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Evaluation of Recently Released Common Bean (Phaseolus vulgaris L.) Varieties in Kafa and Sheka Zones, South Western Ethiopia

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ABSTRACT

Common bean (Phaseolus vulagris L.) is a very important legume crop grown worldwide and it is one of the most important and widely cultivated crops in Ethiopia. A field experiment was conducted on farmer's field of Yeki and Gimbo districts of Sheka and Kafa zones, respectively in South Nation, Nationalities and peoples' region (SNNPR). The objective of the study was to select the best performing common bean varieties that will increase productivity and production of common in the target areas. Nine improved common bean varieties, namely Dame, Dimtu, Dinknesh, Katb-B9, Melka-Dima, Nasir, Sab632, Ser119 and Ser125 were used for this study. The experiment was carried out using a randomized complete block design (RCBD) with three replications in 2018 growing season under rain fed condition. Significant location difference (P<0.001) were observed for all parameters except hundred seed weight and grain yield. The variety x location interaction was significant (P<0.001) only for days to flowering, plant height and grain yield. Among the tested varieties, SER119 variety matured relatively early (81 days). The highest grain yield per hectare was obtained from variety Nasir (2929.75 kgha-1) followed by variety SER119 (2799.50 kgha-1) and variety Dinknesh (2476.71 kgha-1) whereas the lowest yield was harvested from variety Sab632 (1491.60 kgha-1). Therefore, Nasir, Ser119 and Dinknesh varieties can be recommended as promising varieties to be promoted in the study areas.

Key words: *Common bean; Evaluation; Phaseolus vulgaris; Varieties*

Introduction

Common bean (Phaseolus vulagris L), also known as dry bean or haricot bean, is the most widely distributed Phaseolus species as it is grown across all the continents with a broad range of adaptation to various environmental conditions. It is a very important legume crop grown worldwide and it is one of the most important and widely cultivated crops in Ethiopia [1]. It is grown predominantly under small holder producers as an important food crop and source of cash. It is cultivated primarily for dry seeds, green pods (as snap beans) and green-shelled seed. It is the second most important source of human dietary proteins and the third most important source of calories [2]. According to Miklas et al. this crop has a high nutritional value with important protein contents (~22%), minerals (calcium, copper, iron, magnesium, manganese, zinc), and vitamins necessary to warrant the food security of people in the developing countries [3]. High in nutrients and commercial potential, common bean holds large guarantee for combating hunger, increasing income and improving soil fertility.

There are wide ranges of common bean types grown in Ethiopia including mottled, red, white and black varieties [4]. The most commercial varieties are pure red and pure white color beans and these are becoming the most commonly grown types with increasing market demand [5]. Common bean production is heterogeneous in terms of ecology, cropping system and yield [6]. It grows in most of the agro-ecology zones of low and mid altitude areas of the country. Common bean is very preferred by Ethiopian farmers because of its fast maturing attributes that enables households to get cash returns essential to pay for food and other household needs when other crops have not yet matured [7].

Gimbo and Yeki districts in respective zone of Kafa and Sheka are suitable for growing common bean in south western Ethiopia. However, the lack of improved varieties of common bean is the major problem that plays a great role for the

lower yield of the crop in the study area. Therefore, there is need to introduce the improved common bean varieties released in Ethiopia to the target area in order to improve the productivity of the crop in the study area. Therefore, the study was initiated with the objective of selecting the best performing common bean varieties in the study area in terms of seed yield and related attributes.

Materials and Methods

Description of the experimental area

The study was carried out at two locations, Yeki (Sheka zone) and Gimbo (Kafa zone) in South Nation, Nationalities and peoples Region (SNNPR). Yeki district is located at about ~600 km southwest from Addis Ababa and geographically pointed at 7º3' 42'' N latitude and 35º18' 35'' E longitude with altitude of 1200 m.a.s.l. Gimbo district is located at ~400 km southwest from Addis Ababa, at 7º20′ 52''N latitudes and 36º10′ 38″ longitudes with an altitude of 1450 m.a.s.1.

