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Registration of Faba Bean Variety Named "Besmena"

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Abstract: Faba bean (*Vicia faba* L.) variety named "Besmena" with the pedigree designation of EK06007-2 has been released by Sinana Agricultural Research Center in Ethiopia. The variety is best adapted to altitudes ranging between 2300-to-2600 meters above sea level in the country. The variety was developed through selection. It has been tested at Sinana, Sinja and Agarfa from 2018 to 2020 main cropping seasons. Besmena is characterized by Medium-seeded with Light green seed color and gave high seed yield (3320 kg ha^{-1}) and stable performance across years and locations. It has about 14.97% yield advantage over the best standard check variety, "Shallo". Based on most stability parameters, Besmena showed relatively better grain yield performance and stability across a range of environments and years than the standard checks Shallo and Mosisa. This variety is moderately resistant to the major Faba diseases such chocolate spot, Rust and Aschochyta blight, and could be cultivated across a number of locations in the high-altitude areas of Bale and other similar agro ecology of the country to boost productivity and marketability of the crop and improve farmers' income.

Keywords: Disease Resistance, Grain Yield, Vicia Faba L.

1. Introduction

Faba bean (*Viciafaba* L.) is a diploid (2n = 12 chromosomes) crop that is one of the most vital food legumes cultivated in the temperate and subtropical regions of the world [12]. It is cultivated for the purpose of both human food and animal feed. The mature seeds can be eaten fresh or cooked in different forms such as: steaming, roasting, frying and other most common cooking methods similar to other legumes [5]. Faba bean grain is high in protein (28–32%) compared to field peas (24%) and are low in oil. It is also rich in minerals such as calcium, phosphorus as well as vitamins even though there is slight variation among varieties [7]. It also has value as an export crop for feed markets [9].

Faba bean were also known by N fixation crop which is considered as high among the grain legumes [4]. It is mainly produced in an elevation of 1800 to 3000 m.a.s.l. [8, 11]. The crop usually grows in Nitisol and Vertisol dominated areas of Ethiopia mixed with cereals and field peas. Among pulse crops produced in Ethiopia, Faba bean leading in terms of area coverage and total production. The average national yield of faba bean is about 2.33 t ha^{-1} [1] which is very low compared to the average yield of 3.7 t ha^{-1} in major producer countries [6].

Production of faba bean in the country couldn't attain the maximum yield potential of the crop because of biotic and abiotic stresses that collectively cause great yield losses. Among the major constraints to increased faba bean production are lack of improved varieties, chocolate spot (Botrytis fabae), root-rot, Faba bean gall and rust diseases, insect, pests, broad leaf and grass weeds, water-logging, and cold and drought weather conditions [2, 3]. Therefore, faba bean research program in Ethiopia has been focused on increasing production and productivities of the crop through developing and promoting improved cultivars with high and stable yield, and resistant/tolerant to biotic and abiotic stresses [10]. The objective of this study was to register stable high yielding and disease resistant/tolerant Fababean variety for highlands Bale and other similar agro-ecologies.

2. Origin and Varietal Evaluation

Besmena (EK06007-2) along with 13 genotypes were obtained from Holeta Agriculture Research Center of the Ethiopian Institute of Agriculture Research. The genotypes were evaluated along with the standard check variety, "Mosisa and Shallo", across three locations (Sinana, Sinja and Agarfa) from 2018-2020. One genotype "EK06007-2" were selected as candidate variety based on a combined data analysis of variance and mean performances comparison of genotypes. The promising candidate variety and the standard check variety, "Mosisa and Shallo", were eventually promoted to a variety verification trial. The candidate variety and standard check variety were planted in plots with a size of 10 m x 10 and evaluated by the national variety release technical committee at three locations during the 2020/21 cropping season. Finally, the national variety release technical committee selected "EK06007-2" genotype for release. EK06007-2 has better yield advantage, and good resistance to major diseases like chocolate spot, Rust and Aschochyta blight.

3. Agronomic and Morphological Characteristics

In an attempt to develop Besmena, higher seed yield with good agronomic performance and resistance to major Fababean diseases were important traits of consideration. The newly released faba bean variety 'Besmena' is characterized by an indeterminate growth habit. Its flower color is white with black spots. The seed coat and cotyledon colors are White with Light green and Yellow, respectively. The average number of days required by the variety to reach its 50% flowering and 95% physiological maturity were 59 and 139, respectively, with the average plant height being 117 cm (Table 1, Table 3). The average number of pods per plant is 10 (Table 4).

