International Journal of Science and Qualitative Analysis
2022; 8(1): 18-21
http://www.sciencepublishinggroup.com/j/ijsqa
doi: 10.11648/j.ijsqa.20220801.13
ISSN: 2469-8156 (Print); ISSN: 2469-8164 (Online)

Performance Evaluation of Improved Haricot Bean (*Phaseolus vulgaris* L) Varieties at East Shewa, Mid Rift Valley of Oromia

Urgaya Balcha*, Temesgen Dinsa

Adami Tulu Agricultural Research Center, Batu, Ethiopia

Email address:
urgayab@gmail.com (U. Balcha)
*Corresponding author

To cite this article:
Urgaya Balcha, Temesgen Dinsa. Performance Evaluation of Improved Haricot Bean (*Phaseolus vulgaris* L) Varieties at East Shewa, Mid Rift Valley of Oromia. *International Journal of Science and Qualitative Analysis*. Vol. 8, No. 1, 2022, pp. 18-21.
doi: 10.11648/j.ijsqa.20220801.13

Received: June 29, 2022; **Accepted**: July 29, 2022; **Published**: August 10, 2022

Abstract: Haricot bean (*Phaseolus vulgaris* L.) is one of the most important food legumes of Ethiopia and it is considered as the main cash crop and the least expensive source of protein for the farmers in many lowlands and mid altitude of the country. Low production and productivity, which is mainly associated with lack of access for improved varieties, was one of the major problems. Therefore, to overcome the above stated problems and to acquaint smallholder farmers with new technologies of widely grown pulse crops production, well-performed, adaptable and high yielding haricot bean varieties. Seven haricot bean (*Phaseolus vulgaris* L.) varieties and one local check were evaluated in 2019 and 2020 cropping seasons at Dugda, Lume and Adami Tulu districts of East Shoa zone, Mid rift valley of Oromia. The trial was laid out in the randomized complete block design with three replications. Combined analysis of variance (ANOVA) showed significant variability among varieties for all the parameters studied such as days to heading, days to maturity, number of pods/plant, number of seeds/pod, plant height and seed yield.. The varieties Awash-2 and Sikiya were found to be high yielding varieties with mean seed yield levels of 24.02 and 23.35 qtls ha^{-1}, respectively. Therefore these two varieties are recommended for future use in the study area and similar environments.

Keywords: Haricot Bean, Seed Yield, Variety, Evaluation

1. Introduction

Haricot bean (*Phaseolus vulgaris* L.) is an important pulse crop in Ethiopia and in theworld. The crop ranks first globally while it stands second next to faba bean in Ethiopia [6]. Common bean (*Phaseolus vulgaris* L.) is an annual herbaceous plant domesticated independently in ancient Mesoamerica and in the Andes, and now is grown worldwide for both dry seeds or as a green bean. The importance of the common bean cannot be over emphasized. Apart from providing the subsistence needs such as food to many people in the world, beans are also sold in local markets and urban areas to provide cash to farmers and traders [12]. Of the five domesticated species of Phaseolus, the common bean (P. vulgaris) is the most widely grown, occupying more than 85%ofproduction area sown to all Phaseolus species in the world [3]. It is produced primarily in tropical low-income countries, which account for over three quarters of the annual world production.

Haricot bean (*Phaseolus vulgaris* L.) is one of the most important food legumes of Ethiopia and it is considered as the main cash crop and the least expensive source of protein for the farmers in many lowlands and mid altitude of the country. In Ethiopia, population is growing in more rate than the agricultural production does. To feed this increasing population the agricultural production should grow accordingly with the same pace or even more. Pulses crops are the most important crops in the national strategy of food self-reliance and foreign exchange earnings. Therefore, to increase the productivity of the farmers, it is crucial to

increase the awareness of farmers towards the usage of different improved technologies that increase their production and accelerate food security through proper implementation [10]. The national average productivity of haricot bean is about 18.22 tons ha^{-1} for white haricot bean and 16.79 tons ha^{-1} red haricot bean [2].

