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Mungbean Cultivars (Vigna radiata L.)Evaluation Trial Based on Selected Physiological Growth Parameters at Hawassa University, Ethiopia

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Abstract
The world population is increasing at alarming rate and obviously overwhelming majority of this Populous world is suffering due to the insufficient and imbalanced diet. Mungbean is produced for both human consumption and as fodder.The experiment was conducted in the field of advanced crop physiology experimental station, in Hawassa University College of Agriculture Campus with the objective of Evaluation of Mungbean cultivars variation on selected physiological growth parameters . Design RCBD with three replication and three improved Mungbean cultivars (MH-97-6, Sunaina and Goffa Local) were used in this experiment. All agronomic practices uniformly was applied per plot. All necessary data were collected and analyzed using MS-Excel and manually. Results showed that there were significant variations among the mungbean cultivars relative growth rate, crop growth rate, biomass yield, net assimilation rate, specific leaf area and leaf area ratio. The higher (767.0833 gm) and lower (569.625 gm) biomass yield obtained from the two cultivars Goffa Local and MH-97-6 respectively where as higher NAR and RGR was recorded on Goffa local, sunaina and MH-97-6 respectively but low NAR value obtained from MH-97-6. Hence, the variation in cultivars for different growth parameters is important for the improvement of the cultivars for the further production.
Keywords: Mungbean (Vigna radiata L.), Growth parameters, Cultivars and variation

1. Introduction

The world population is increasing at alarming rate and obviously overwhelming majority of this Populous world is suffering due to the insufficient and imbalanced diet. The plant scientists are facing the Challenge that how to meet the food requirement of this unchecked population. Mungbean (*Vigna radiata* L.) commonly known as green gram is an ancient and well-known pulse crop of Pakistan (Govt. of Pakistan, 2009). It is produced for both human consumption and as fodder. Its seed contains 24.3% protein and 0.67% fats (F. Rasul, M A. Cheema, A. Sattar, M. F. Saleem, and M.A. Wahid .2012).

The mung bean has been grown in India since ancient times. Mung bean is an annual crop, cultivated mostly in rotation with cereals (Department: Agriculture, Forestry and Fisheries .2010). Among the pulse crops Mungbean (L.) has a special importance of intensive crop production due to its short growth period. The crop is potentially useful for improving cropping pattern as it can be grown as a cash crop due to its rapid growth and early maturing characteristics. In a symbiotic relationship with the soil bacteria, Mungbean roots can fix atmospheric nitrogen and thus improve soil fertility (R.K. Naresh, Purushottam, S.P.Singh, Ashish Dwivedi and Vineet Kumar.2013)

The optimum temperature range for good production is 27-30°C. Mungbean prefers well-drained soils with a medium to heavy texture. It does not grow well where there is soil compaction or waterlogging. In the upland, Ferrosols (Labanseak) and Vertosols (Kampong Siem) are ideal for growing mungbean (Australian Centre for International Agricultural Research .2015). Mung bean is a quick crop, requiring 75–90 days to mature. It is a useful crop in drier areas and has a good potential for crop rotation and relay cropping with cereals using residual moisture (A. Asfaw, F. Gurum, F. Alemayehu, and Y. Rezene.2012).

Variation in dry matter accumulation and pod production in different genotypes may be related to some factors such as leaf area (LA), crop growth rate (CGR), net assimilation rate (NAR) and relative growth rate (RGR). Pandey *et al.* (1978) analyzed growth parameters of five varieties of black gram in order to study the physiological causes of yield differences and observed differences in CGR, NAR, RGR and LA among the varieties (Mma Mondal, Msa Fakir, M Nurul Islam and Ma Samad2011).

Not much effort is being made in the breeding of new varieties of mung bean in Ethiopia; however, there are a few varieties available, such as SML-134, Kewet Mete,Sunaina, MH-97-6 and Goffa local. Goffa local is green in color, perform best and is the variety preferred by farmers.