Experimental materials and design

The experiment was laid in a randomized complete block design (RCBD) with three replications. Nine improved common bean varieties, namely Dame, Dimtu, Dinknesh, Katb B9, Melka-Dima, Nasir, Sab632, Ser119 and Ser125 were used in the study. The varieties were obtained from Melkassa Agricultural Research Center. The plot size was 2 x 2.4 m (six rows of two-meter length) with harvestable plot size of 1.6 x 2 m and a spacing of 0.40 m between rows and 0.10 m between plants was maintained. The spacing between replications, and plots within each block was 1.5 and 0.5 m, respectively. NPS fertilizer at the rate of 100 kg/ha was applied at the time of sowing. Weeding and other agronomic practice were conducted based on production package.

Data collection

Traits such as days to flowering and days to maturity were recorded. Days to flowering was recorded by counting the number of days after emergence when 50% of the plants per plot had the first open flower. Days to maturity was recorded when 95% of pods matured per plot. Plant based data were collected from five randomly selected plants from four central rows, the first row and sixth rows excluded as border effect, to determine plant height and yield components like pods per plant and seed per pod. 100 seed weight was determined by taking a random sample of 100 seeds from the harvested yield of a plot. Four central rows were harvested for determination of grain yield and adjusted to 12% moisture content.

Data analysis

Collected data were subjected to the analysis of variance (ANOVA) using the statistical Software program of R, version 3.3.4 [8]. Mean separation was carried out to determine significant differences among varieties using Fisher's Least Significant Difference (LSD) test at 5% probability level and Coefficient of Variance (C.V) was calculated to reveal the relative measure of variation that exists within data. Data from both locations were combined after testing for ANOVA assumptions such as, normality and homogeneity.

Results and Discussion

Analyses of variance revealed significant varietal differences ($P<0.001$) in days to flowering, days to maturity, plant height, number of pods per plant, number of seeds per pod, hundred seed weight and grain yield (Table 1). Significant variety differences ($p<0.001$) were observed for all parameters. The variety x location interaction was significant ($p<0.01$) only for days to flowering, plant height and grain yield (Table 1). This significant difference of variety × location interactions indicate differential response of varieties to different agro ecologies for these characters while, days to maturity, number of pods per plant, number of seeds per pod and hundred seeds weight showed stability among the both locations (Table 1).

Based on combined mean separation, the highest days to 50% flowering (46.16 days) was obtained for variety Dame followed by Dinkinesh (43.83 days) and the lowest days to 50% flowering was obtained for variety Ser125 (41.16 days) followed by Ser119 (41.50 days), Nasir (41.67 days) and Dimtu (41.67 days). The highest days to 90% maturity was obtained for variety Dame (89.67 days) followed by Katb-B9 (85.00 days) and the lowest days to 90% maturity was obtained for variety Ser119 (81 days) followed by Nasir (82 days) which indicated that Ser119 and Nasir were matured earlier (Table 2). The highest plant height was recorded for variety Dame (57.56 cm) followed by Nasir variety (57.40 cm) and the lowest plant height was recorded for Katb-b9 variety (41.96 cm). The highest number

Table 1: Mean square values of Combined ANOVA for grain yield and agronomic data of common bean varieties at Yeki and Gimbo districts of Sheka and Kafa zones, SNNPR.

SOV	DTF	DTM	PH	NPPP	NSPP	HSW	YLD (kgha^{-1})
Variety	14.41***	39.00***	242.3 ***	43.88***	1.80***	143.125***	1561113***
Rep	3.556	4.222	454.4	0.01	0.0161	18.769	807647
Loc	118.51***	143.40 ***	7198.00***	851.25***	3.63**	11.02^{ns}	16299^{ns}
Variety*Loc	0.76*	2.65^{ns}	85.4*	14.45^{ns}	0.22^{ns}	16.03^{ns}	1109454**
Residuals	2.50	4.53	30.4	6.68	0.30	15.45	281887

SOV= Source of variation, DTF= Days to flowering, DTM= Days to maturity, PH= plant height, NPPP= number of pod per plant, NSPP= Number of seed per pod, HSW= Hundred seed weight, YLD (kg/ha^{-1}= Yield in kilogram per hectare, NS= Non-significant, *= Significant at the 0.05 level, **= Significant at 0.01 level, ***= Significant at 0.001 level

Table 2: Combined mean of grain yield and agronomic data of common bean varieties tested at Yeki and Gimbo districts of Sheka and Kafa zones, SNNPR.