4. Grain Yield Potential, Stability and Reaction to the Major Diseases

The candidate variety; EK06007-2 was significantly out yielded the standard checks variety Shallo and Mosisa during 2018-2020 main cropping seasons at Sinana, Sinana and Agarfa (Table 2). This variety was the top yielding in most of the testing locations with an overall average grain yield of 3320 kg ha^{-1} (Table 3). Besides the yield potential performance, it showed good level of lodging resistance and disease tolerance to common Fababean diseases (Table 4).

Partitioning the GxE interaction effect based on a joint linear regression method (Eberhart and Russel, 1996) showed that the candidate variety is among the genotypes which gave high yield with values of regression slope (b) and deviation from regression (Sij2) not significantly different from 1 and 0 respectively. Generally, variety Besmena (EK06007-2) is showed yield advantage of 3320 kg ha^{-1} (14.97%) over the standard checks; Shallo variety (Table 1, Table 2). Consequently; Besmena was promoted to variety verification trial in 2021 and released for large scale production since 2022.

5. Variety Maintenance

The breeder and foundation seed will be maintained by Sinana Agricultural Research Center/ Oromia Agricultural Research Institute.

Table 1. *Morpho-agronomic and quality trait description of Besmena.*

No	Agronomical and Morphological Characteristics		
1	Adaptation area		Highlands of Bale: Sinana, Goba, Agarfa, Gassera, Goro (Meliyu), Adaba, Dodola and other similar agro-ecologies
2	Altitude (m.a.s.l.)		2300 – 2600
3	Rainfall (mm)		750 – 1000
4	Seed Rate (Kg/ha)		175-225
5	Planting date		End of July to Early August
6	Fertilizer Rate (NSP kg/ha)		100
7	Days to Flower		59
8	Days to Maturity		139
9	Plant Height (cm)		117
10	1000 Seed Weight (gm)		754
11	Seed Color		White with Light green
12	Cotyledon Color		Yellow
13	Sock ability (%)		98.0
14	Flower Color		White with black spot
15	Yield (Qt/ha)	On-station (Research Field)	29-33
		On-farm	20-29
16	Disease reaction		Tolerant to chocolate spot, Rust andAschochyta blight
17	Yield advantage over Shallo (%)		14.97
18	Year of Release		2022
19	Breeder and Maintainer		SARC (OARI)

Table 2. *Mean grain yield (kg/ha) of 14 Fababean genotypes across locations and years.*

Entry	Sinana			Sinja			Agarfa			Mean	Yield Adv. over St. check
	2018	2019	2020	2018	2019	2020	2018	2019	2020		
Shallo x EH98143-1-2-1-0	2183	2188	1855	3708	2028	3822	587	4757	2376	2612	
Shallo x EH00100-2-1-3-0	2227	1351	1325	3472	2061	4292	787	3460	2852	2425	
Shallo x EH00097-2-1-2-0	2150	1745	1512	3954	2185	2815	714	3933	2265	2364	
Shallo x EH00098-7-1-2-0	2391	1973	1845	4009	1976	3583	1129	3931	2840	2631	
EK 05024-3	1838	1539	1820	3223	2094	3594	566	3312	2290	2253	
Shallo x EH 99019-5-2-2-0	1931	1848	2560	3975	1894	4273	1147	4129	2530	2699	
Shallo x EH00102-5-5-1-0	2010	1605	1464	3301	1815	3432	691	2860	2496	2186	
Shallo x EH00100-2-2-4-0	2592	2066	1733	3955	1908	3683	747	3724	2775	2576	
EK 06027-2	2178	2553	2996	3373	2762	3527	445	3460	3029	2703	
EK 06007-2 (Besmena)	*3390*	*2935*	*3187*	*4123*	*2691*	*4226*	*1725*	*4498*	*3108*	*3320*	*14.97%*
EK 06007-4	1764	2145	2946	3394	1842	2896	443	3399	2764	2399	
Mosisa	2310	1973	2558	3911	1770	4011	1205	3342	2694	2642	
Shallo	3011	2019	2846	3899	2361	3923	1461	3567	2923	*2890*	
Local check	2161	1703	1265	1879	1980	3793	705	2736	2578	2089	
Mean	2295	1975	2137	3584	2062	3707	882	3702	2680	2556	
5%LSD	544.1	445.5	460.7	1014.0	620.2	965.6	281.5	1026.0	728.0	485	
CV	17.0	16.0	20.0	19.0	21.0	18.0	26.0	19.0	19.0	21.7	