Objectives: - To Evaluate Mungbean cultivars variation on selected physiological growth parameters

2. Materials and Methods

2.1Description of the Study Area

The experiment was conducted in the field of advanced crop physiology experimental station, in Hawassa University College of Agriculture Campus at Hawassa during the period first week of March 2017 to first week

of June 2017. Hawassa is the capital of Southern Nation Nationalities and People's Region (SNNPR) which is found 275 km south of Addis Ababa that capital of Ethiopia. It has an altitude of 1650 masl, and is located at 7^0 03.194' N and 38^0 28.279' E. The average rainfall is 900 mm with minimium13^{0}C and maximum 27 ^{0}C. The experimental site soil type is sandy loam with pH of around 5.5. Laboratory activities were conducted at plant and horticultural Sciences school in advanced crop Physiology laboratory.

2.2Treatments and Experimental Design

- **Treatmen**t: - Three improved Mungbean varieties (MH-97-6, Sunaina and Goffa Local) were used as treatments.
- **Materias used: -** Well tilled plot was selected and prepared , For layout : strings, stakes, Tape meters were used. TSP (trisulfure phosphate) of 20 g were added per plot which was calibrated as 50kg per hectare
- **Design**: - Treatments were assigned on randomized complete block design (RCBD) with three replications and Munbean was sown with plant spacing 40 x 10 cm, plot size 2m x 2m, 5 rows per plot and total area of plot 4 m^2 and gross experimental area 7mx7m,on March 11/ 2017. Seeds were drilled per hole and then thinned 40x10 cm spacing between row and plant respectively.

2.3Data Collected

After 22 and50 days from emerging the first and the second samples were taken by destructive sampling respectively. For both samples, three plants per plot were taken randomly from the second and fourth rows, measured leaves area by leaf area meter to determine leaves area (cm^2), subjected leaves and stems to oven dry for about 48 hours by 70^{o}c to dry weights of stems and leaves (gm). After 65 days of emergence two middle rows of each plot (1.6m^2) were harvested destructively as the final samples which were important to determine or measure aboveground dry weight biomass.

2.4Growth parameters (growth analysis)

The growth analysis Specific leaf area (SLA), Leaf area ratio (LAR), Relative growth rate(RGR),Leaf weight ratio(LWR),Leaf area index(LAI),Crop growth rate(CGR) and Net Assimilation rate (NAR) were carried out by the following the formulas:-

- **Specific leaf area (SLA)**

$SLA=\frac{A}{Wleaf}$ Where SLA is specific leaf area ($cm^2\ g^{-1}$), A is leaf area (cm^2) and W_{leaf} is leaf dry weight (g)

- **Leaf area ratio (LAR)**

$LAR = \frac{A}{W}$ Where LAR is leaf area ratio ($cm^2\ g^{-1}$), A is leaf area (cm^2) and W is plant dry weight (g)

- **Net assimilation rate (NAR)**

: $NAR= \frac{(W_2-W_1)(\ln A_2-\ln A_1)}{(A_2-A_1)(T_2-T_1)}$

Where, NAR is Net Assimilation Ratio (g cm^{-2} day^{-1}), W_2 and W_1 are the Dry Matter (DM) (g) at the sampling times T_2 and T_1 (day) respectively. A_2 and A_1 are leaf area (cm^2) at the sampling times T_2 and T_1 (day) respectively.

- **Relative growth rate (RGR)**

$$RGR = \left(\frac{(\ln W_2 - \ln W_1)}{(T_2 - T_1)} \right)$$

Where RGR is relative growth rate (g $g^{-1}day^{-1}$),
W_2 and W_1 are the Dry Matter (DM) (g) at the sampling times T_2 and T_1 (day) respectively.

- **Crop growth rate (CGR)**

$$RGR = \left(p \frac{w2 - w1}{(T_2 - T_1)} \right)$$ =$gm^{-2}day^{-1}$ where, p is ground area on which w_1 and w_2 have been estimated

- **Leaf area Index (LAI)**
  LAI= A/P, A, leaf area; p, plot (ground) area

2.5 Data Analysis

Each growth analysis were analyzed and computed as mean values ± STD (standard deviation by using the respected formula for each treatment (Mungbean cultivars). Dry matter data of Munbean above ground biomass for each treatment were subjected to Analysis of Variance (ANOVA), which was appropriate to RCBD experimental design, and analyzed using micro-soft Excel and sas software version 9.00 programs and tested significance at 5% level of significance using the F test and means were separated and compared using LSD.

