled type common bean varieties with stable performance across environments is one of the factors constraining productivity of the crop in the country.

Objective: The objective of the study was to identify and release stable, high yielding and disease resistant common bean varieties for cultivation in Eastern and Western Hararghe Zones and other similar agro-ecologies.

Materials and Methods: Fifteen common bean genotypes along with the standard check “Tafach (SAB-632)” were evaluated across four locations in 2017 and 2018 main cropping seasons using a triple lattice design. The promising genotype, DAB-410 was selected and promoted to a variety verification trial and was tested with the standard check “Tafach” at four on-station and eight on farm sites during the 2019 main cropping season. The National Variety Release Technical Committee of Ethiopia evaluated the candidate variety in accordance with the National Variety Release Procedure.

Results: The candidate variety (DAB-410) produced an average seed yield that exceeded the average yield of the standard check, “Tafach” variety by about 23.7% and showed a stable performance across locations over the two years. The variety is resistant to rust, anthracnose, and halo blight, while being moderately resistant to angular leaf spot and common bacterial blight. It has an upright (Type II) indeterminate bush growth habit and good pod clearance. Based on the data of its performance under several environmental conditions as evaluated the Variety Release Technical Committee and shown by its reports, the national variety release standing committee approved the official release of DAB-410.

Conclusion: “Mi’oftu” (DAB-410) showed a stable high yield performance and resistance to major diseases in the region. Therefore, the variety has been recommended for cultivation in East and West Hararghe Zones and other areas with similar agro-ecological conditions.

Keywords: Canning quality; Disease resistance; Speckled bean; Stable; Yield performance

1. Introduction

Common bean is a diploid ($2n = 2x = 20$) annual grain legume widely cultivated in South America, Asia and Africa. It is an important source of protein, carbohydrates, and micronutrients. It plays an important role in sustaining food and nutrition security. Common bean is an important component of agro-biodiversity and provides food, cash income, feed, and improved soil fertility through its mutual association with rhizobium bacteria that fixes atmospheric nitrogen, thereby reduces the cost of chemical fertilizer and its negative impacts on the environment (Reckling *et al.*, 2016). Thus, the crop contributes to the food security and livelihood of smallholder farmers throughout the tropics (Graham and Vance, 2003; Foyer *et al.*, 2016). In Ethiopia, common bean is cultivated as sole crop and intercropping with cereals such as sorghum and maize. Intercropping of common bean with cereals is widely practiced in eastern Ethiopia where around 91% of the farmers' intercrop

beans with sorghum and maize due to the small landholding. It is also used as a break crop for diseases (Chemedo Fininsa, 2003).

Common bean is an essential component of smallholder farming system in many parts of Ethiopia. Among the legumes, common bean has showed a very high increase both in production and export value over the recent years; with increments of 218,940 ha to 313,261 ha in area, 147,210 to 559,477 tons in production, and 0.72 t ha^{-1} to 1.79 t ha^{-1} in productivity between 2000 to 2020 (FAO, 2021). Despite the observed increase in yield, the national common bean yield (1.8 t ha^{-1}) is yet far below the crop's potential yield ($> 4 \text{ ton ha}^{-1}$) observed in research sites in eastern Ethiopia (FAO, 2021). Lack of high-yielding varieties of speckled type market class is one of the challenges facing exports of the speckled beans. Furthermore, speckled common bean market class variety has not yet been released for the agro-ecology of eastern Ethiopia. Thus, speckled type market

class common bean genotypes were introduced from International Centre for Tropical Agriculture (CIAT)-ECABREN (East and Central Africa Bean Research Alliance) and evaluated in eastern Ethiopia in Babile, Fedis, Haramaya and Hirna districts for yield, disease resistance, and other desirable traits. From the tested genotypes, DAB-410 showed stable performances across environments with high yield and resistance to the major common bean diseases.

Therefore, DAB-410 was released through the national variety release procedures for cultivation in Eastern and Western Hararghe Zones and other areas with similar agro-ecology. Based on its genetic attributes, the researchers and farmers named the released common bean variety Mi'oftu, meaning "tasty" in the local Oromo language. It is believed that Mi'oftu will serve as an additional option in speckled bean market class and join the international common bean market.

2. Sources of Germplasm and Evaluation

Sixty-four DAB (Drought Andean Bean) lines were initially bred for drought tolerance and introduced as fixed lines from CIAT/ECABREN. The genotypes were initially evaluated for yield and disease resistance in advanced observation nurseries and preliminary variety trial (PVT) at Haramaya University, Raree site, in 2015 and 2016, respectively with two replications using alpha lattice design. Fifteen genotypes were selected from PVT and evaluated against the standard check (Tafach) at eight

environments, *i.e.* four locations (Babile, Fedis, Haramaya and Hirna) for two years (2017 and 2018). The genotypes were planted using triple lattice design with three replications. Each genotype was planted in six rows and data were collected from the central four rows in each plot. In 2019, the promising genotype (DAB-410) along with the standard check (Tafach) and recent check (Brazil-2) were tested to verify at the four locations (Babile, Fedis, Haramaya and Hirna) and two farmers' field in each location.

