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Evaluation of Common Bean Varieties for Yield and Yield Component in Segen Area Peoples Zone SNNPRS, Ethiopia

Dembele Ersulo* Ashenafi Dana
Southern Agricultural Research Institute, Arbaminch Agricultural Research Center

Abstract
Studies on the evaluation of variety performance provide opportunities to increase productivity of common bean. Therefore, the current study evaluates the performance of varieties on yield and yield components of common bean during the main cropping season of 2015 and 2016 at four locations in Segen Zone,Konso woreda (Southwestern Ethiopia) with the objectives of selecting high yielding common bean varieties those are adapted to the study area. Fifteen released common bean varieties and one local cultivar were planted in randomized complete block design with three replications. The analysis revealed that significant variation for all traits except maturity date. Highest yield obtained from Nasir(2136 kgha^{-1}) and Hawassa dume (1948 kgha^{-1}) followed by Sari (1751 kgha^{-1}) were as at Addis Gebere, high grain yield was obtained from Sari (2227 kgha^{-1}), Hawassa dume (2111 kgha^{-1}) and Dimtu (2073 kgha^{-1}). For average mean yield from overall location, high yield obtained from Hawassa dume (2129 kgha^{-1}) and Nasir (2002 kgha^{-1}) followed by Sari (1989 kgha^{-1}). Results revealed that Hawassa dume, Nasir and Sari were best performed and better adapted varieties than the others respectively. Therefore, the above mentioned varieties are promising varieties for the production area and recommendable for area with similar agro-ecologies.
Keywords: Phaseolus Vulagris L, Evaluation, Grain yield,Varieties.

1. Introduction

Common bean (*Phaseolus Vulagris* L) is an annual crop which belongs to the family Fabaceae. It grows best in warm climate at temperature of 18 to 24oC (Teshale et al., 2005).

Common bean (*Phaseolus vulgaris* L.) is one of the principal grain legumes of eastern and southern Africa, occupying more than 4 million hectare annually and providing food for more than 100 million people (Wortmann *et al.,* 1998). It is the second most important source of dietary protein and the third most important source of calories for lower income African households after cassava and maize (Broughton *et al*., 2003).

In Ethiopia, common bean is grown predominantly under smallholder producers as an important food crop and source of cash. The crop grows well between 1400 and 2000m above sea level. In 2011/12, total common bean production in the country was about 3,878,023.01 quintals (1.77% of the grain production) on approximately 331,708.15 hectares of land (2.74% of the grain crop area) (CSA, 2011).

Access to new and improved agricultural technologies is limited around Konso and the potential of pulse crops is not exploited due to lack of improved varieties and poor management practices. So far, the national and regional research institutions in the country have released many varieties improved for yield and yield related traits. However, these technologies did evaluate for their adaptability potential under this area. Therefore, to overcome the above stated problems and to familiarize smallholder farmers with new technologies, there is need to evaluate widely grown, well-performed common bean varieties to target area. So, this research was initiated with the objective of selecting the high yielding common bean varieties adapted to the study area.

2. Materials and methods

2.1 Description of the study areas

This study was conducted at Addis geber and Arfyde Kebeles of Konso Woreda, in segen Area people's Zone. Mean annual minimum and maximum temperature 27-32^{o}c respectively and dominant soil type of the area is, loam and sandy clay and an elevation of the area was 1400- 2600 masl. The mean annual rain fall varies from 500-1300 mm, with two rainy seasons (bimodal); the belg (short rain season) and meher (main season) and mean annual temperature 27-32^{o}c. The dominant crops growing around the experimental area are teff, sorghum, common bean and pigeon pea (KWARDO, 2015, unpublished).

2.2 Experimental treatments and Design

The experiment consists of fifteen released common bean varieties (H.Dume, Sari, Awash1, Ibado, Omo95, Dimitu, Dinknesh, Dame, Nasir, chore, Cranscope, Argene, DRK, Awash-melka and AFR-702 and one local cultivar as a treatment and arranged in randomized completed block design with three replications. The experimental plot size was 2.4mx3m (7.2m^2) which has 6 rows and 4 central rows were harvested. The spacing between rows and plant was 40cm and 10cm respectively. The fertilizer and seed rate was used as per recommendation and all other necessary cultural and agronomic practices were applied.