3. Result and discussion

3.1Mungbean cultivars Variation in specific leaf area and leaf area ratio

Table -1: SLA (Specific Leaf Area) and LAR (Leaf Area Ratio) for two samples

	1st Sample		2nd Sample	
	SLA (cm^2g^{-1})	LAR (cm^2g^{-1})	SLA (cm^2g^{-1})	LAR (cm^2g^{-1})
Trt				
Sunaina	60.80787±9.514	46.58474±7.981653	155.8889±16.69473	90.69486±10.41097
MH-97-6	58.28±7.194091	43.8528±3.38598	112.9627±35.45205	66.84819±18.92605
Goffa-L	72.16019±0.792059	51.45253±0.806804	133.895±9.441825	76.05607±4.675801

*First Sampling at 22 days after emergence and Second sampling at 50 days after emergence

The above table(1) shows that the Mungbean cultivars vary for specific leaf area and leaf area ratio in two round samples. The cultivar Gofa local showed higher specific leaf area and leaf area ratio in samples one but it has intermediate value in second sample where as Sunaina showed higher specific leaf area and leaf area ratio in second sample but intermediate value in first sample. Cultivar MH-97-6 showed lower value for both specific leaf area and leaf area ratio in both samples as compared to the rest two cultivars.

3.2 Mungbean cultivars Variation in different Growth parameters

Mungbean cultivars vary for the relative growth rate, leaf weight ratio, crop growth rate, leaf area index and net assimilation rate and the variation was analyzed and presented in the following Table-2

(*Wallace 1965*) predicted that cultivars with a higher LAR would have a higher NAR, this agrees with my current experimental report result. *Poorter(1990)* reported that there is correlation between LAR, the ratio between total leaf area and total plant weight, and RGR was very high. This positive correlation was mainly due to the SLA, the ratio between leaf area and leaf weight, and to a lesser extent caused by the leaf weight ratio, the fraction of plant biomass allocated to the leaves, this disagree with our current experimental result.

Table-2 Growth parameters analysis.

Trt	LWR1 (gg^{-1})	LWR2 (gg^{-1})	NAR (mg dm^{-2})	RGR (mgg^{-1} day^{-1})	LAI1 (cm^{-2})	LAI2 (cm^{-2})	CGR (gm^{-2} day^{-1})
Sunaina	0.775	0.580769	**49.5**	56	0.000535±6.456153	0.006555±30.91489	0.0000595
MH-97-6	0.773585	0.636145	**2.3**	66.5	0.000645±6.39799	0.006885±42.06054	0.000111
Goffa-L	0.711111	0.570588	**59**	64.4	0.000641±3.191812	0.007215±41.0635	0.0000803
Mean±STD	0.753232± 0.021064	0.595834 ±0.020368	36.9333±17.5325	62.3±3.208			0.0000836±0.000014958

According to the above table (2) the three cultivars are similar for leaf weight ratio (LWR (gg^{-1})), leaf area index (LAI (cm^{-2})) and crop growth rate (CGR (gm^{-2} day^{-1})), meanwhile, the cultivars vary for net assimilation rate (NAR (mg dm^{-2})) and relative growth rate (RGR (mgg^{-1} day^{-1})). Higher NAR (mg dm^{-2}) and RGR (mgg^{-1} day^{-1}) obtained from cultivars and MH-97-6 respectively but lower NAR (mg dm^{-2}) was recorded from the cultivars MH-97-6. The relative growth rate has inverse relationship to the net assimilation rate.

