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Evaluation of improved mung bean (*Vigna radiata* L.) varieties for yield in the moisture stress conditions of Abergelle Areas, Northern Ethiopia

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ABSTRACT: Mung bean (*Vigna radiata* L.) also known as green gram, golden gram, Oregon peas and chokoro (Swahili), is an economically important short duration legume crop for drought prone/ moisture stressed areas. Due to drought escape/early maturity in case of terminal drought in Ethiopia, improvement of grain yield of Mung bean (*Vigna radiata* L.) is the main objective to avoid food insecurity. A field experiment was carried out during the 2016 and 2017 main cropping seasons using a randomized complete block design with three replications in order to evaluate eight characteristics viz., days to 50% flowering, seed filling period, 90% physiological maturity, plant height, number of pod per plant, number of seeds per pod, seed yield and thousand seed weight for six mung bean varieties under rain-fed conditions at Abergelle Agricultural Research Center on station in Ethiopia. Analysis of variance showed that, differences varietal was observed for traits studied ($p \leq 0.05$) except number of pods per plant. The variety Rasa had better performance than the other varieties with the highest seed yield (1776 kg ha^{-1}), while the lowest seed yield was obtained from local Sheraro (889 kg ha^{-1}). Thus, Rasa is recommended as promising variety to the farmers of Abergelle areas.

Keywords: Food security, legume crop, moisture stress, seed yield, *Vigna radiata*.

INTRODUCTION

Mung bean *(Vigna radiate* L.*)* also known as green gram, golden gram, Oregon peas and chokoro (Swahili), is native to Bangladesh, India and Pakistan. Grain legumes are the most important food and feed crops in the semi-arid areas of Ethiopia. Protein rich dry land grain legumes, mainly haricot bean, pigeon pea, cowpeas and mung beans are the other crops used in the strategy for improving food security, improving nutrition and generating income. These crops also contribute to improvement of the natural resource base through addition of organic matter and biological nitrogen fixation. Mung bean is grown widely for use as a human food (as dry beans or sprouts) but can be used as a green manure crop and as forage for livestock (CSA, 2016).

The crop is characterized by fast growth under warm conditions, low water requirement and excellent soil fertility enhancement via nitrogen fixation (Yagoob and Yagoob, 2014). Fertilization of this crop occurs through self-pollination without requirement of other pollinators like insects, water and wind (Rashid et al., 2013). Among legumes, mung bean is noted for its protein and lysine-rich grain, which supplements cereal-based diets (Khan et al., 2012, Minh, 2014). The crop is utilized in several ways; seeds, sprouts and young pods are all consumed and provide a rich source of amino acids, vitamins and minerals (Somta and Srinives, 2007). The seed (dry beans) contains 24.2% protein, 1.3% fat and 60.4% carbohydrate (Hussain et al., 2011). It is also known to be very healthy and packed with a variety of nutrients such as vitamin B, vitamin C, protein, manganese and a lot of other essential nutrients required for effective functioning of the human health. Mung bean is low in calories and rich in fiber and easily digestible crop without cause flatulence as happens with many other legumes (Minh, 2014). Sprouts

are high in protein (21 to 28%), calcium, phosphorus and certain vitamins. Because they are easily digested, replace scarce animal protein in human diets in tropical areas of the world (MoA, 2017).

The low land areas of Ethiopia are climatically characterized by high temperature and insufficient amount of rainfall during the crop-growing season. In most of these areas, rainfall distribution is erratic and unreliable. Very short growing seasons are available for the crops grown in this part of the country. Abergele Agricultural Research Center mandate area is part of the dry lowland areas of Tigray region, northern Ethipia. The rain fall is unpredictable in amount and distribution; moreover, the duration is very short. As a result, crops are frequently exposed to moisture stress at critical stages of growth which result in either low yield or total crop failure. Those crops which are early maturing, drought tolerant and resistant to higher temperatures are of great interest to the farmers of the lowland areas of Ethiopia. Several legumes exhibit good drought and heat resistance and this make them potentially very valuable for crop diversification in low rain fall conditions (Dereje et al., 1995).