2.3 Data collection

Five plants from internal rows were randomly selected and data like, Number of pod per plants and number of seed per pod were recorded. Days to 50% flowering Days to 95% physiological maturity and grin yield were recorded as whole plot base.

2.4 Data analysis

The analysis of variance was done using statistical analysis system, Genstat Software. Mean separation was made and used with Least Significant Difference (LSD) for the comparison among the experimental varieties at 5% probability level.

3. Results and Discussion

The mean value of analysis of variance for yield and yield related traits are presented in Table1 for over locations and Table 2 for Arfyde and Addis Gebere respectively.The analysis of variance revealed that common bean varieties evaluated were significantly different ($p< 0.05$) at both locations and over locations in all parameters except maturity date. At Arfyde highest grain yield obtained from Nasir (2136 $kgha^{-1}$) and Hawassa dume (1948 $kgha^{-1}$) followed by Sari (1751 $kgha^{-1}$) without significant difference between three. Were as at Addis Gebere high grain yield obtained from Sari (2227 $kgha^{-1}$), Hawassa dume (2111 $kgha^{-1}$) and Dimtu (2073 $kgha^{-1}$). But for average mean yield from overall location, high yield obtained from Hawassa dume (2129 $kgha^{-1}$) and Nasir (2002 $kgha^{-1}$) without significant difference between two. Similar study was conducted by Wondimu *et al*, (2018) and high grain yield obtained from Nasir(196.5$kgha^{-1}$).In the contrary, Biru and dereje,(2014) conducted similar study and investigated low yield from Hawassa dume (1150kg). The lowest grain yield is obtained from Argene (1174 $kgha^{-1}$).

Highest number of pod per plant was recorded on Argene (19.26) and Dimtu (15.60). On the other hand the lowest number of pod per plant (8.77and7.93) obtained from DRK at Addis Gebere and Arfyde respectively. This result is in agreement with Gebre-Egziabher *et al*, (2011) lowest pod per plant obtained on DRK (7.21).Number of pod per plant is influenced by growth habit of common bean varieties. For instance, Worku (2008) reported that the indeterminate types of common bean varieas produce higher number of pod per plant compared with determinate type (Worku (2008). At Arfayde, High number of seed per pod obtained from Omo-95(5.35), Dimtu (5.31) and Awash-1(5.23) without significant difference between three. Were as at Addis Gebere, high number of seed per pod obtained from Awash Melka (5.77), Dimtu(5.54) and Argene (5.43) without significant difference between three. On the other hand for over location, highest number of seed per pod obtained from Awash-1 and Awash Mleka for (5.12) The highest number of seed per pod from Awash melka was in line with a previous study by Wondimu *et al*, (2018) who reported highest number of seed per pod obtained from Awash melka (5.45). Tsubo *et al*, (2004) reported that haricot bean varieties exhibited variations in number of seeds per pod. Wondimu *et al*, (2018) reported number of seeds in indeterminate and bush genotypes was superior to semi-climbing types and upright growth habit allows better light distribution throughout canopy of bush type varieties of common bean.

Table 1: The mean of common bean yield and yield component parameters over locations 2015-2016 cropping season