3.3Mungbean cultivar variations in biomass yield

The variation in accumulation of biomass for different mungben cultivars was determined by analyzing the sun dried sample biomass data and summarized with the following ANOVA and mean separation Table 3 and 4 respectively

Table 3: ANOVA table for Biomass

SV	df	ss	MS	F cal	F tab 5%
rep	2	4340.566	2170.283	0.477651^{NS}	6.94
trt	2	251064.7	125532.4	27.62804*	6.94
error	4	18174.63	4543.658		
total	8	273579.9			

Cv(%)=9.95

Cv=Coefficient of variation

*= *Significant at 5% probability level*, NS= *Non Significant at 5% probability level*

The above ANOVA table (3) shows that the mungbean cultivars were significantly different from each other whereas the cultivars were not significantly different among the three blocks.

Table 4: **Summery for mean separation of mungbean cultivars biomass yield**

No	treatments	Mean biomass yield(gm)	Grouping
1	Sunaina	695.5833	B
2	MH-97-6	569.625	C
3	Goffa-L	767.0833	A
	LSD	10.6	

Means with the same letters are not significantly different.

The above mean separation table (4) indicates that higher (767.0833 gm) and lower (569.625 gm) biomass yield obtained from the two cultivars Goffa Local and MH-97-6 respectively. Dry matter accumulation in crops has a direct relationship with leaf area ratio and net assimilation ratio.

4.Conclusions

In general the genetic factor is a key factor for achieving optimum growth and dry matter production of crops. The genetic and environmental factors can cause a different level of variation of the tested characteristics of Mungbean cultivars. Cultivars Goffa local showed variation in biomass yield and net assimilation rate where as the cultivar MH-97-6 has higher relative growth rate but it has lower specific leaf area, leaf area ratio, net assimilation rate and biomass yield than the others. Therefore, the variation in cultivars for different growth parameters is important for the improvement and selection of the cultivars for the further production.

5. Reference

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Appendices

1. Summary of raw data for first sample

SUMMARY OF DATA

	Sample -1						
Rep	Trt	LA /3	LA/1	LDW/3	LDW/1	SDRwt/3	SDRWt/1
1	Sunaina	58.77666667	19.59222	0.8	0.266667	0.3	0.1
1	MH-97-6	111.9066667	37.30222	1.7	0.566667	0.6	0.2
1	Goffa-L	88.10666667	29.36889	1.2	0.4	0.5	0.166667
2	MH-97-6	74.63333333	24.87778	1.7	0.566667	0.3	0.1
2	Sunaina	100.1666667	33.38889	1.5	0.5	0.4	0.133333
2	Goffa-L	84.84	28.28	1.2	0.4	0.5	0.166667
3	MH-97-6	45.58666667	15.19556	0.7	0.233333	0.3	0.1
3	Goffa-L	57.88666667	19.29556	0.8	0.266667	0.3	0.1
3	Sunaina	33.74	11.24667	0.8	0.266667	0.3	0.1

LA/1 =Leaf area per plant, LA/3= Leaf area per three plant LDW/1 = leaf dry weight per plant LDW/3= leaf dry weight per three plant SDRWt/1=stem dry weight per plant and SDRWt/3=stem dry weight per three plant

2. Summary of raw data for the second sample

sample -2

Plot No.	Rep	Trt	LA/3	LA/1	LDW/3	LDW/1	SDRWt/3	SDRWt/1
1	1	Sunaina	881	293.6667	6.4	2.133333	4.6	1.533333333
2	1	MH-97-6	1010.69	336.8967	7.8	2.6	5.7	1.9
3	1	Goffa-L	736.2	245.4	5.2	1.733333	4.3	1.433333333
4	2	MH-97-6	882.99	294.33	6.4	2.133333	4.3	1.433333333
5	2	Sunaina	877.78	292.5933	6.4	2.133333	5.3	1.766666667
6	2	Goffa-L	1112.1	370.7	13.6	4.533333	5.5	1.833333333
7	3	MH-97-6	584.81	194.9367	5.2	1.733333	3.6	1.2
8	3	Goffa-L	749.2	249.7333	5	1.666667	3.6	1.2
9	3	Sunaina	601.17	200.39	4.9	1.633333	3.7	1.233333333

LA/1 =Leaf area per plant, LA/3= Leaf area per three plant, LDW/1 = leaf dry weight per plant , LDW/3= leaf dry weight per three plant, SDRWt/1=stem dry weight per plant and SDRWt/3=stem dry weight per three plant