Access to new and improved agricultural technologies is limited in East in the study area, most probably due to lack of allowance of our center to do any research on pulse crops including haricot bean and others [11]. Currently there are several new varieties released in our country which are expected to be best for our mandate areas [6]. So far, the national and regional research institutions in the country have released many varieties for commercial Production [1]. However, these technologies did not tested for their adaptabilitypotential under mid rift valley part of Oromia and did not reach the smallholder farmers living in mid rift valley parts of Oromia. Therefore, toovercome the above stated problems and to acquaint small holder farmers with new technologies of widely grown pulse crops production, well-performed, adaptable and high yielding haricot bean varieties.

2. Materials and Methods

Description of the study area: The experiment was conducted at Adami Tulu, Dugda and Lume Districts.

Experimental materials and design: The eight newly released determinate type haricot bean varieties were used. The Randomized Complete Block Design with three replications was used. Experimental unit comprised five rows of 3 meters length with row-to-row distance of 40 cm and plant-to-plant distance of 10 cm.

Table 1. *Lists and descriptions of haricot bean varieties used in the experiment.*

No	Variety	Days to maturity	Areas of adaptation		Yield (tha^{-1})		Released center	Year of release
			Altitude	Rainfall	Research	Farmers		
1	SCR-26-26 (Sikiya)	75-90	1300-1900	500-1100	25-31	18-27	Hawassa	2017
2	DAB-277 (Fetenech)	75-90	1300-1900	500-1100	26	20	Hawassa	2017
3	Gorossa	89	1100-1950	500-850	17-27	17-23	Melkasa	2017
4	Awash Mitin	94	1100-2100	500-1100	20-25	19-23	Melkasa	2017
5	Derash	94	1000-1850	500-750	21	19-21	Melkasa	2017
6	Zoasho (DAB 96)	87	1100-1950	500-850	19-24	21	Melkasa	2017
7	Awash-2						Melkasa	2013
8	Awash-1						Melkasa	1990

3. Data's Collected

Days to flowering: was recorded as the number of days from sowing to when 50% of plants in a net plot produced flower through visual observation.

Days to physiological maturity: This was recorded as the number of days from sowing to the time when about 90% of the plants in a plot had mature pods in their upper parts with pods in the lower parts of the plants turning yellow. The yellowness and drying of leaves were used as indication of physiological maturity.

Plant height: It was measured as the height (cm) of ten randomly taken plants from the ground level to the apex of each plant at the time of physiological maturity from the net plot area and the means were recorded as plant height.

Number of pods per plant: Number of pods were counted from ten randomly taken plants from the net plot area at harvest and the means were recorded as number of total pods per plant.

Number of seeds per pod: It was recorded from ten randomly taken pods from each net plot at harvest.

Grain yield (qt ha^{-1}): The four central rows were threshed to determine seed yield and the seed yield was adjusted to moisture level of 10%. Finally, yield per plot were converted to per hectare basis and the average yield was reported in kg ha^{-1}.

4. Statistical Analysis

All the measured parameters were subjected to analysis of variance (ANOVA) appropriate to factorial experiment in RCBD according to the General Linear Model (GLM) of SAS software (Version 9.3) and the interpretations were made following the procedure described by Gomez. Least Significance Difference (LSD) test at 5% probability level was used for mean comparison when the ANOVA showed significant differences [8].

5. Result and Discussions

5.1. Analysis of Variance

The collected data were analyzed using SAS statistical package software [9]. Analysis of Variance (ANOVA) was done for grain yield and other six yield related traits mentioned below. Mean square of analysis of variance for all genotypes at different environmental conditions for grain yield and yield related traits are presented in Table 2. The combined analysis of variance showed that year and location effects were significant for all parameters. Year*variety effects were highly significant for plant height and grain yield. Loc*Year*Varieties were highly significant for Plant height and grain yield [13]. Location by variety effects were highly significant only for Plant height and non significant for all other traits including yield [14]. This suggests that grain yield of haricot bean varieties did not vary across environmental conditions. [5].