Mung bean is very early maturing crop and drought resistant and has great potential for the semi-arid areas with short growing cycle. Special features are high yield, good nutritive value, the earliness/ drought escape features and the reasonable cost of production. However, it is less cultivated pulse crop in Abergelle due to lack of improved varieties. Therefore, the objectives of this study were to evaluate and select early matured, well adaptable and high yielding mung bean varieties in Abergelle condition.

MATERIALS AND METHODS

Description of the study area

The field experiment was carried out under rain-fed conditions at Abergelle Agricultural Research Center on station during the 2016 and 2017 main cropping seasons. Abergelle is located in the central zone of Tigray region at about of 903 km north of Addis Ababa and 120 km south west of 'Mekelle' and situated at 13°14’06” N latitude and 38°58’50” E longitude. The area is agro-ecologically characterized as hot warm sub-moist lowland (SMl-4b) located at an altitude of 1450 masl. Plains, hills and river valley, characterize the topography of the district and it is highly exposed to soil erosion. Most soils of the district are dominated by sandy textured with poor water holding capacity and less fertile hence most crops failed to produce good yield (Assefa, 2007).

The dominant soil types of the study area are fine-grained ones called ‘walka’, ‘bahkel’, ‘hutsa’, and ‘mekayih’. The average annual rainfall varies from 350 to 650 mm and the temperature ranges from 18 to 42^{o}C. The distribution of rainfall is erratic and variable, which results in strong variation in crop yields (Assefa, 2007). The rainfall distribution is unimodal, concentrated during the summer (July to August) leading to one cropping season per year.

Experimental design and crop management

The experimental material comprised six Mung bean genotypes including five lines (Borda. Rasa, Shoarobit, Arkebe and NVL-1) from Melkasa Agricultural Research Center (MARC) and one local landrace (Sheraro) originated from Abergelle (Table 1). The seeds of six entries were sown in randomized complete block design (RCBD) with three replications.

The plot size was 4 x 3.2 m (12.8 m^2) having 8 rows with harvestable plot area of 1.6 x 4 m (6.4 m^2) with four rows and spacing 40 cm between rows and 10 cm between plants was maintained. The spacing between plots and blocks were 0.50 and 1m, respectively. Di-ammonium phosphate (DAP) fertilizer was applied at a rate of 100 kg ha^{-1} at planting. Livestock were excluded by fencing. No irrigation was applied. Weeds were controlled periodically by hand weeding and other management practices like pest or disease-control was done as required.

Data collection and sampling techniques

Days to 50% flowering

This was determined by counting the number of days from emergence to the time when 50% of the plant start flowering through visual observation.

Days to 90% physiological maturity

This was recorded as the number of days from emergence to the stage when 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.

Seed filling period

It was recorded as days from flowering to maturity.

Plant height

The height of the plant measured at physiological maturity from the ground surface to the tip of the main stem was recorded in centimeters from 5 plants. Five plants were randomly selected from the four central rows to determine the yield related traits as given below.

Table 1. Description of the experimental materials.

Genotypes	Year of release	Seed size	Status	Source
Borda (MH-97-6)	2008	Small	Released variety	Awasa ARC
Rasa (N-26)	2011	Small	Released variety	Melkasa ARC
Shoarobit	-	Small	Introduced	Melkasa ARC
Arkebe (SML-668)	2014	Small	Released variety	Humera ARC
Sheraro	-	Small	Local cultivar	Sheraro area
NVL-1	2014	Small	Released variety	Melkasa ARC

ARC = Agricultural Research Center.

Number of pods per plant

Five plants were randomly selected from the four central rows to determine the yield related traits. Fertile number of pods from 5 sampled plants were counted and recorded.

Number of seeds per pod

Five plants were randomly selected from the four central rows to determine the yield related traits. Number of seeds per pod was determined from the average number of seeds per 10 pods per 5 sampled plants.