No	Variety	DTF	DTM	PH	NPPP	NSPP	HSW(gm)	YLD(kgha^{-1})
1	Dame	46.16^{a}	89.67^{a}	57.56^{a}	16.40^{de}	3.24^{e}	36.81^{a}	1672.63^{c}
2	Dimtu	41.67^{c}	82.00^{cd}	55.65^{a}	22.46^{ab}	4.66^{ab}	26.26^{d}	2471.41^{ab}
3	Dinknesh	43.83^{b}	83.50^{bc}	56.13^{a}	26.26^{a}	4.55^{ab}	27.53^{cd}	2476.71^{ab}
4	Katb-B9	42.66^{bc}	85.00^{bc}	41.96^{d}	17.33^{cde}	3.87^{cde}	33.58^{ab}	1726.12^{c}
5	M.Dima	42.67^{bc}	84.43^{b}	45.73^{cd}	17.40^{cde}	3.71^{de}	37.38^{a}	2367.31^{ab}
6	Nasir	41.67^{c}	82.00^{cd}	57.40^{a}	25.46^{a}	4.98^{a}	31.48^{bc}	2929.75^{a}
7	Sab632	42.67^{bc}	83.16^{bcd}	42.70^{cd}	14.33^{e}	3.76^{cde}	36.21^{a}	1491.60^{c}
8	Ser119	41.50^{c}	81.00^{d}	48.90^{bc}	21.90^{abc}	4.36^{abc}	28.10^{cd}	2476.50^{a}
9	SER125	41.16^{c}	82.33^{cd}	53.90^{ab}	19.26^{bcd}	4.20^{bcd}	24.65^{d}	2088.30^{bc}
10	Means	42.67	83.55	51.10	20.10	4.15	31.33	2224.79
11	CV (%)	3.70	2.54	10.80	14.03	13.31	12.54	23.86
12	LSD(P ≤ 0.05)	1.85	2.49	6.47	4.88	0.64	4.61	622.94

of pods per plant was obtained from Dinkinesh (26.26 pods/plant), while the lowest number of pods per plant was obtained for Sab632 (14.33) followed by Dame (14.40). Maximum number of seeds per pod was noted in Nasir variety (4.98), whereas, the lowest number of seeds per pod (3.24) was obtained for Dame Variety. The highest hundred seed weight was recorded for Melka dima variety (37.38 gm) followed by Dame (36.81 gm) whereas the lowest was recorded for Ser125 (24.65 gm). Grain yield was ranged from 1491.60 kg ha^{-1} (variety Sab 632) to 2929.70 kg ha^{-1} (variety Nasir). Therefore, the maximum grain yield ((2929.70kg ha^{-1}) was recorded for variety Nasir followed by Ser119 (2476.50 kg ha^{-1}) and Dinknesh (2476.71kg ha^{-1}). The existence of genotypic variation in grain yield and yield components of common bean has been reported by various authors, reported that, wide genetic variation in yield and its related traits among different common bean varieties [9].

Conclusion

Testing of improved varieties is the best technology to improve productivity of the crop. Based on the results of this study, significant varietal differences (P<0.001) were observed in days to flowering, days to maturity, plant height, number of pods per plant, number of seeds per pod, hundred seed weight and grain yield. There were also significant location differences for most of parameters. The variety x location interaction was significant for days to flowering, plant height and grain yield. Among the tested varieties, SER119 variety relatively matured early (81 days). The highest grain yield per hectare was recorded for variety Nasir (2929.75 kgha^{-1}) followed by variety SER119 (2799.50 kgha^{-1}) and variety Dinknesh (2476.71 kgha^{-1}). Therefore, Nasir, Ser119 and Dinknesh varieties can be recommended as promising varieties and to be promoted in the study areas.

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