Table 2. *Mean Square values from ANOVA for Haricot bean Parameters.*

	DF	DH	DM	PH	NPB	NPP	SPP	Yld
Rep	2	157.54 ^{ns}	134.89 ^{ns}	103.99 ^{ns}	1.42 ^{ns}	23.20 ^{ns}	1.55 ^{ns}	16.20^{ns}
Loc	2	57.92***	6.27 ^{ns}	2287.13***	7.50***	1095.21***	0.01 ^{ns}	146.35***
Year	1	4.34^{ns}	52.56***	20175.83***	128.82***	160.86*	0.02 ^{ns}	389.10***
Variety	7	145.86***	417.45***	1192.08***	1.08*	346.02***	1.47 ^{ns}	173.20***
Loc*Variety	14	0.70 ^{ns}	0.95 ^{ns}	132.73***	0.50 ^{ns}	33.53 ^{ns}	0.81 ^{ns}	10.96^{ns}
Loc*Year	2	246.59***	20.02*	870.57***	19.32***	639.60***	4.10*	41.50*
Year*Variety	7	1.30 ^{ns}	1.41 ^{ns}	397.40***	0.50 ^{ns}	54.24*	1.17 ^{ns}	39.90**
Loc*Year*Variety	14	1.77 ^{ns}	0.87 ^{ns}	195.02***	0.26 ^{ns}	33.48 ^{ns}	1.30 ^{ns}	12.63^{ns}
Error		6.95	6.70	56.77	0.44	24.91	0.95	10.36
R^2		0.75	0.84	0.88	0.83	0.75	0.40	0.73
CV		5.57	2.85	13.11	17.10	21.50	16.88	15.98
Root MSE		2.63	2.58	7.52	0.66	4.99	0.97	3.21
Mean		47.32	90.64	57.34	3.90	23.2	5.77	20.14

WhereCV=Coefficient of Variation, R^2= R-Square, DF=Degree of freedom, DH= Days to heading, DM=Days to maturity, PH=Plant height in cm, NPB=Number of primary branches, PP=Number of pods per plant, SPP= Number of seeds per pod, Yld= Yield in quintals per hectare.

5.2. Mean Performance of the Varieties for the Characters

Range and mean values for the eight characters are presented in Table 3. The variation with respect to days to heading and days to maturity was ranged from 42.16 to 51.94 and 80.50 to 96.66 respectively, showing a wide range of variation among the varieties for maturity [4]. Based the study result the early maturing variety was Derash and the variety with the longest days of maturity was SCR-26-26 (Sikiya). The plant height ranges from 46.13 (Derash) to 68.00 (Awash-2). The highest number of pods per plant, seeds per pod and yield was recorded by the variety Awash-2. The highest yield was recorded by variety Awash-2 (24.02) followed by Sikiya (23.35) and Awash -2 (25.68), where as the lowest yield was recorded by variety Derash (16.37). This work is in harmony with the finding of [7] who reported that the highest grain yield of Market type haricot bean was recorded for the variety Awash-2 in east Hararghe zone.

