

Registration of “*Hegere and Duromsa*” common bean (*Phaseolus vulgaris* L.) varieties for mid-lowlands of Guji zones and similar agro-ecologies in Ethiopia

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ABSTRACT

Aim: The aim of this study was to evaluate and release high yielding, stable/wider adaptation and resistant to major common bean diseases for the mid-lowlands of Guji zones and similar agro-ecologies.

Materials and Methods: Total of thirteen (13) common bean genotypes were evaluated in multi-location trial at four locations viz, Adola-woyu, Kiltu-sorsa, Gobicha and wodera for two consecutive years during main cropping season.

Results: Out of tested genotypes, varieties such as **Hegere** (NSEA515-11-1) and **Duromsa** (NSEA515-11-31) were found to be superior in grain yield, stable in performance and tolerant to major common bean diseases. The variety “**Hegere**” is characterized with red seed color associated with preferable for food, high grain yield with average of 2.90 tons ha⁻¹ and which is showed a yield advantage of 16% and 23% over the standard check (SER-119) and local check, respectively. While, variety “**Duromsa**” had creamy seed color, high seed weight and also given the most stable high grain yield (2.78 tons ha⁻¹) with yield advantage of 11% and 17% over the standard and local checks, respectively.

Conclusion: It was concluded that two common bean varieties, *Hegere* and *Duromsa* were released for their higher yield, stable in yield performance across tested locations and also revealed resistant reaction to major bean diseases as compared to the standard and local checks.

Keywords: Common bean; duromsa; hegere; multi-location trial; registration

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Introduction

Common bean (*Phaseolus vulgaris* L.) (2n=2x=22) belongs to the order *Rosales*, family *Fabaceae*, subfamily *Papilionoideae*, tribe *Phaseoleae* (CIAT, 2006). Common bean is one of most important food legumes of Ethiopia and it is considered as the main cash crop and least expensive source of protein for farmers in many lowlands and mid altitude of the country. It is high in starch, dietary fiber and is an excellent source of potassium, selenium, molybdenum, thiamine, vitamin B6 and folic acid (Maiti and Singh, 2007). It is used as food in different form the green unripe pods are cooked or conserved as vegetable and the ripe seeds cooked for “nifro” or boiled with mixed with sorghum or maize and can be consumed as “woti” using powder form (MoARD, 2009).

Common bean production is concentrated in two regional states: Oromia (50%) and SNNPR (27%) (CSA, 2018). In the 2020/21 cropping season, the total area and total production for red common bean was estimated to be 208,295.03 ha and 3,670,300.05 qt, respectively. In Guji zone coverage area of 13,00.92 ha was for red beans and average productivity of 235,293.67 qt (18.09 qt/ha) (CSA, 2021).

Variety releasing is an ongoing process since a given variety has performed well for specific period of time and reduces its production potential after a while due to segregation, becoming susceptible to diseases, and to some degree due to out crossing. Therefore, rather than trying to develop new variety after the given variety become out of production due to different factors, it is a must to have stable and widely adapted with different merits over the previously released variety before a given variety become out of production. Therefore, due to the

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significance of having released variety, the present study was undertaken with the objective of to evaluate and release high yielding, stable/wider adaptation and resistant to major common bean diseases for the mid-lowlands of Guji zones and similar agro-ecologies.

Materials and Methods

The field experiments were conducted at eight locations for two consecutive year's main cropping season from April to July at Adola-woyu, Kiltu-sorsa, Gobicha and Wodera. The locations represent mid-lowlands of Guji Zone, receiving medium to low rainfall and characterized by a bimodal rainfall distribution. The first rainy season was from early April up to July and the second season starts in early September and ends to late November. The major soil types were red basaltic soils and Orthic Aerosols. The soil was clay in texture and slightly acidic with pH value of around 6.4. The hottest period of the year extends from onward of December up to Marchs whereas the coldest period extends from June to December. The verification trial was conducted during the 2021/22 main cropping season.

Varietal Origin and Evaluation

Hegere and *Duromsa* varieties were formerly introduced from Melkassa Agricultural Research

center and developed through selection breeding method. A total of 12 selected genotypes were evaluated at multi-locations against the standard check (SER-119) and local check for two consecutive years (2019/20-2020/21) main cropping season at Adola-woyu, Kiltu-sorsa, Gobicha and Wodera. The two genotypes, *Hegere* (NSEA515-11-1) and *Duromsa* (NSEA515-11-31) gave above ten percent (>10%) yield advantages and had preferable performances over the standard and local checks. The varieties showed better performance for grain yield and resistant to major diseases and possessed good agronomic traits than all the tested genotypes and checks.

Varietal Characteristics

The varieties *Hegere* and *Duromsa* requires 43 and 44 days to flowering; and 93 and 94 days to reach physiological maturity, respectively. In addition, those varieties had plant height of 90.62cm and 74.38cm with an indeterminate (bush type) of growth habit having flower color of pink and white, respectively. *Duromsa* has high thousand seed weight of 313.5g with creamy seed color, while *Hegere* has thousand seed weight of 233.6g with deep red seed color. Summary of the agronomic and morphological characteristics of varieties were given (Table 1).