Table 3. *Mean seed yield and other Agronomic traits of 14 faba bean genotype tested in Regional Variety Trial combined at Three sites (Agarfa, Sinja and Sinana) over three years 2018 – 2020.*

Entry	DF	DM	Stand (%)	PH (cm)	Disease score (1-9 scale)			NPP	NSPP	TSW (g)	SY (kg/ha)
					Rust	Chs	AsB				
Shallo x EH98143-1-2-1-0	58	138	80	117	7	7	5	14	2	543	2612
Shallo x EH00100-2-1-3-0	58	137	79	113	7	7	5	12	2	499	2425
Shallo x EH00097-2-1-2-0	59	138	80	115	7	7	4	12	2	526	2364
Shallo x EH00098-7-1-2-0	58	138	79	116	5	6	5	12	3	524	2631
EK 05024-3	58	138	78	115	7	5	5	13	3	627	2253
Shallo x EH 99019-5-2-2-0	58	138	79	115	7	7	4	13	3	522	2699
Shallo x EH00102-5-5-1-0	58	138	81	118	7	7	5	11	3	593	2186
Shallo x EH00100-2-2-4-0	58	138	81	120	6	6	5	13	2	566	2576
EK 06027-2	60	139	82	120	5	4	4	10	3	699	2703
EK 06007-2 (Besmena)	*59*	*139*	*81*	*117*	*4*	*4*	*3*	*10*	*3*	*754*	*3320*
EK 06007-4	60	140	80	119	5	6	5	10	3	733	2399
Mosisa	58	139	80	119	5	4	5	13	2	489	2642
Shallo	58	139	80	121	5	5	4	13	3	488	*2890*
Local check	58	138	79	118	7	7	5	14	2	451	2089
Mean	58	138	80	118				12	3	572	2556
5%LSD	1.7	1.8	3.5	11.9				3.3	0.3	38.0	485
CV	6.3	2.8	9.6	21.9				22.3	21.4	14.3	21.7

Note: DF = days to 50% maturity, DM, days to 90% maturity, PH = plant height (cm), Chs = Chocolate spot, AsB= Aschocyta Blight, NPP= Number of pods per plant, NSPP= Number of seed per pod, TSW= Thousand seed weight (g), SY = Seed yield (kg).

Table 4. *Mean seed yield, agronomic traits and disease reaction of 'Besmena' along with standard and Local checks tested in two environments at varietal verification levels during 2018-2020 cropping seasons.*

Entry	Agronomic traits								Disease Reaction (1-9)		
	DF	DM	Stand%	PH (cm)	NPP	NSPP	TSW (g)	SY (kg/ha)	Rust	Chs	AsB
EK 06007-2	59	139	81	117	10	3	754	3320	4	4	3
Mosisa	58	139	80	119	13	2	489	2642	5	4	5
Shallo	58	139	80	121	13	3	488	2890	5	5	4
Local check	58	138	79	118	14	2	451	2089	7	7	5

Note: DF = days to 50% maturity, DM, days to 90% maturity, PH = plant height (cm), Chs = Chocolate spot, AsB= Aschocyta Blight, NPP= Number of pods per plant, NSPP= Number of seed per pod, TSW= Thousand seed weight (g), SY = Seed yield (kg).

6. Conclusion

"Besmena" produced high yield, and it had a more stable performance in seed yield over locations and years than the standard check varieties. The variety is moderately resistant to major Fababean disease such as, chocolate spot, Rust and Aschochyta blight. Besmena have light green seed color with better yield stability than the check variety (Shallo and Mosisa). This variety was the top yielding in most of the testing locations with an overall average grain yield of 3320 kg $ha^{-1.}$ Besmena had yield advantage of 14.97% over the standard checks; Shallo variety. Therefore, wide cultivation of Besmena variety will boost productivity and marketability of the crop and improve farmers' income.

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