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ADAPTATION STUDY OF MUNG BEAN (*VIGNA RADIATE*) VARIETIES IN RAYA VALLEY, NORTHERN ETHIOPIA

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ABSTRACT

In order to investigate the adaptability of mung bean varities; a study was carried out at the research field of Mehoni Agricultural Research Center in 2014/15 cropping season. Nine varities were arranged in 3*3 lattice design with three replications in six rows per plot with 2.4 m wide and 4 m long, and with spacing of 40 cm between rows and 10 cm between plants. Days to flowering, Days to maturity, Plant height, number of pods per plant, number of seeds per pod, hundred seed weight and grain yield per hectare was significantly influenced by variety. The highest grain yield (1362.50 kg ha^{-1}) was obtained from Black bean variety; followed by Shewa robit (1225.00 kg ha^{-1}). On the contrary, the lowest grain yield value (242.60 kg ha^{-1}) was obtained at MH BR-1 variety. Thus, both black bean and Shewa robit varities were best adapted in Raya valley.

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Contribution/Originality: This research finding contributes concrete information and attends the issues of best adaptable varieties to the specific agro-ecology (Raya valley) for mung bean producers.

1. INTRODUCTION

It is the seed of *Phaseolus radiates* L. an annual herb of the Leguminosae family. It has green skin and is also called green bean. It is sweet in flavor and cold in nature [1]. Mungbean is an annual food legume belonging to the subgenus *Ceratotropis* in the genus *Vigna*. Mungbean was used to be known as *Phaseolus aureus* before it was moved to the *Vigna* genus [2]. The genus *Vigna* has been broadened to embrace about 150 species; twenty two species are indigenous to India and sixteen to Southeast Asia, but the principal number of species are originate in Africa [3].

Ketinge, et al. [4] Stated that mungbean (*Vigna radiata* L. Wilczek) is an essential short duration, self pollinated diploid legume crop with high nutritive significances and nitrogen fixing capacity. It is an eco-friendly food grain leguminous crop of dryland agriculture with wealthy basis of proteins, vitamins, and minerals.

Worldwide, a total of 43,027 mungbean accessions are available at core collections or Gene Bank at different stations and over 110 mungbean cultivars have been released by AVRDC in South Asia and around the world. Mungbean germplasm is available as wild, cultivated and weedy populations, but very little is known about the population structure, diversity, gene flow, and introgression. The seeds of mungbean contain an average of 26% protein, 62.5% carbohydrates, 1.4% fat, 4.2% fibers, and vitamins [5].

Mung bean is originated from India and it has diversified to East, South, Southeast Asia (China) and some countries in Africa. It is also a recent introduction in Ethiopian pulse production and grown in the north eastern part of Amhara region (North Shewa, Oromiya special zone and Southern Wollo), SNNPR (Gofa area) and pocket areas in Oromiya region (Hararge). The average yield of the crop is limited to 600-800 kg/ha due to different reasons [1]. Ethiopia Commodity Exchange (ECX) announces the debut of a new commodity, green mung bean, into its trade floor. Green mung bean is the sixth product that Ethiopian Commodity Exchange is trading. Coffee, sesame, white pea beans, maize and wheat have been traded in Ethiopian Commodity Exchange so far. Mung bean is mostly produced in Amhara regional state particularly in some areas of North Shewa and South Wollo as well as in some woreda's of Benishangul Gumuz regional state [6]. Despite its growing demand in the international market there is chronic supply gap in Ethiopia from the production side. However Ethiopia's mung bean export has grown slightly from time to time [1].

There is a need to expand its production to other potential areas where moisture stress is confront for producing long maturing crops like the raya valley in northern Ethiopia. The study area is potential for lowland pulses like mung bean. But, the farming system is based on local varities that are low yielder, late maturing and vulnerable to pests. However, the improved varieties are not yet introduced to farmers in moisture stress areas particularly in Raya valley. Therefore, this activity was carried out to investigate and select the best adapted mung bean variety for the study area.

