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Full Length Research

Performance evaluation of common bean [*Phaseolus vulgaris (*L.)] varieties for yield and yield components at Jinka, Southern Ethiopia

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ABSTRACT: A field experiment was conducted on the research field of Jinka Agricultural Center, South Omo Zone, Southern Ethiopia using eighteen improved common bean [*Phaseolus vulgaris* (L.)] varieties under rainfed conditions from 2019 to 2020 main cropping seasons. The objective of the study was to select the best performing common bean varieties in the target areas. The common bean varieties were eight red types, five speckle/mottled, and five white/creamy (SER125, DRK, DAB107, ROR1, KATB9, Remede, Hawassa Dume, Tatu, SAB632, Redwolyita, GLP2, Deme, Brazil2, KATB 1, Awash Metene, SAB736, Awash2, Wajo). The experiment was carried out using a randomized complete block design (RCBD) with three replications. The combined analysis of variance results showed that there were significant differences observed among the common varieties for all the studied traits. Based on the pooled mean over years, the seed yield ranged from 1338.867 kg ha^{-1} for the variety DAB107 to 3069.867 kg ha^{-1} for the variety SER125. The maximum seed yields of 3069.867 kg ha^{-1} for the variety SER125, 2845.600 kg ha^{-1} for the variety Deme, and 2825.267 kg ha^{-1} for the variety Tatu. The grain yield advantages of 45.46, 41.16, and 40.73% were obtained from the improved varieties SER125, Deme, and Tatu, respectively over the standard check variety namely Hawassa Dume. Therefore, the common bean varieties such as SER125, Tatu, and Deme could be recommended for the study area and other similar agro-ecologies, however, further research should be done to put the recommendation on a strong basis.

Keywords: Common bean, grain yield, varieties, yield components.

INTRODUCTION

Common bean [*Phaseolus vulgaris* (L.)] is the most important food legume in the world (CIAT, 2001). It is the most important food legume in Latin America and East and Southern Africa. Common bean is a traditional crop of the neotropics, where it was domesticated several thousand years ago (Freytag and Debouck, 2002). Though the total world production of the common bean could not be calculated with certainty due to confusion with other legumes in some of the data, estimated between 11 and 12 million tons (FAO, 2006). The total common bean production in sub-Saharan Africa is around 3.5 metric tons with 62% of production in East African countries of Burundi, DR Congo, Ethiopia, Kenya, Rwanda, Tanzania, and Uganda, making this the most important region for the crop within the African continent (Broughton et al., 2003). Common bean is a major grain legume that is consumed worldwide for its edible seeds and pods. Accordingly, sub-Saharan African (SSA) is the second-largest consumer of common bean, after Latin America and the Caribbean region, although its per capita consumption remained constant in the past three decades (FAOSTAT, 2020). It is playing a crucial role across the world mainly in the warm

and lowland areas of the country including Ethiopia (Temesgen and Zewdu, 2021). As suggested by Alemu (2017), the common bean is the third most important source of calories after maize and cassava, serving millions of low-income households. Additionally, it is an important component of the traditional cropping system in developing countries, especially in sub-Saharan African (SSA) (Nassary et al., 2020).

Common bean is the most important grain legume for human consumption. Given that most protein consumed by the poor is from plant sources, being protein-rich, beans play an especially significant role in the human diet. Although far less important than cereals as a source of calories, beans supply a significant proportion of carbohydrates. Like other legumes, they are also a key source of minerals; especially iron. Common bean is an important income source; its straw serves as feed for livestock, and also improves soil fertility by its virtue of nitrogen fixation in the cropping system. Although the potential yield of beans is as high as 5 tons ha^{-1} (Graham and Ranalli. 1997), the average yield of local bean varieties in the study area is very low.

In Ethiopia, generally, legumes are the major sources of protein where common bean accounts for the largest proportion next to faba bean and field pea. It is one of the major grain legumes widely cultivated and grown as a source of protein and cash by smallholder farmers in Southern Ethiopia. Even if its production is concentrated in low land areas, but the extent of production of common bean in the target area especially in the South Omo Zone is with the use of farmers' variety rather than the improved varieties so far. The lack of improved varieties of common bean is the bottleneck, and also one of the top problems for the low yield of the common bean in the study area. Therefore, the need to introduce the improved common bean varieties to the target area is paramount important to come up with improved productivity in the study area. To this end, this research is initiated to select the best performing common bean varieties in the study area.