Table 3. *Mean Values of each Haricot bean varieties.*

		DH	DM	PH	NPB	NPP	SPP	Yld	Rank
1	SCR-26-26 (Sikiya)	51.94^{a}	96.66 ^{a}	63.63^{ab}	3.62 ^{cd}	20.50 ^{b}	5.85^{ab}	23.35 ^{a}	2
2	Awash-2	47.55 ^{c}	91.11 ^{c}	68.00 ^{a}	3.68^{bcd}	28.92 ^{a}	6.24 ^{a}	24.02 ^{a}	1
3	Awash-1	48.00^{bc}	91.38 ^{c}	64.08^{ab}	3.55 ^{d}	27.41 ^{a}	5.90^{ab}	22.68 ^{a}	3
4	Awash Mitin	46.66 ^{cd}	87.94 ^{d}	58.23 ^{c}	4.00^{abc}	28.80 ^{a}	6.04^{ab}	20.41^{b}	5
5	Derash	42.16 ^{e}	80.50 ^{e}	46.13 ^{d}	4.05^{abc}	18.60 ^{b}	5.66^{ab}	16.37^{b}	8
6	Gorossa	47.55 ^{c}	93.27 ^{b}	49.76 ^{d}	4.11^{ab}	19.63 ^{b}	5.42 ^{b}	17.14^{c}	6
7	Zo-asho	49.33 ^{b}	93.50 ^{b}	60.11 ^{c}	4.06^{ab}	20.18 ^{b}	5.57 ^{b}	20.51^{c}	4
8	DAB-277	45.38 ^{d}	90.77 ^{c}	48.76 ^{d}	4.17 ^{a}	21.62 ^{b}	5.48 ^{b}	16.37^{c}	7

Where DH= Days to heading, DM=Days to maturity, PH=Plant height in cm, NPB=Number of primary branches, PP=Number of pods per plant, SPP= Number of seeds per pod, Yld= Yield in quintals per hectare

6. Summary and Conclusions

Generally, the present study entails the presence of significant variations among Haricot bean varieties. Based on the combined analysis result, the varieties Awash-2 and Sikiya offered better performance over the other varieties regarding seed yield. Accordingly these two varieties are recommended for the study area and similar agro ecologies. Hence if the above mentioned varieties are demonstrated and popularized to the small scale holder farmers and commercial farms they can boost the income of poor farmers and commercial farms.

Acknowledgements

The authors would like to acknowledge AGP-II for funding during 2019/20 and Oromia Agricultural Research Institute (OARI) for funding during 2020/21 and Adami Tulu Agricultural Research Center for facilitating the working conditions throughout the research period.

Appendix

Table A1. *Mean Values of each Haricot bean varieties at each years and Locations.*

	Location	DH	DM	PH	NPB	NPP	SPP	Yld
1	A/Tullu	46.29[b]	90.25[a]	52.35[b]	3.73[b]	28.61[b]	5.78[a]	22.1[a]
2	Dugda	48.47[a]	90.72[a]	65.22[a]	4.36[a]	21.45[a]	5.78[a]	19.58[b]
3	Lume	47.20[b]	90.95[a]	54.45[b]	3.63[b]	19.56[b]	5.75[a]	18.75[c]
	Mean	47.32	90.64	57.34	3.90	23.20	5.77	20.15

Table A2. *Mean Values of each Haricot bean varieties at each years and Locations.*

	Variety	2019			2020			
		A/Tullu	Dugda	Lume	A/Tullu	Dugda	Lume	Com. Mean
1	Awash-1	24.32	26.24	24.54	22.08	20.42	18.49	22.68
2	Awash-2	24.92	26.32	20.36	24.66	24.39	23.47	24.02
3	Awash Mitin	19.54	28.38	14.51	22.45	19.85	17.78	20.42
4	DAB-277	15.90	22.13	14.27	18.47	11.30	17.85	16.65
5	Derash	17.23	17.89	11.74	20.15	15.30	15.96	16.38
6	Gorossa	13.81	21.82	15.81	20.09	14.14	17.22	17.15
7	SCR-26-26	22.74	25.39	22.74	21.51	25.51	22.24	23.36
8	Zo-Asho	19.81	27.25	16.47	23.43	14.43	21.68	20.51
Env. Mean		19.78	24.43	17.55	21.61	18.17	19.34	20.15

References

[1] Arke A, Zeleke F, and Amsalu B. 2016. AMMI and GGEModels Analysis of Stability and GEI of Common Bean (*Phaseolus vulgaris* L.) Lines in Ethiopia. Journal of Biology, Agriculture and Healthcare. 6 (9): 127-135.