2. MATERIALS AND METHODS

2.1. Description of the Experimental Area

The study was conducted at the research station of Mehoni Agricultural Research center in the Raya Valley in 2014/15 main season, Northern Ethiopia, (12° 41'50" S or N; 39° 42'08" W or E; 1578 m). The site receives a mean annual rainfall of 540 mm with an average minimum and maximum temperature of 22 and 32°C, respectively. The soil textural class of the experimental area is clay loam with pH of 7.9-8.1. The area is characterized by mixed farming system both crop and livestock production [7].

2.2. Treatments and Experimental Procedures

The design of the experiment was 3x3 lattice with three replications. A total of nine varieties (MB 6148-05-12, Mong whole, Black bean, Asha, MH 85 –1, MH BR -1, MB 6173 B-23, Shewa robit and MH -97 -6) were used in the study. The plot size was 4 m × 2.4 m (9.6 m^2) having 6 rows with harvestable plot size of 1.6 m × 4 m (6.4 m^2) and a spacing of 0.40 m between rows and 0.10 m between plants. 1.50 m between replication, 1 m between blocks and leave 0.50 m between plots within each block was maintained. 100 kg of DAP was set aside homogeneous for all treatments. Management practices like weeding, watering and thinning were done uniformly to all plots as per recommendations.

2.3. Data Collection and Statistical Analysis

During the experiment data on individual plant basis plant height (cm), number of pods per plant, number of seeds per pod, and on plot basis days to 50% flowering, days to maturity, grain yield (kg ha^{-1}), 100 seed weight (g) were collected and analysed.

Data on phenological, growth and yield components were subjected to analysis of variance (ANOVA) using SAS computer package version 9.1 [8] at $P<0.05$. when there were a significant difference among the treatment means the least significant difference (LSD) test will be used to compare the mean separations at $P<0.05$ [9].

3. RESULTS AND DISCUSSION

3.1 Growth and Phenological Parameters

3.1.1. Days to 50% Flowering

The effect of variety on days to 50% flowering, was very highly significant (Table 1), in which the maximum days to 50% flowering were observed in variety Black bean (58.00 days) followed by MB 6173 B-23 and Mong whole (55.00 days), where as the minimum value was observed in MH BR-1 having 45 days (Table 3).

3.1.2. Days to 90% Maturity

Table 1 also indicated that days to 90% maturity, which was found highly significant, ($P<0.001$). Concerning the mean value of the cropping season, significantly higher and lower days to 90% maturity were found 86.00, 84.67 and 76.67, 75.67 days, at those varieties of Black bean, MB 6173 B-23 and Shewa robit, MH BR-1, respectively (Table 3). This showed that both Shewa robit and MH BR-1 matured much earlier than other varieties. This investigation is in line with previous reports by Wendm [10] Analysis of variance exhibits highly significant differences among mungbean accessions with respect to days to maturity.

3.1.3. Plant Height

Analysis of variance revealed that variety did exert very significant influence ($P<0.0001$) on plant height (Table 1). Significantly higher plant height (34.67 cm) was obtained at Shewa robit which, however, did not statistically different with Black bean (34.33 cm) variety; whereas, significantly lower plant height was obtained at

MH 85-1 and Asha (30 cm) which was at parity with MH-97-6 (30.33 cm) and MB 6148-05-12 (30.33 cm) varieties (Table 3). This finding was in line with result of Rasul, et al. [11].

Table-1. Mean square from analysis of variance for performance of mung bean in Phenology and Growth Traits

SOV	DF	DF50%	DM	PH
Trt	8	55.84***	41.09***	11.60***
Rep	2	0.48	1.81	0.48
Error	16	2.3	1.73	0.52
CV		2.95	1.62	2.27

Where, ns; not significant at P< 0.05, * significant at P< 0.05; ** significant at P<0.01 and *** significant at P< 0.001 probability level. SOV: Source of variation, DF: Degree of freedom, CV: Coefficient of variance, DF50%: Days to 50% flowering, DM, Days to 90% maturity, PH: Plant height (cm),

Table-2. Mean square from analysis of variance for performance of mung bean in yield and its components