MATERIALS AND METHODS

Description of the study area

The experiment was conducted at the research farm of Jinka Agricultural Research Center located 729 km southwest of the capital Addis Ababa at E 36° 33' 02.7" longitude and N 05° 46' 52.0" latitude and an altitude of 1383 meters above sea level. The long-term weather data for the center revealed that the maximum and minimum monthly average temperature of the main center is 27.55 and 16.55°C, respectively; whereas, the maximum and minimum monthly average temperature of the growing period was 26.61 and 16.94°C, respectively. The long-term rainfall data for the area revealed that the mean annual rainfall of the area is 1274.67 mm; while the mean monthly rainfall of the area for the growing season was 130.38 mm.

Treatments and experimental design

The experiment consisted of eighteen improved common bean varieties were obtained from Awassa Agricultural Research Center, Hawassa, Ethiopia, and Melkassa Agricultural Research Center, Adama, Ethiopia. Out of these, eight red types, five speckle/mottled, and five white/creamy (SER125, DRK, DAB107, ROR1, KATB9, Remede, Hawassa Dume, Tatu, SAB632, Redwolyita, GLP2, Deme, Brazil2, KATB 1, Awash Metene, SAB736, Awash2, Wajo). The field experiment was laid out in a randomized complete block design (RCBD) with three replications. Common bean was sown in six rows per plot with a spacing of 40 cm between rows and 10 cm between plants within a row with a gross plot area of 4.8 m^2.

Data collection

Crop phenological data such as days to maturity was recorded. Days to maturity were recorded when 90% of pods matured per plot. Four central rows were harvested for the determination of grain yield. Grain yield was adjusted to 12.5% moisture content. Five plants were randomly selected from the four central rows to determine yield and yield components, which consisted of the number of pods per plant and the number of seeds per pod. Pod number per plant was determined by counting pods of the five randomly selected plants while the number of seeds per pod was recorded by counting the total number of seeds in a pod from ten randomly sampled pods taken from the five randomly selected plants.

Data analysis

Analysis of variance was performed using the R Statistical Software Version 3.4.2. Effects were considered significant in all statistical calculations if the p-values were $\leq$0.05. Means were separated using Fisher's Least Significant Difference (LSD) test. For combined analysis of variance, homogeneity of error variance was tested by the F-max method of Hartley (1950).

RESULTS AND DISCUSSION

The combined analysis of variance results over years showed that there were very highly significant differences observed among the common bean varieties for days to maturity, the number of branches per plant, plant height, the number of pods per plant, the number of seeds per pod, 100 seed weight, and grain yield (Table 1). This

Table 1. Combined values for mean square of growth parameters, yield components and grain yield of common bean at Jinka, from 2019 to 2020.

Source of variations	No	DM	BN	PHT	PPP	SPP	HSW	GY
Rep	2	9.152*	0.01525ns	71.327**	0.2592^{ns}	0.2592^{ns}	2.553^{ns}	568431**
Variety	17	46.832***	1.15183***	161.282***	3.5611***	3.5611***	194.151***	1817148***
Year	1	3.865^{ns}	0.74186^{ns}	13.448^{ns}	0.6713^{ns}	0.9479^{ns}	4.844^{ns}	4303ns
Variety*year	17	0.141^{ns}	0.05779^{ns}	0.565^{ns}	0.0581^{ns}	0.0717^{ns}	0.076^{ns}	4529ns
Year Rep)	2	0.165^{ns}	0.03377^{ns}	0.896^{ns}	0.0195^{ns}	0.0468^{ns}	0.049^{ns}	4605ns
Residuals	68	3.668	0.10142	12.299	0.9215	0.2272	2.419	94844

Note that: *, ** and *** indicate significance at p< 0.05, p< 0.01 and p< 0.001, respectively and 'ns' indicate non-significant, DF= degree of freedom, DM = date of maturity, PHT= plant height (cm), BN= number of branches per plant, PPP= pods per plant, SPP= seeds per pod, HSW= 100 seeds weigh (g) GY= Grain Yield (kg ha^{-1}).

finding is in agreement with the previous results of Tekle et al. (2014), Gereziher et al. (2017) and Dembele and Ashenafi (2018) who reported that there were significant differences observed among the common bean varieties for yield and yield-related traits.