Seed yield

Five plants were randomly selected from the four central rows to determine the yield related traits. The central four rows were threshed from each plot and seeds obtained from them was adjusted to standard moisture level (10%) per plot in grams and converted into ton per hectare.

Thousand seed weight

It was determined from the 1000-seeds weight at (10%) moisture content of the seed randomly selected from the plot and expressed in grams.

Data analysis

Homogeneity of error variance was tested prior to combined analysis using Bartlett's test (Steel and Torrie, 1980) and statistical analyses was performed using Genstat statistical program version 16th edition. Means were separated using Fisher's Least Significant Difference (LSD) test at 5% level of probability as stated in Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Variation in seed yield and seed yield components

The combined analysis of variance revealed that the studied varieties were significantly different for most of the traits measured except number of pods per plant (Table 3). A significant difference was observed between varieties for days to flowering, seed filling period and physiological maturity (Table 2). Even though, Rasa was flowered (39 days) and matured (64 days) earlier than the other varieties. As a result, Rasa filled its seeds in a short period of time (25 days), thus, making it more adaptable in drought prone areas. Varietal differences revealed that, the Mung bean genotypes used in this study possessed a high variability and are genetically diversified.

This finding agrees with other studies (Asfaw et al., 2012; Adhiena et al., 2015; Wedajo, 2015; Teame et al., 2017; Habte, 2018; Lema et al., 2018; Kassa et al., 2018) who have reported variability among mung bean varieties for yield in Ethiopia.

Plant height (PH)

Highly significant ($p \leq 0.01$) difference was observed between varieties for plant height (Table 2). The highest plant height (70.17 cm) was recorded for Sheraro local, whereas, the shortest plant height (55.22 cm) was recorded for Arkebe. In line with the finding, the existence of genotypic variation in plant height (Fahad et al., 2014; Zelalem, 2014 and Teame et al., 2017) has been reported for common bean.

Number of pods per plant (NPP)

There was no significant difference ($p<0.01$) exhibited among mung bean varieties for number of pods per plant.

Number of seeds per pod (NSP)

Mung bean varieties exhibited variation for number of seeds per pod. The variety Rasa produces a greater number of seeds per pod (16.42) compared to the other varieties, while, local sheraro produces the lowest number of seeds per pod, about 10.47 seeds per pod.

Seed yield (SY)

A significant variation was observed among Haricot bean

Table 2. Combined mean values of agro-morphological (phenological, growth, yield and yield related) traits of Mung bean varieties grown at Abergelle on station.

Genotypes	Traits							
	DF	DM	SFP	PH	NPP	NSP	SY	1000SW
Rasa	39^{d}	64^{d}	25^{b}	55.22^{b}	16.60	16.42^{a}	1776^{a}	58.80^{a}
Arkebe	41^{c}	66^{d}	25^{b}	53.77^{b}	16.10	10.52^{b}	912^{c}	49.33^{c}
NVL-1	42^{c}	69^{c}	27^{ab}	59.46^{b}	15.16	10.55^{b}	1507^{b}	58.30^{a}
Borda	42^{c}	68^{c}	26^{b}	56.58^{b}	17.02	11.32^{b}	1596^{b}	51.93^{b}
Shoarobit	45^{b}	73^{b}	29^{a}	59.12^{b}	15.33	11.52^{b}	1033^{c}	47.0^{c}
Sheraro	50^{a}	76^{a}	27^{ab}	70.17^{a}	17.33	10.47^{b}	889^{c}	46.0^{c}
LSD	2.68	2.45	3.04	8.48	ns	4.65	206.3	5.83

Means with the same letters within the columns are not significantly different at p≤0.05. DF = days to flowering, SFP = seed filling period, DM = days to physiological maturity, PH = plant height, NPP = number of pods per plant, NSP= number of seeds per pod, SY = seed yield, 1000SW = thousand seed weight and LSD = least significance difference.