SOV	DF	NPP	NSP	HSW	GY
Trt	8	82.84***	4.60***	5.67***	435386***
Rep	2	0.70	0.48	0.78	3141.08
Error	16	1.03	0.27	0.24	1835.76
CV		8.13	8.45	7.40	5.62

Where, ns; not significant at P< 0.05, * significant at P< 0.05; ** significant at P<0.01 and *** significant at P< 0.001 probability level. SOV: Source of variation, DF: Degree of freedom, CV: Coefficient of variance, NPP, Number of pods/plant, NSP, Number of seeds/pod, HSW, Hundred seed weight (g), GY: Grain yield (kg ha^{-1})

3.2. Yield Components

3.2.1. Number of Pods per Plant

Number of pods per plant is a key factor for determining the yield performance in leguminous plants. The productive capacity of mungbean plant is ultimately considered by the number of pods per plant. Results from the analysis of variance, showed that variety had significant influence on number of pods per plant. Significantly higher (21.00) pod number per plant was obtained at black bean variety followed by shewa robit (19.67). But significantly lower (7.33) number of pods per plant was obtained at MH BR-1 variety (Table 4). Likewise the above results, Wedajo [12]; Ahmad, et al. [13] and Rasul, et al. [11] stated that mung bean cultivars had significant effect on number of pods plant.

3.2.2. Number of Seed per Pod

Analysis of variance, Table 2 indicated that the presence of a highly significant difference among the different varieties (P<0.001). The mean comparison (Table 4) revealed that, black bean produced considerably higher (8.00) seeds per pod followed by shewa robit (7.67) and MB 6173 B-23 (7.67). However, significantly lower (5.00) number of seeds per pod was obtained at MH BR-1 and MH-97-6 variety. These results agree with those of Ahmad, et al. [13]; Rasul, et al. [11] and Uddin, et al. [14] who reported difference in seeds per pod among the cultivars might be due to genetically determined differences.

3.2.3. Hundred Seed Weight

Mean square of analysis of variance, Table 2 revealed that the existence of significant difference (P<0.001) for hundred seed weight due to variation in variety in 2014/15 cropping season. The highest hundred seed weight (8.67 g) was obtained from black bean variety; however it was statistically at parity with shewa robit (8.33 g) whereas the lowest value (5.00 g) was obtained from MH BR-1 and asha variety. These results were similar to those reported by Wedajo [12] and Ahmad, et al. [13] that differences among the 100 grains weight in these cultivars might be due to hereditary superiority, growth rate, crop potential of yield, higher nutrients translocation, assimilation and dry matter partitioning.

3.2.4. Grain Yield

Dry matter production and its transformation into economic yield is the vital result of diverse physiological, biochemical, phenological and morphological actions taking place in the plant system. There was significant difference on grain yield with respect to varietal effect of mung bean crop. Variety exerted very highly significant (P<0.001) effect on total yield (Table 2). Considerably higher grain yield (1362.50 kg ha^{-1}) was obtained from black bean variety; followed by shewa robit (1225.00 kg ha^{-1}) and MB 6173 B-23 (1032.83 kg ha^{-1}) varieties. On the contrary, the lower grain yield value (379.70 kg ha^{-1}, 242.60 kg ha^{-1}) was obtained at asha and MH BR-1 varieties respectively (Table 4). The higher yield of variety black bean and shewa robit may due to higher number pods per plant (21.00, 19.67) and number seeds per pods (8.00, 7.67) respectively. Significant effect of mung bean genotypes on grain yield had been reported by Wedajo [12]; Rasul, et al. [11] and Omid [15].