The result also showed that significant differences were observed among the common bean varieties for days to maturity (Table 1). This finding is in agreement with the previous works (Tekle et al., 2014; Gereziher et al., 2017; Dembele and Ashenafi, 2018; Yohannes et al., 2020; Temesgen and Zewdu, 2021). The number of days to attain physiological maturity ranged from 86.25 days for the variety Wajo to 95.88 days for the variety ROR1 (Table 2). On the contrary, Temesgen and Zewdu (2021) reported that days to maturity ranged from 59.67 days for the variety KATB-9 to 69.33 days for the variety Nasir at Meiso, Ethiopia.

The combined analysis of variance result exhibited that significant differences were observed among the common bean varieties for the number of branches per plant (Table 1). The number of branches per plant ranged from 1.00000 for the varieties DAB107 and Red-Wolaita to 2.443333 for the variety ROR1 (Table 2).

The result also depicted that significant differences were observed among the common bean varieties for plant height (Table 1). Similar results were reported by the previous works of Gereziher et al., (2017), Dembele and Ashenafi (2018), and Yohannes et al. (2020). On the contrary, Temesgen and Zewdu (2021) reported that there were no significant differences observed among the common bean varieties for plant height. In this study, plant height ranged from 37.33000 (cm) for the variety Red-Wolaita to 56.99667 (cm) for the variety ROR1 (Table 2). Also, Yohannes et al. (2020) reported that among the 33 common bean genotypes, plant height ranged from 25.7 cm for the variety NVA 682 to 56.3 cm for the variety Vasir at Areka, Ethiopia.

In this study, there were significant differences observed among the common bean varieties for the number of pods per plant (Table 1). This finding is in agreement with the reports of Tekle et al. (2014) Gereziher et al. (2017), Dembele and Ashenafi (2018), Yohannes et al. (2020) and Temesgen and Zewdu (2021). The number of pods per plant ranged from 8.853833 for the variety KATB9 to (15.333333) for the variety Remeda (Table 2). Similarly, Yohannes et al. *(*2020) reported that the number of pods per plant ranged from 5.33 for the variety Tatu to 22.67 for the variety SEC 20 at Areka, Ethiopia.

The result showed that there were significant differences observed among the common bean varieties for the number of seeds per pod (Table 1). This finding is in line with the reports of Tekle et al. (2014), Gereziher et al. (2017), Dembele and Ashenafi (2018) and Yohannes et al. (2020). The number of seeds per pod ranged from (4.244383) for the variety Awash-2 to 6.688333 for the variety Remeda (Table 2). Similarly, Yohannes et al. *(*2020) reported that the number of seeds per pod ranged from 3.01 for the variety SAB-735 to 5.72 for the variety SEC 20 at Areka, Ethiopia.

The analysis of variance result showed that there were significant variations observed among the common bean varieties for hundred seeds weight (Table 1). This finding is in agreement with the previous reports of Tekle et al. (2014), Gereziher et al. (2017), Dembele and Ashenafi (2018) and Yohannes et al. (2020). The values for 100 seed weight in gram ranged from 38.00000 for the variety GLP2 to 59.25833 for the variety Tatu. Correspondingly, Yohannes et al. (2020) reported that the values for hundred seed weight ranged from 13.67 g for the variety Awash Melka to 48.67 g for the variety Deme at Areka, Ethiopia.

Table 2. Combined results of mean values of growth parameters, yield components, and grain yield of common bean at Jinka from 2019 to 2020.