Varieties	FD	MD	NPP	NSP	GY(kgha^{-1})
Awash-1	43.42^{cdef}	84.67	14.10^{abc}	5.12^{ab}	1498^{cd}
Omo-95	45.17^{abcde}	84.25	11.82^{def}	4.95^{abc}	1533^{cd}
H.dume	44.33^{abcde}	84.58	12.1^{bcde}	4.15^{ef}	2129^{a}
Dinknesh	45.92^{a}	87.33	12.70^{cde}	4.92^{abc}	1668^{cd}
Chore	45.92^{a}	86.83	12.62^{cde}	4.41^{cde}	1676^{cd}
Awashmelka	45.58^{abc}	85.67	14.63^{abc}	5.12^{ab}	1724^{cd}
DRK	43.25^{def}	86.33	8.35^{f}	4.06^{ef}	1372^{d}
Dimtu	45.50^{abcd}	86.75	14.15^{abc}	5.43^{a}	1726^{c}
Dame	45.08^{abcde}	86.67	9.58^{ef}	4.09^{ef}	1481^{d}
Local	44.25^{abcdef}	86.92	11.58^{def}	3.78^{f}	1408^{cd}
Sari	45.75^{ab}	86.00	11.10^{def}	4.45^{cdef}	1989^{b}
AFR-702	43.17^{ef}	85.83	10.87^{def}	4.33^{def}	1597^{cd}
Cranscope	43.58^{bcdef}	85.50	10.72^{def}	4.12^{ef}	1663^{cd}
Ibado	42.00^{f}	83.92	11.03^{def}	4.02^{f}	1485^{cd}
Nasir	43.50^{bcdef}	85.92	15.43^{ab}	4.75^{bcd}	2002^{ab}
Argene	44.83^{abcde}	85.50	16.30^{a}	4.75^{bcd}	1174^{e}
CV(%)	6.4	4.7	25.39	15.9	13.26
LSD(%)	3.25	NS	3.71	0.58	5.10
Mean	44.45	85.79	12.32	4.56	16.17

Note: means with the same letters are not significantly different. NSP=number of seed per pod, NPP=number of pod per plant, GY=grain yield in tone per hectare, HSW=hundred seed weight, FD=50% flowering date, MD=90% maturity date, CV=coefficient of variation and LSD=least significance.

Table 2: The mean of common bean yield and yield component parameters at Arfyde and Addis Gebere Kebele 2015-2016 cropping season

	Arfyde					Addis Gebere				
Varieties	FD	MD	NPP	NSP	GY (kgha^{-1})	FD	MD	NPP	NSP	GY (kgha^{-1})
Awash-1	42.83^{def}	83.00	16.61^{b}	5.15^{ab}	1538^{c}	44.00^{bcd}	86.33	11.6^{cdef}	5.09^{cd}	1457^{fg}
Omo-95	44.83^{abcd}	84.00	13.60^{bcd}	5.35^{a}	1514^{cd}	45.50^{abcd}	84.50	10.03^{fg}	4.54^{efg}	1553^{defg}
H.dume	43.17^{cdef}	82.67	12.77^{bcde}	4.25^{cde}	1948^{ab}	45.50^{abcd}	86.50	11.47^{def}	4.05^{g}	2111^{ab}
Dinknesh	45.00^{abcd}	86.83	11.73^{cde}	4.80^{ab}	1538^{c}	46.83^{a}	87.83	13.67^{bc}	5.04^{cd}	1798^{cdef}
chore	45.33^{abc}	86.17	12.30^{cde}	4.17^{cdef}	1372^{cde}	46.50^{ab}	87.50	12.93^{cde}	4.95^{cde}	1981^{cd}
Awashmelka	46.00^{ab}	85.17	14.40^{bc}	4.27^{cde}	1456^{cd}	45.17^{abcd}	86.17	14.87^{b}	5.77^{a}	1991^{c}
DRK	41.83^{ef}	84.83	8.77^{e}	3.93^{def}	1198de	44.67^{abcd}	87.83	7.93^{g}	4.18^{fg}	1546^{defg}
Dimtu	45.83^{ab}	86.00	12.70^{bcde}	5.31^{a}	1480^{cd}	45.17^{abcd}	87.50	15.60^{a}	5.54^{ab}	2073^{ab}
Dame	45.00^{abcd}	85.83	8.90^{e}	3.88^{ef}	1258^{cde}	45.17^{abcd}	87.50	10.27^{efg}	4.30^{fg}	1703^{cdef}
local	47.00^{a}	89.17	13.37^{bcd}	4.52^{bc}	1230^{cde}	43.50^{d}	84.67	9.80^{fg}	3.35^{h}	1586^{defg}
Sari	45.50^{abc}	86.50	11.33^{cde}	4.30^{cdef}	1751^{b}	46.00^{abc}	85.50	10.87^{def}	4.61^{def}	2227^{a}
AFR-702	41.83^{ef}	85.50	9.90^{de}	4.06^{def}	1276^{cde}	44.50^{abcd}	86.17	11.83^{def}	4.60^{def}	1917^{cd}
Cranscope	42.83^{def}	85.00	10.97^{cde}	3.76^{f}	1479^{cd}	44.33^{abcd}	86.00	10.47^{efg}	4.48^{efg}	1846^{cdef}
Ibado	40.83^{f}	82.00	10.00^{de}	3.70^{f}	1465^{cd}	41.17^{e}	85.83	12.07^{cdef}	4.33^{fg}	1505^{efg}
Nasir	43.33^{cde}	85.00	16.80^{b}	4.62^{b}	2136^{a}	43.67^{cd}	86.83	14.07^{bc}	4.87^{cde}	1869^{cde}
Argene	43.67^{bcde}	84.33	19.26^{a}	4.27^{cde}	10.77^{e}	46.00^{abc}	86.67	13.33^{bcd}	5.43^{ab}	1271^{g}
CV(%)	4.7	3.8	24.8	13.5	18.6	5.3	2.7	20.4	9.1	19.8
LSD(%)	2.41	NS	4.225	0.69	3.16	2.79	NS	2.81	0.49	4.02
Mean	44.05	85.12	12.71	4.434	14.70	44.85	86.46	11.93	4.68	17.65

