American-Eurasian J. Agric. & Environ. Sci., 2 (6): 696-701, 2007
ISSN 1818-6769

Performance of Mung Beans (*Vigna mungo* (L.) Hepper) Grown in Mid-west Nigeria

J.K. Mensah and Olukoya R. Tope

Department of Botany, Ambrose Alli University, P.M.B. 17, Ekpoma, Nigeria

Abstract: Seeds of three different genotypes of mung beans, *Vigna mungo* (L.) Hepper, (TVm1, TVm11 and TVm15) were evaluated to determine the performance of their phenotypic characters at Ekpoma in Edo State, Mid West Nigeria. Significant differences were observed between the genotypes for characters such as number of seeds per pod, days to maturity and weight of 50 seeds. Some characters were found to be controlled by additive genes, because of their high heritability and genetic gain values, thus selection based on these characters will be effective for high yield. They include plant height, number of branches per plant, number of nodules per plant, days to maturity, number of pods per plant, number of seeds per plant, dry weight per plant and seed yield per plant. Characters found to correlate positively with seed yield include days to maturity, number of branches, pods per plant and seeds per plant. From the yield and yield attributes of the three genotypes studied, TVm11 is the most suitable for the Esan Plateau in Mid-West Nigeria.

Key words: Mung bean · seed yield · yield components · genotypes · heritability

INTRODUCTION

The development of genotypes, which can be adapted to a wide range of diversified environments, is the ultimate goal of plant breeders in a crop improvement programme [1]. This goal, is made all the more important when one considers the increasing demand for high protein and energy crops as experienced in a protein-hungry world such as Nigeria.

The genetic variability and correlation for quantitative characters are of utmost importance in selecting suitable genotypes and reliable yield components for efficient yield improvement [2]. The results of several extensive studies carried out on genetic variation confirmed the study of Johnson *et al.* [3], which combined the study of heritability and genetic advance in soybean. Heritability and genetic gain have been found to be more reliable in predicting the effects of selection. Information on genetic variability and inter-relationship sprogramme to develop high yielding types of crops. Some component traits are important for indirect selection for yield, particularly if their heritabilities and expressivities are high [2, 4]. High phenotypic and genetic coefficients of variation have been observed for seed yield per plant, number of branches per plant, plant height, number of pods per plant and 100 seed weight [5]. The genotypic coefficient of variation alone, however, is not sufficient in determining the amount of variation that is heritable and the heritable portion of the variation could be found with the help of heritability estimates [5].

The mung bean is an important grain legume, which has recently been introduced into Mid-western Nigeria to supplement the dietary requirements of the indigenous communities. The present investigations was undertaken to: study the performance of characters in three of the recently introduced genotypes of mung beans-TVm1, TVm11 and TVm15; and also to determine the heritability, genetic gain and correlation of the different components of yield in order to improve on their performance on the Esan Plateau of Edo State in Mid-western Nigeria.

MATERIALS AND METHODS

The field study was conducted at the Botanical gardens of the Department of Botany, Faculty of Natural Sciences, Ambrose Alli University, Ekpoma, (Latitude 6° 42'N, Longitude 6° 68'E) between September and November 2005. Healthy and uniformly sized seeds from three genotypes of mung beans (*Vigna mungo* (L.) Hepper-TVm1, TVm11 and TVm15) were obtained from the International Institute for Tropical Agriculture (IITA), Ibadan. Nigeria. The seeds were evaluated using the Randomized Complete Block (RCB) design and the genotypes replicated three times for each genotype under

Corresponding Author: Dr. J.K. Mensah, Department of Botany, Ambrose Alli University, P.M.B. 17, Ekpoma, Nigeria

rain fed conditions. Weeding was carried out at regular intervals to enhance yield.

The parameters studied include: plant height, number of leaves per plant, branches per plant, nodules per plant, pod per plant, seeds per pod, seeds per plant; maturity time, dry weight per plant, dry weight of 50 seeds, yield per plant and total protein content according to Pulmmer [6].

Data obtained were subjected to Analysis of Variance (ANOVA). The significance of the two sources of variance (replicates and genotypes) was determined at the F = 0.05 level of probability. The means of the replicates and genotypes were separated using the Turkey HSD test method.