Varieties	DM	BN	PHT	PPP	SPP	HSW	GY
SER125	92.53333^{bcd}	1.675^{cde}	49.26667^{cde}	13.232667^{cd}	5.057217^{ef}	51.60833^{c}	3069.867^{a}
DRK	88.63333^{f}	1.165^{fg}	46.08833^{efgh}	11.388333^{efg}	4.333333^{h}	44.94333^{fgh}	1343.800^{g}
DAB107	88.32333^{fg}	1.00000^{g}	42.61000^{ghi}	9.11000^{h}	4.647167^{fgh}	47.44333^{de}	1338.867^{g}
ROR1	95.88333^{a}	2.443333^{a}	56.99667^{a}	10.942000^{fg}	5.916050^{bc}	39.55333^{kl}	1762.650^{def}
KATB9	94.65667^{ab}	1.5500^{bcdef}	47.94333^{def}	8.853833^{h}	4.283267^{h}	43.25000^{hi}	1728.900^{def}
Remede	91.38333^{d}	1.71333^{cd}	50.49833^{cd}	15.333333^{a}	6.688333^{a}	50.41667^{c}	1880.067^{de}
H. Dume	92.81667^{bcd}	1.33333^{efg}	52.99667^{abc}	13.275333^{cd}	5.673333^{cd}	41.69500^{ij}	1674.433^{efg}
Tatu	93.30000^{bcd}	2.2750^{ab}	56.30000^{ab}	15.000000^{ab}	6.463950^{ab}	59.25833^{a}	2825.267^{ab}
SAB632	89.00000^{f}	1.27500^{fg}	46.16500^{efgh}	12.192667^{de}	5.000000^{efg}	48.34100^{d}	1443.000^{fg}
Redwolyita	88.15000^{fg}	1.00000^{g}	37.33000^{j}	11.362667^{efg}	5.280500^{de}	44.44000^{gh}	1652.533^{efg}
GLP2	89.15000^{ef}	1.39000^{def}	46.33000^{efg}	12.020000^{ef}	5.280500^{de}	38.00000^{l}	1506.133^{fg}
Deme	91.30000^{de}	1.275000^{fg}	42.00000^{i}	12.015000^{ef}	4.348200^{h}	45.33333^{fg}	2845.600^{ab}
Brazil2	94.15000^{abc}	2.000000^{bc}	49.16500^{cde}	14.001667^{bc}	6.000000^{bc}	45.33333^{fg}	1672.000^{efg}
KATB 1	88.15000^{fg}	2.00000^{bc}	42.16333^{hi}	15.016667^{ab}	5.000000^{efg}	40.42883^{jk}	2251.267^{c}
Awash metene	88.16500^{fg}	2.000000^{bc}	49.83333^{cde}	12.383333^{de}	5.453767^{cde}	46.34100^{ef}	2609.600^{b}
SAB736	92.16667^{cd}	1.36100^{defg}	51.16500^{cd}	10.510000^{g}	4.470433^{gh}	57.00000b	1435.267^{fg}
Awash2	88.20000^{fg}	1.28050^{fg}	44.33333^{fghi}	9.000000^{h}	4.244383^{h}	46.25833^{ef}	2045.667^{cd}
Wajo	86.25000^{g}	2.00000^{bc}	52.83333^{bc}	14.003333^{bc}	4.349867^{h}	52.17050^{c}	1978.600^{cde}
CV (%)	2.112097	20.06	7.30	7.86	9.27	3.32	15.81
LSD (0.05)	2.206591	0.3669	4.0403	1.10594	0.5491778	1.791981	354.8039

DM = days to maturity, PHT= plant height (cm), BN= number of branches per plant, PPP= pods per plant, SPP= seeds per pod, HSW= 100 seeds weigh (g) GY= Grain Yield (kg ha^{-1}), H. Dume = Hawassa Dume.

The analysis of variance results for mean square revealed that there were significant differences observed among the common bean varieties for grain yield (Table 1). This finding is in agreement with the previous works (Tekle et al., 2014; Gereziher et al., 2017; Dembele and Ashenafi, 2018; Yohannes et al., 2020; Temesgen and Zewdu, 2021). The grain yield ranged from 1339.1 kg ha^{-1} for the variety DAB 107 to 3186.8 kg ha^{-1} for the variety SER125 in 2019 (Table 3). Also, the grain yield ranged from 1339.1 kg ha^{-1} for the variety DAB 107 to 3128.7 kg ha^{-1} for the variety SER125 in 2020 (Table 4). The grain yield over years ranged from 1338.867 kg ha^{-1} for the variety DAB107 to 3069.867 kg ha^{-1} for the variety SER125 (Table 2). Correspondingly, Yohannes et al. (2020) reported that the grain yield of common bean ranged from 1147 kg ha^{-1} for the variety Awash Melka to 4462 kg ha^{-1} for the variety SEC 20; Temesgen and Zewdu (2021) reported that grain yield ranged 1031.33 kg ha^{-1} for the variety Awash-1 to 2620 kg ha^{-1} for the variety SER 125. Therefore, the common bean variety SER 125 gave the maximum grain yield and showed a stable yield performance across years, while the variety DAB 107 gave the minimum grain yield across years.

In this study, the grain yield advantages of 45.46, 41.16 and 40.73% were obtained from the improved varieties SER125, Deme, and Tatu, respectively over the standard check variety namely Hawassa Dume. Based on the overall mean performance and yield advan-tages, the best performing varieties such as SER125 (3069.867 kg ha^{-1}), Deme (2845.600 kg ha^{-1}), and Tatu (2825.267 kg ha^{-1}) would be recommended even though

Table 3. Mean values of growth parameters, yield components and grain yield of common bean at Jinka in 2019.