Table 1. Summary of the description of agronomic and morphological characteristics of two new common bean varieties

Variety name		<i>Hegere</i> (Nasir x SER16)	<i>Duromsa</i> (NSEA515-11-31)
Adaptation area		Lowland to midland areas of Guji zones and similar agro-ecologies	
Altitude (m.a.s.l)		1450-1900	1450-1900
Rainfall(mm)		500-750	500-750
Soil type		Clay	Clay
Seed rate (kg/ha): Row planting		70-80	80-90
Spacing (cm)	Between plants	10	10
	Between rows	40	40
Fertilizer rate (kg/ha)	NPS	121	121
	UREA	-	-
Planting date		From 1 st week to 3 rd week of September	From 1 st week to 3 rd week of September
Days to flowering		43.25	44.21
Days to maturity		91.12	92.33
Plant height (cm)		90.62	74.38
Growth habit		Indeterminate (Bush type)	Indeterminate (Bush type)
1000 seed weight (g)		233.6	313.5
Yield (tons/ha)	Research field	2.53 - 3.39	2.63 - 3.26
	Farmers field	2.15 - 2.73	2.21 - 2.70
Seed color		Deep red	Creamy
Flower color		Pink	White
Cotyledon color		Light yellow	White speckled
Seed size		Small	Small
Seed shape		Kidney	Kidney

Table 2. Combined mean performances of grain yield and reaction to diseases of 11 genotypes during 2019/20 and 2020/21 main cropping season.

Code	Genotypes	Overall Mean (tons ha ⁻¹)	(%Yield advantage	Diseases reaction (1-9 scale)			
				CBB	ALS	Bean Rust	Anthraco nose
G1	NSEA515-11-34	2.823 ^{ab}		3	3	1	2
G2	NSEA515-11-1	2.900 ^a	16.00	3	3	1	2
G3	NSEA515-11-30	2.517 ^{cd}		4	3	1	2
G4	NSEA515-11-31	2.768 ^{a-c}	11.20	3	2	1	2
G5	NSEA515-11-42	2.468 ^d		3	3	1	2
G6	NSEA515-11-46	2.369 ^d		4	3	1	2
G7	NSEA515-11-52	2.642 ^{a-d}		3	4	2	3
G8	NSEA515-11-63	2.587 ^{b-d}		3	3	2	2
G9	NSEA515-11-65	2.475 ^d		3	4	2	2
G10	SER-119	2.502 ^{cd}		3	3	1	3
G11	Local Cultivar	2.362 ^d		4	4	5	3
	Means	2.56		3	3	3	2
	LSD(5%)	0.69		0.54	0.52	0.41	0.42
	CV(%)	16.9		30.2	29.4	31.1	36.7

Yield Performances

The combined yield of the two years across four locations showed that, *Hegere* (NSEA515-11-1) and *Duromsa* (NSEA515-11-31) gave 2.90 tons ha⁻¹ and 2.78 tons ha⁻¹, respectively. *Hegere* has 16% and 23% yield advantages over standard check (SER-119) and local check, respectively. Also *Duromsa* has 11% and 17% yield advantages over checks (Table 2).

Stability Performances

The two varieties showed stable yield performances across tested locations and over years. Based on the stability performances, the new varieties, *Hegere* (NSEA515-11-1) and *Duromsa* (NSEA515-11-31) were stable for grain yield and the GGE biplot confirmed that the varieties were the most stable (Fig. 1).

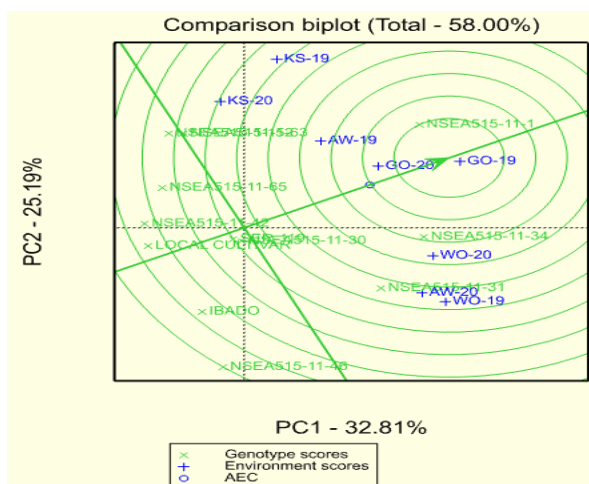


Fig 1. GGE bi-plot based on genotype-focused scaling for comparison of common bean genotypes for their yield potential and stability.

Reaction to Major Diseases

Diseases severity data across locations and over years were recorded for major common bean diseases. Both *Hegere* (NSEA515-11-1) and *Duromsa* (NSEA515-11-31) varieties had scored 2-3 scale, which is being characterized as moderately resistant to evaluated diseases (Table 2).

Adaptation and Agronomic Recommendation

Newly released common bean varieties, *Hegere* and *Duromsa* were recommended for the midlands to low-altitudes of Guji zones and similar agro-ecologies of Ethiopia. They are well adapted in areas having altitude ranges from 1450 to 1900 meters above sea level and annual rainfall of 500 to 750mm. *Hegere* and *Duromsa* are performs best if it produced with the recommended fertilizer rate of 121 kg NPS/ha and seed rate of 80 kg/ha and 90 kg/ha, respectively in clay soil. Recommended planting time is started from early to end of April in Meher season and from early to end of September in Belg season depending on the set of rainfall.

Variety Maintenance

The breeder and foundation seed will be maintained by Bore Agricultural Research Center.

Conclusions

After the final evaluation of variety verification, two common bean varieties, *Hegere* and *Duromsa* were released for their higher yield, stable in yield performance across tested locations and also revealed resistant reaction to major bean diseases as compared to standard and local checks used in this study. Variety *Hegere* had

ranked first for grain yield with other desirable traits and had red seed color whereas variety *Duromsa* has also high grain yield with weighty thousand grain weight and had attractive seed color (creamy). Based on these merits, these two varieties were released for midland to low-altitudes of Guji zones and similar agro-ecologies. Therefore, smallholder farmers, seed enterprises and other common bean producers in Guji zones and other similar agro-ecologies can produce *Hegere* and *Duromsa* with their full recommended packages.

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