Table 3. Mean sum of squares from combined ANOVA for agro-morphological (phonological, growth, yield and yield related) traits of Mung bean varieties tested at Abergelle on station.

Traits	Mean square					Mean	CV (%)
	Replication (DF=2)	Variety (DF=5)	Year (DF=1)	V*Y (DF=5)	Error (DF=22)		
Days to flowering	9.75	81.32**	72.25**	41.85**	2.51	42.92	3.7
Days to maturity	2.132	124.03**	600.25**	114.52**	2.09	69.19	2.1
Seed filling period	5.632	11.244*	256.0**	34.47**	3.223	26.28	6.8
Plant height	28.56	206.93**	1597.87**	551.44**	25.06	59.05	8.5
Number of pods per plant	12.144	4.73^{ns}	3.092^{ns}	19.367^{ns}	9.463	16.26	18.9
Number of seeds per pod	3.664	31.835*	38.234*	8.168*	7.542	11.84	10.8
Seed yield	73716	895256**	147680*	307263**	14842	1285	9.5
Thousand seed weight	29.99	184.77**	546.0**	90.93**	11.86	51.89	6.6

*, ** = significant at P≤ 0.05 and P≤ 0.01, respectively, DF= degree of freedom, V*Y= variety by year interaction effect and CV (%) = coefficient of variation in percent.

varieties in their response to seed yield. The highest seed yield was recorded from the variety Rasa (1776 kg ha^{-1}) while the lowest yield was recorded from local sheraro (889 kg ha^{-1}). The trial site is characterized with less moisture and low soil fertility condition; hence varieties which tolerate these stresses perform best. Successful cultivars must have good yield and other essential agronomic characters. Rasa had significantly higher yield than the other mung bean varieties and this variety required lesser number of days to filled its seeds, thus, making it more adaptable in drought prone areas. The greatest yield of this variety could be due to its inherent genetic potential. It could be also due to better local adaptation to study area.

Thousand seed weight (1000SW)

The varieties tested had a significant variation among each other for thousand seed weight. Rasa produces the highest seed weight (59 g) followed by NVL-1 (58.3) while local sheraro was the lowest (46 g) followed by shoarobit (47 g). Overall, large seeded bean type showed highest thousand seed weight while for small seeded bean type was lowest.

Generally, the range of variation was wide for most of the yield and yield related traits such as, seed yield, 1000-seed weight and number of pods per plant while other traits showed low to fairly high range values (Table 2). The current variations in yield and yield related traits among varieties consent with previous reports (Asfaw et al., 2012; Adhiena et al., 2015; Wedajo, 2015; Teame et al., 2017; Habte, 2018; Lema et al., 2018; Kassa et al., 2018) on mung bean in Ethiopia.

Conclusion and recommendation

Analysis of variance of data showed significant varietal differences at p≤0.05 for days to 90% physiological

maturity, plant height, seed yield, biomass yield, thousand seed weight and harvest index. The combined analysis result indicated that the early maturing mung bean variety Rasa had the highest seed yield (1776 kg ha^{-1}), while the lowest seed yield was obtained from local sheraro (889 kg ha^{-1}). Overall, Rasa had significantly higher yield (perform well and gave better yield) than the other mung bean varieties and this variety required lesser number of days to filled its seeds, thus, making it more adaptable in the study area. The greatest yield of this variety could be due to its inherent genetic potential. Besides, it was more suitable to areas with unreliable rainfall in terms of total amount, distribution and duration where crop failure is often attributed to early cessation of rains and thereby making it adaptive to the study area. As compared to the rest, Rasa is therefore recommended as promising variety to the farmers of Abergelle areas.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

Adhiena, M., Muez, M., Mizan, T. (2015). Evaluation of mung bean ngenotypes for seed yield and other yield related traits in low lands of South Tigray, Ethiopia. *Journal of Natural Sciences Research*, 5(13),165-167.