The coefficient of variation, which is a measure of dispersion, was calculated based on the formula suggested by Allard [7]. The genetic analysis was based on growth and yield as they relate to genotypic and phenotypic expressions. The genetic parameters studied were heritability, genetic advance at 10% selection index (K = 2.06) and genetic gain. They were calculated according to the methods given by Allard [7]. Correlation coefficient was determined using the Pearson's product-moment correlation coefficient formula according to Steel and Torrie [8].

RESULTS

Growth studies: The results of the growth characters exhibited by the three genotypes of mung beans are presented in Table 1. Plant heights increased steadily from week 2 to week 9 (Fig. 1). At week 9, the mean plant height of the plants varied from 12.7±1.20 to 38.0±9.33 cm. The mean heights of TVm1 versus TVm11 and TVm1 versus TVm15 were not significantly different ($p>0.05$) but the means of TVm11 and TVm15 were significantly different ($p<0.05$) from each other. The number of primary branches per plant at nine weeks after planting varied from 3.4±0.09 to 7.3±1.55.

However, they were not significantly different from each other ($p>0.05$).

The number of nodules per plant, at nine weeks after planting (9 WAP), varied from 22.0-60.3±25.20. TVm11 recorded the least number of nodules per plant (Table 1). There were no significant differences in the number of nodules produced per plant by TVm1, TVm11 and TVm15 ($p>0.05$).

The number of days to maturity ranged between 60.0±0.58 and 62.0±0.58 days for TVm1; 61.0±0.58 and 63.0±0.58 days for Tvm11 and Tvm15 65.0±0.58 and

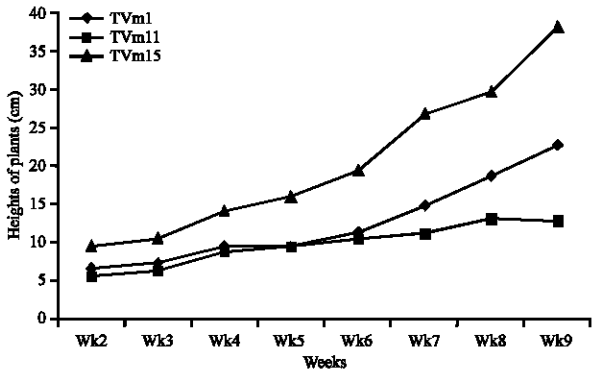

Fig. 1: Variations in plant heights of three genotypes of mung bean

Table 1: Evaluation of the growth characters of three genotypes of mung bean

Genotypes	Height/plant (cm)	No. of branches/plant	No. of nodules/plant	No of days to maturity
Tvm1	22.6±2.05	3.4±0.09	60.3±25.21	61.0±0.58
TVm11	12.7±1.20	6.9±0.60	22.0±11.06	62.0±0.58
TVm15	38.0±9.33	7.3±1.55	55.7±2.85	66.0±0.58
Mean	24.4±4.60	5.8±0.78	46.0±10.01	63.0±0.82
P-value	0.066884	0.107311	0.245220	0.000947

Table 2: Evaluation of the yield characters of three genotypes of mung bean

Genotypes	No. of pods/plant	No. of seeds/pod	No. of seeds/plant	Dry weight/ plant (g)	Dry weight of pods (g)	Dry weight of 50 seeds (g)	Yield/ plant (g)	Seed protein (%)
TVm1	5.5±1.65	10.9±0.86	60.8±23.20	17.8±3.19	8.8±1.94	4.6±0.03	5.6±2.13	13.11±1.32
TVm11	54.4±29.04	6.7±0.23	375.4±206.28	25.5±7.53	16.8±4.98	2.5±0.12	19.4±9.97	17.73±1.33
TVm15	32.3±16.89	7.2±0.54	254.4±136.47	53.1±17.82	31.4±5.61	3.3±0.09	16.8±9.01	16.75±1.36
Mean	30.7±12.02	8.3±0.67	230.2±85.09	32.1±7.79	12.0±2.54	3.5±0.30	13.9±4.46	15.86±1.15
P-values	0.175831	0.012454	0.203712	0.176727	0.307906	0.000368	0.223246	0.2456

67.0±0.58 days for TVm 15. The differences between the mean numbers of days to maturity for TVm1 and TVm15, TVm11 as well as TVm15 were significant but the means of TVm1 and TVm11 were not (Table 1).