Varieties	DM	BN	PHT	PPP	SPP	HSW	GY
SER125	94.980^{ab}	1.8833^{abc}	50.200^{abc}	13.440^{abcd}	5.1100bc	45.220^{fghi}	3143.9^{a}
DRK	88.733^{cde}	1.3300^{cd}	46.510^{abcd}	11.443^{cdefg}	4.3333c	51.883^{cd}	1386.8^{d}
DAB107	88.547^{cde}	1.0000^{d}	42.553^{bcd}	9.220^{fg}	4.6633bc	47.553^{defg}	1339.1^{d}
ROR1	96.433^{a}	2.5533^{a}	57.327^{a}	11.107^{defg}	5.9967ab	39.773^{jk}	1763.0^{cd}
KATB9	92.533^{ab}	1.5500^{bcd}	48.220^{abcd}	8.887^{g}	4.4400c	43.500^{ghij}	1729.1^{cd}
Remede	91.433^{bcd}	1.7733^{abcd}	50.663^{abc}	15.333^{a}	6.6667a	50.500^{cde}	1880.1^{cd}
H. Dume	92.967^{abc}	1.3333^{cd}	53.327^{ab}	13.440^{abcd}	5.6667abc	42.057^{hijk}	1674.5^{d}
Tatu	93.600^{abc}	2.3300^{ab}	56.600^{a}	15.000^{ab}	6.6667a	52.330^{bc}	1978.9^{bc}
SAB632	89.000^{bcd}	2.5533^{a}	46.330^{abcd}	12.330^{bcde}	5.6667abc	48.660^{cdef}	1443.0^{d}
Redwolyita	88.300^{de}	1.3300^{cd}	37.660^{d}	11.660^{cdefg}	6.6700a	38.000^{k}	1652.8^{d}
GLP2	89.300^{bcd}	1.0000^{d}	46.660^{abcd}	12.000^{cdef}	5.0000bc	44.660^{fghi}	1506.2^{d}
Deme	91.600^{abcd}	1.6600^{bcd}	42.000^{cd}	12.000^{cdef}	4.6600 bc	45.500^{fghi}	2825.4^{ab}
Brazil2	94.300^{abc}	1.3300^{cd}	49.330^{abc}	14.000^{abc}	6.0000ab	45.500^{fghi}	1672.0^{d}
KATB 1	88.300^{cd}	1.0000^{d}	42.660^{bcd}	15.000^{ab}	4.6600bc	40.830^{ijk}	2251.4^{bcd}
Awash metene	88.330^{cd}	1.6600^{bcd}	51.000^{abc}	12.600^{abcde}	5.6600abc	46.660^{efgh}	2609.9^{abc}
SAB736	92.660abc	1.6600^{bcd}	51.330^{abc}	10.600^{efg}	4.6600bc	57.000^{ab}	1435.4^{d}
Awash2	88.300^{cd}	1.3300^{cd}	45.000^{bcd}	9.000^{g}	4.3300c	46.500^{efgh}	2845^{ab}
Wajo	86.300^{d}	2.0000^{abc}	53.000^{abc}	14.000^{abc}	4.6600bc	59.500^{a}	2045.8^{bcd}
Mean	90.868	1.6702	48.354	12.281	5.2320	46.979	1954.6
CV (%)	2.15	15.60	7.41	7.5	8.64	3.24	15.50
LSD (0.05)	6.0052	0.8007	11.005	2.8321	1.3896	4.6837	930.72

DM = days to maturity, PHT= plant height (cm), BN= number of branches per plant, PPP= pods per plant, SPP= seeds per pod, HSW= 100 seeds weigh (g) GY= Grain Yield (kg ha^{-1}) H. Dume = Hawassa Dume.

Table 4. Mean values of growth parameters, yield components and grain yield of common bean at Jinka in 2020.