Table-3. Mean performance of mung bean varieties for phenology and growth traits

Variety	DF50%	DM	PH
MB 6148-05-12	47.67d	78.33ef	30.33c
Mong whole	55.00b	84.33ab	31.67b
Black bean	58.00a	86.00a	34.33a
Asha	54.00b	83.33bc	30.00c
MH 85-1	51.00c	81.33cd	30.00c
MH BR-1	45.00e	75.67g	31.00bc
MB 6173 B-23	55.00b	84.67ab	34.00a
Shewa robit	47.33de	76.67fg	34.67a
MH-97-6	50.33c	80.33de	30.33c
LSD	2.63	2.27	1.25
CV	2.95	1.62	2.27

Where, CV: Coefficient of variance, LSD, Least Significant Difference, DF50%, Days to 50% flowering, DM, Days to 90% maturity, PH: Plant height (cm),

Table-4. Mean performance of mung bean varieties for yield and yield components

Variety	NPP	NSP	HSW	GY
MB 6148-05-12	12.33c	6.00b	6.67c	815.10d
Mong whole	10.00d	5.67bc	6.00cd	699.47e
Black bean	21.00a	8.00a	8.67a	1362.50a
Asha	9.00de	5.33bc	5.00e	379.70g
MH 85-1	8.33de	5.33bc	5.67de	528.13f
MH BR-1	7.33e	5.00c	5.00e	242.60h
MB 6173 B-23	16.67b	7.67a	7.67b	1032.83c
Shewa robit	19.67a	7.67a	8.33ab	1225.00b
MH-97-6	8.33de	5.00c	6.00cd	573.97f
LSD	1.76	0.90	0.84	74.16
CV	8.13	8.45	7.40	5.62

Where, CV: Coefficient of variance, NPP: Number of pods/plant, NSP: Number of seeds/pod, HSW: Hundred seed weight (g), GY: Grain yield (kg ha^{-1})

3.2.5. Correlation of Characters

A Pearson correlation analysis was done to assess the association of various agronomic characters of mung bean. Both positive and non associations between characters of the component crop have been observed and discussed below.

Table-5. Pearson correlation coefficients between characters of mung bean components.

	PH	DF	DM	NPP	NSP	HSW	GY
PH	1						
DF	0.29^{ns}	1					
DM	0.2^{ns}	0.97***	1				
NPP	0.87***	0.35^{ns}	0.25^{ns}	1			
NSP	0.84***	0.33^{ns}	0.25^{ns}	0.89***	1		
HSW	0.82***	0.30^{ns}	0.22^{ns}	0.90***	0.83***	1	
GY	0.80***	0.38*	0.30^{ns}	0.95***	0.88***	0.93***	1

Where: *** Correlation is significant at the 0.001 level, * Correlation is significant at the 0.05 level; PH=Plant Height, DF = Days to 50% Flowering, DM = Days to 90% maturity, NPP = Number of pods per plant, NSP = Number of seeds per pod, HSW = Hundred seed weight, GY = Grain yield

According to the Pearson correlation analysis result (Table 5) of mung bean both very highly significant positive and non significant correlations were observed between all the parameters. Except days to 90% maturity, all the parameters affect yield positively. Plant height (r=0.80***), days to flowering (r=0.38*), number of pods per plant (r=0.95***), number of seeds per pod (r=0.88***) and hundred seed weight (r=0.93***) were strongly correlate positively with grain yield. This shows that these factors were responsible for the production grain yield of mung bean.

In contrast) days to 90% maturity (0.30^{ns}) non significantly correlate with yield, which means these factors had negative effect on grain yield.

4. CONCLUSION

Mungbean (*Vigna radiata* L. Wilczek) is an essential short duration, self pollinated diploid legume crop with high nutritive values and nitrogen fixing ability. It is an eco-friendly food grain leguminous crop of dryland agriculture with rich source of proteins, vitamins, and minerals. From this research output, black bean produced greatly higher (1362.50 kg ha^{-1}) grain yield followed by shewa robit (1225.00 kg ha^{-1}) whereas significantly lower (242.60 kg ha^{-1}) grain yield was obtained at MH BR-1 variety. On the other hand, significantly higher and lower days to 90% maturity were found (86.00, 84.67 and 76.67, 75.67 days), at those varieties of black bean, MB 6173 B-23 and shewa robit, MH BR-1, respectively. This showed that both shewa robit and MH BR-1 matured much earlier than other varieties. The study area was characterized by shortage and erratic rainfall, thus earliness is best criteria for selection and recommendation of varities in such areas. Therefore, it could be concluded that both black bean and shewa robit varieties might be recommended for farmers and growers of mung bean in the study area.

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