Asfaw, A., Gurum, F., Alemayehu, F., & Rezene, Y. (2012). Analysis of multi-environment grain yield trials in mungbean (*Vigna radiata* L.) Wilczek based on GGE bipot in Southern Ethiopia. *Journal of Agricultural Science and Technology*, 14(2), 389-398.

Assefa, D. (2007). Transplanting Sorghum as a means of ensuring food security in low rainfall Sorghum growing areas of northern Ethiopia. *DCG report No. 48*.

Central Statistical Agency (CSA) (2016). Agricultural sample survey report on area and production of crops (Private Peasant Holdings 'Meher' Season): Statistical Bulletin 579. Addis Ababa, Ethiopia.

Dereje, N., Teshome, G., & Amare, A. (1995). Lowland pulses improvement in Ethiopia. pp. 41-47. In: Twenty-five years of research experience in lowland crops. Proceedings of the 25th Anniversary of Nazreth Research Center. Melkassa, Ethiopia. Pp. 22-23.

Gomez, A. A., & Gomez, K. A. (1984). *Statistical procedures for agricultural research, 2nd edition*. John wiley and Sons Inc., New York.

Habte, U. (2018). Evaluation of adaptability of mungbean varieties in moisture stress of Eastern Harerghe Zone. *Agricultural Research and Technology*, 13(2), 55-58.

Hussain, F., Malik, A. U., Haji, M. A., Malghani, A. L. (2011). Growth and yield response of two cultivars of mung bean (*Vigna radiata* L.) to different potassium levels. *The Journal of Animal & Plant Sciences*, 21(3), 622-625.

Kassa, Y., Admasu, D., Tigabe, A., Abie, A., & Mamo, D. (2018). Participatory on farm evaluation of improved mungbean technologies in the low land areas of North Shewa Zone Amhara Region, Ethiopia. *Journal of Agricultural Extension and Rural Development*, 10(8), 158-164.

Khan, M. A., Naveed, K., Ali, K., Bashir, A., & Samin, J. (2012). Impact of mungbean-maize intercropping on growth and yield of mungbean. *Pakistan Journal of Weed Science Research*, 18(2), 191-200.

Lema, M., Mekonnen, B., & Gudero, G. (2018). Performance and Growth Analysis of Three Mungbean (*Vigna Radiate* (L.) Wilczek) Genotypes at Hawassa, Ethiopia. *International Journal of Horticulture & Agriculture*, 3(2), 1-4.

Minh, N. P. (2014). Different factors affecting to mungbean (Phaseolus aureus) tofu production. *International Journal of Multidisciplinary Research and Development,* 1(4), 105-110.

Ministry of Agriculture (MoA) (2017). Animal and Plant Health Regulatory Directorate. Crop variety register issue No. 19. Addis Ababa, Ethiopia.

Rashid, K., Daran, A. B. M., Nezhadahmadi, A., Yusof, M. F. B. M., Azhar, S., (2013). Intraspecific crosses and morphological studies of two cultivars of Vigna radiate through *in-vitro* and *in-vivo* techniques. *Life Science Journal*, 10(2), 2549-2555.

Somta, P., & Srinives, P. (2007). Genome research in mungbean (*Vigna radiata* (L.) Wilczek) and blackgram (*V. mungo* (L.) Hepper). *Science Asia*, 33(Suppl 1), 69-74.

Teame, G., Ephrem, S., Lemma, D., & Getachew, B. (2017). Adaptation study of mung bean (Vigna radiata) varieties in Raya valley, Northern Etiopia. *Current Research in Agricultural Sciences*, 4(4), 91-95.

Wedajo, G. (2015). Adaptation study of improved mung bean (*Vigna radiata*) varieties at Alduba, South Omo, Ethiopia. *Research Journal of Agriculture and Environmental Management*, 4(8), 339-342.

Yagoob, H., Yagoob, M. (2014). The effects of water deficit stress on protein yield of mungbean genotypes. *Peak Journal of Agricultural Science*, 2(3), 30-35.