[2] CSA (Central Statistics Agency). Agricultural Sample Survey 2019/2020 (2012 E. C.). Report on Area and Production of Major Crops (Private Peasant Holdings, Meher Season). Volume I Addis Ababa, Ethiopia (2020).

[3] Fekadu Gurmu. 2007. Participatory Varietal Selection of Haricot Bean (*Phaseolus vulgaris* L.) Varieties in Umbullo Wacho and Beresa Watersheds in the Southern Region. In: Operational Research and Capacity Building for Food Security and Sustainable Livelihoods. Proceedings of Irish Aid Supported Operational Research Review Workshop 11-13 January 2007. Hawassa University, Awassa, Ethiopia.

[4] Gauch, HG (2006). Statistical analysis of yield trials by AMMI and GGE. *Crop Sci.* 46: 1488-1500.

[5] Gauch, H. G Jr, P. H. Piepho and Annicchiarico P. (2008). Statistical analysis of yield trials by AMMI and GGE: further considerations. *Crop Sci*. 48: 866-889.

[6] MOA (Ministry of Agriculture and rural development). 2020. Animal and Plant Health Regulatory Directorate. Crop Variety Register. Issue No. 23. Addis Ababa, Ethiopia.

[7] Motuma Dalasa, Habte Berhanu and Adugna Hunduma (2020) Adaptation trial of Market Types Common Bean (*Phaseolus Vulgaris*L.) Varieties in Eastern Hararghe Zone, Oromia. In the Proceedings of Review Workshop on Completed Research Activities of Crop Research Directorate held at Adami Tulu Agricultural Research Center, Adami Tulu, Oromia, Ethiopia 2020. pp: 251-56.

[8] R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

[9] SAS., 2003. SAS Online Doc, Version 9.3. SAS Institute Inc., Cary NC., USA.

[10] Shumi D, Alemayehu D, Afeta T, Debelo B. Effect of Phosphorus Rates in Blended Fertilizer (NPS) and Row Spacing on Production of Bushy Type Common Bean (*Phaseolus Vulgaris* L.) at Mid-land of Guji, Southern Ethiopia. J Plant Biol Soil Health. 2018; 5 (1): 7.

[11] Tamene T, and Tadesse S. 2014. Sites Regression GGE Biplot Analysis of Haricot Bean (*Phaseolus vulgaris* L.) Genotypesin three Contrasting Environments. World Journal ofAgricultural Research, Vol. 2 (5), 228-236 Walelign Worku. 2017. Haricot Bean Production Guide: with emphasis on southernEthiopia.

[12] Tadele Tadesse, Gashaw Sefera, Belay Asmare, Amanuel Teklaign. Application of AMMI for Grain Yield Stability Analysis in Large Speckled Bean Genotypes Grown in Midlands of Bale Zone. *Chemical and Biomolecular Engineering*. Vol. 3, No. 3, 2018, pp. 17-21. doi: 10.11648/j.cbe.20180303.11.

[13] Teshale, Assefa, Girma, Abebe, Chemeda, Fininsa, Bulti, Tessoand Abdel-Rahman M. Al-Tawaha. (2005). Participatory Bean Breeding with Women andSmall Holder Farmers in Eastern Ethiopia. *WorldJournal of Agricultural Sciences,* 1: 28-35.

[14] Zeleke Ashango, Sentayehu Alamerew (2017). Seed Yield Stability and Genotype × Environment Interaction in Common Bean (*Phaseolus vulgaris* L.) Varieties in Dawro Zone, Southwestern Ethiopia. GreenerJournal of Plant Breeding and Crop Science, 5 (1): 001 012, http://doi.org/10.15580/GJPBCS.2017.1.08301640.