3. Varietal Characteristics

Mi'oftu is characterized by an indeterminate bush (type II) growth habit. It is, thus, resistant to lodging. Its average canopy height was 31.8 cm and varied across the growing environments (Table 1). It has a light green leaf color. It is categorized under medium maturity class with an average of 95 days required to maturity. However, the maturity periods of the variety may vary between the low and midland areas. In describing the variety, IBPGR (1982) for *Phaseolus vulgaris* L. was adopted. The variety has a large seed size with an average of 46.4g of 100 seed weight. It has a kidney seed shape and red speckled seed coat color. The grain yield of Mi'oftu ranged from 2.4 to 2.7 ton ha⁻¹ in the potential areas (Haramaya and Hirna) and between 1.2 to 1.5 ton ha⁻¹ in less potential lowland areas (Babile and Fedis) (Table 3). On average, Mi'oftu had a 23.7% yield advantage over Tafach (the standard check).

Table 1. Average agronomic performance of Mi'oftu, and Tafach.

Genotype	Days to flowering	Days to maturity	Plant height (cm)	Pods plant ⁻¹	Seeds pod ⁻¹	100 seed weight (g)	Average yield (ton ha ⁻¹)
Mi'oftu	43.3	95.9	31.8	8.7	4.4	46.4	2.40
Tafach	43.1	94.7	33.0	9.6	4.4	44.4	1.94

4. Reaction to Diseases

Based on the standard of 1–9 scale for disease assessment (Schoonhoven and Paster-Corrales, 1987), Mi'oftu showed resistant reaction for rust (*Uromyces appendiculatus*),

anthracnose (*Colletotricum lindemuthianum*) and halo blight (*Pseudomonas syringae* pv. *phaseolicola*). On the other hand, it showed a moderately resistant reaction for common bacterial blight (*Xanthomonas campestris* pv. *phaseoli*) and angular leaf spot (*Phaeoisariopsis griseola*) (Table 2).

Table 2. Disease severity scores of Mi'oftu and Tafach.

Genotype	CBB	HB	ANT	ALS	Rust
Mi'oftu	3.3	1.0	1.4	3.6	1
Tafach	3.2	1.0	1.4	3.8	1

Note: Disease score based on 1–9 scale; where, 1 = highly resistant and 9 = highly susceptible; CBB = Common bacterial blight, HB = Halo blight, ANT = Anthracnose, and ALS = Angular leaf spot.

Table 3. Mean grain yield (ton ha⁻¹) of Mi'oftu and Tafach evaluated at four locations for two years.

Genotype	2017				2018				Overall mean	Yield advantage (%)
	Babile	Fedis	Haramaya	Hirna	Babile	Fedis	Haramaya	Hirna		
Mi'oftu	1.32	1.21	2.36	3.57	1.20	1.52	2.77	4.38	2.40	23.7
Tafach	1.17	1.01	2.16	2.85	0.78	1.07	1.86	3.43	1.94	

5. Quality Attributes

The analysis for grain seed iron and zinc concentrations was conducted at HarvestPlus lab, Rwanda and the result showed that Mi'oftu contains 76 ppm Fe and 33 ppm Zn while Tafach contains 72.1 ppm Fe and 31ppm Zn. The canning quality traits were tested at Elfora Agro-

Industries Plc., Wondogenet, and Mi'oftu showed good canning quality traits such as washed drained weight, flavor and taste, appearance, uniformity and brine clarity (Table 4).

Table 4. Canning quality of Mi'oftu, Tafach and Brazil-1 varieties.

Genotype	Washed weight (g)	Flavor and taste	Appearance	Uniformity	Degree of clumping	Degree of splitting	Brine clarity
Brazil-1	286.4	4	4.8	1.4	2.6	4.2	3.6
Tafach	279.9	4	4.4	2.2	2.2	3.6	2.4
Mi'oftu	316.3	4.4	3.6	1.8	2	2.6	3.6

Note: *Brine clarity*: 1 = very cloudy to 7 very clear brine; *Appearance*: 1 = seeds blown apart free seed coats present to 5 = 90% of seeds intact and no free seed coats; *Flavor and taste*: 1 = unpleasant flavor to 5 = good flavor; *Degree of splitting*: 1 = very broken to 5 = slightly intact; *Degree of clumping*: 1 = bean clumped solidly to 3 = no clumping; and *Uniformity of seed size*: 1 = very uniform to 7 = very varied.

6. Conclusion

The results of this study have demonstrated that the newly released common bean variety, Mi'oftu is superior to the commercial Tafach variety as well as the recently released Brazil-2 variety in terms of yield and seed quality traits. The variety has shown a stable yield performance across the test locations and was found to be consistent over the years in its yielding ability. Consequently, the variety has been recommended for production in the low and mid-altitude areas of eastern Ethiopia and other areas with similar agro-ecologies in the country. The breeder and pre-basic seeds of the released variety will be maintained by the Lowland Pulse Research Program of Haramaya University.

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