Varieties	DM	BN	PHT	PPP	SPP	HSW	GY
SER125	92.533^{ab}	1.4667^{bc}	48.333b^{cde}	13.0253^{bc}	5.0044^{defg}	51.333^{b}	3128.7^{a}
DRK	88.533^{cde}	1.0000^{c}	45.667^{cdef}	11.3333^{cd}	4.3333^{efg}	44.667^{efg}	1343.7^{g}
DAB107	88.100^{cde}	1.0000^{c}	42.667^{defg}	9.0000^{ef}	4.6310^{efg}	47.333^{de}	1338.7^{g}
ROR1	95.333^{a}	2.3333^{a}	56.667^{a}	10.7773^{de}	5.8354^{abcd}	39.333^{ij}	1762.3^{defg}
KATB9	94.333^{ab}	1.2200^{c}	50.333^{abc}	8.8210^{f}	4.1265^{g}	43.000^{gh}	1786.3^{defg}
Remede	91.333^{bcd}	1.6533^{abc}	52.667^{ab}	15.3333^{a}	6.7100^{a}	50.333^{bc}	1880.0^{defg}
H. Dume	92.667^{ab}	1.3333^{bc}	56.000^{a}	13.1107^{bc}	5.6800^{bcd}	41.333^{hi}	1674.3^{efg}

Table 4. Contd.

Varieties	DM	BN	PHT	PPP	SPP	HSW	GY
Tatu	93.000^{ab}	2.2200^{a}	46.000^{cdef}	15.0000^{a}	6.2579^{ab}	52.011^{b}	2825.1^{ab}
SAB632	89.000^{cde}	1.2200^{c}	37.000^{g}	12.0553^{cd}	5.0000^{defg}	48.022^{cd}	1443.0^{fg}
Redwolyita	88.300^{de}	1.0000^{c}	46.000^{cdef}	11.0653^{d}	5.2310^{cdef}	44.220^{fg}	1652.3^{efg}
GLP2	88.100^{cde}	1.1200^{c}	42.000^{efg}	12.0400^{cd}	5.2310^{cdef}	38.000^{j}	2845.3^{ab}
Deme	91.600^{acde}	1.2200^{c}	49.000b^{cd}	12.0300^{cd}	4.0364^{g}	45.167^{defg}	1506.1^{efg}
Brazil2	91.000b^{cd}	2.0000^{ab}	41.667^{fg}	14.0033^{ab}	6.0000^{abc}	45.167^{defg}	1672.0^{efg}
KATB 1	94.000^{ab}	2.0000^{ab}	48.667^{bcd}	15.0333^{a}	5.0000^{defg}	40.028^{ij}	2251.1^{cd}
A. Metene	88.000^{de}	2.0000^{ab}	51.000^{abc}	12.1667^{cd}	5.2475^{cde}	46.022^{def}	2609.3^{bc}
SAB736	88.000^{de}	1.0620^{c}	43.667^{def}	10.4200^{def}	4.2809^{fg}	57.000^{a}	1435.1^{fg}
Awash2	91.673^{bc}	1.2310^{c}	51.000^{abc}	9.0000^{ef}	4.1588^{g}	46.017^{def}	2045.5^{de}
Wajo	86.200^{e}	2.0000^{ab}	52.667	14.0067^{ab}	4.0397^{g}	59.017^{a}	1978.3^{def}
Mean	90.48	1.504	47.648	12.123	5.044	46.555	1954.285
CV (%)	2.07	24.41	7.200	8.22	9.91	3.406	15.49
LSD (0.05)	3.1117	0.6095	5.6927	1.6539	0.3387	2.6317	502.52

DM = days to maturity, PHT= plant height (cm), BN= number of branches per plant, PPP= pods per plant, SPP= seeds per pod, HSW= 100 seeds weigh (g) GY= Grain Yield (kg ha^{-1}) H. Dume = Hawassa Dume, A. Metene= Awash Metene.

further study should be carried out including some recently released common bean varieties for improved common bean production.

Conclusion and Recommendation

The results of the analysis of variance showed that all the studied were significantly affected by varieties. Based on the pooled mean over years, the seed yield ranged from 1338.867 kg ha^{-1} for the variety DAB107 to 3069.867, kg ha^{-1} for the variety SER125. Generally, based on the pooled mean over years, the maximum seed yields of 2825.267, 2845.60, and 3069.867 kg ha^{-1} were obtained from the varieties Tatu, Deme, and SER125, respectively. The grain yield advantages of 45.46, 41.16 and 40.73% were obtained from the improved varieties SER125, Deme, and Tatu, respectively over the standard check variety namely Hawassa Dume. Therefore, the varieties Tatu, Deme, and SER125 could be recommended for the study area and other similar agro-ecologies, however, further research should be done to put the recommendation on a strong basis.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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