Note: means with the same letters are not significantly different. NSP=number of seed per pod, NPP=number of pod per plant, GY=grain yield in tone per hectare, HSW=hundred seed weight, FD=50% flowering date, MD=90% maturity date, CV=coefficient of variation and LSD=least significance.

The ANOVA result for combined analysis showed significant variation at ($p<0.001$) between treatments for number of seed per pod and number of pod per plant were as Significant variation at ($p<0.05$) level was observed for flowering date and grain yield. There was no significant variation between treatments for maturity date. For location, significant variation at (0.05) level was observed for all parameters except number of pod per plants. For treatment by location interaction significant variation at ($p<0.05$) was observed for only number of seed per pod.

Table 3: Mean Square Values for Yield and Yield Components of Common Bean as Influenced by variety over locations

Sourceof variation	DF	FD	NPP	NSP	MD	GY(kgha^{-1})
Trt	15	17.04*	55.62**	2.52**	12.46^{ns}	581206*
Lo	1	30.88*	29.77^{ns}	2.97*	85.33*	4203496*
Trt*Lo	15	12.347^{ns}	21.74^{ns}	1.33*	12.32^{ns}	251293^{ns}
Error	60	8.150	21.21	0.53	15.97	395772

NSP=seed per pod, NPP=pod per plant, GY(kgha^{-1})=yield in kilogram per hectare, HSW=hundred seed weight, FD=50% flowering date, MD=90% maturity date, *= Significant at 0.05 probability level,**= Significant at 0.01 probability level, NS=non- significant, TRT=treatment, Lo=locations, NSP=number of seed per pod and Npp= number of pod per plants

4. Summery and conclusion

Production of common bean trough adaptation and selecting high yielding, improved varieties could provide an important contribution to change the livelihood of farmers in in areas like Konso where there is low practice of producing improved varieties of common bean. However there is no practice of using improved verities in this area. Thus this research work initiated to identify high yielding common bean varieties those are adapted to the area and disseminate for further production.

Therefore, performance of fifteen released varieties and one local check was evaluated at Konso woreda of Segen Area People Zone during the 2015 and 2016 cropping season. The result of the study generally revealed that significant difference between common bean varieties for their performances with respect to yield and yield components. Varieties Hawassa Dume, Nasir and Sari were best performed varieties than the others respectively. In the experimental area most of the farmers use local cultivar which is low yielder. Therefore, the result clearly show that the use of high yielding varieties such as Hawassa Dume, Nasir, and Sari could be best substitutes for the local check and promising varieties for the production area. Hence, if the above mentioned varieties demonstrated and popularized to the small-scale holder farmers, they can boost the income of poor farmer.

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