Yield studies: The number of pods per plant varied from 5.5±1.65 to 54.4±29.04 (Table 2). TVm1 recorded the least number of pods and TVm11, the highest. There was no significant difference in the number of pods produced per plant among the genotypes under study ($p>0.05$). The number of seeds per pod for each plant varied from 9.5±0.86 to 12.3±0.86 for the TVm1 genotype, for TVm11, the number varied from 6.3±0.23 to 7.0±0.23 and for TVm15, the variation was from 6.3±0.54 to 8.0±0.54. There was significant difference in the mean number of seeds produced per pod between TVm1 and TVm11 and between TVm1 and TVm15, but no difference was recorded between TVm11 and TVm15 ($p>0.05$).

The mean number of seeds per plant for the genotypes ranged from 60.8-375.4 No significant differences were observed in the means between the three genotypes ($p>0.05$).The dry weights of plants for each genotype varied from 17.8±3.19 to 53.1±17.82. At probability level of 0.05, there was no significant difference between the genotypes. The dry weight per plant varied from 17.80 to 53.1g. However the differences between the genotypes were not significant. ($p>0.05$).

Weight of 50 seeds per plant varied from 4.5±0.03g to 4.6±0.03g for TVm1; 2.3±0.12g to 2.7±0.12g for TVm11 and 3.2±0.09 to. 3.5±0.09g for TVm15, The observed differences in the mean weights for the genotypes were significant ($p<0.05$; Table 2).

The mean grain yield per plant varied among the three genotypes, (5.6-19.4 g/plant) however the differences in yield were not significant ($p>0.05$). The results indicated that the protein content varied from 13.11 to 17.74%. TVm11 recorded the highest value of protein content (17.73%), but the differences were not significant ($p>0.05$), Table 3 revealed that, characters with low coefficient of variation include: number of branches per

Table 3: Coefficient of Variation values (CV) for three genotypes of mung beans

S/N	Character	CV
1.	Heights of plants (at week 9)	0.9061
2.	Number of branches per plant	0.6383
3.	Number of nodules per plant	0.7875
4.	Number of days to maturity	0.0727
5.	Number of pods per plant	1.3824
6.	Number of seeds per pod	0.4332
7.	Number of seeds per plant	1.1942
8	Dry weight per plant	1.0022
9.	Weight of 50 seeds	0.5195
10.	Yield per plant	0.9134

Table 4: Genetic parameters among three mung bean genotypes

S/N	Character	Mean±SE	Genotypic variance	Phenotypic variance	H_O (%)	GA	GG
1	Height of plants	24.4333±4.62	404.6701	490.1634	82.56	37.65	154.10
2.	Number of branches per plant	5.8444±0.78	10.5251	13.9145	75.64	5.89	100.78
3.	Number of nodules per plant	46.0000±10.01	668.6667	1312.3334	50.95	38.02	86.65
4.	Number of days to maturity	63.0000±0.82	20.6667	21.0000	98.41	9.29	14.75
5.	Number of pods per plant	30.7222±12.02	1152.4300	1803.6678	63.89	55.89	181.92
6.	Number of seeds per pod	8.2444±0.67	11.9534	12.7545	93.72	6.89	83.57
7.	Number of seeds per plant	230.1633±85.09	44474.4060	75549.4961	58.87	33.53	14.57
8.	Dry weight per plant	32.1111±7.79	660.0900	1035.6678	63.74	42.25	131.57
9.	Weight of 50 seeds	3.4667±0.30	3.2117	3.2434	99.02	3.67	105.86
10.	Yield per plant	13.9376±4.46	89.4776	162.0513	55.22	14.48	103.89

S.E. = Standard Error, GA = Genetic Advance, H_O = Heritability Value, GG = Genetic Gain

Table 5: Correlation (r) matrix for yield characters of mung beans grown on the Ishan Plateau of Edo State

Characters	No. of branches/plant	No. of pods/plant	No. of seeds/plant	Weight of 50 seeds	Yield/plant
No. of days to maturity	0.717*	0.242	0.317	-0.297	0.508*
No. of branches		0.850*	0.889*	-0.879*	0.965*
No. of pods/plant			0.997*	-0.998*	0.959*
No. of seeds/plant				-1.000*	0.978*
Weight of 50 seeds					-0.973*

*Significant at 5% level

plant, number of days to maturity, number of seeds per pod and weight of 50 seeds. Characters with medium coefficient of variation include: heights of plants, number of nodules per plant, dry weight per plant, dry weight per plant and yield per plant. The characters, which recorded high values of coefficient of variation, hence high variability between genotypes, include: number of pods per plant, number of seeds per plant and dry weight per plant.

Heritability values between the genotypes ranged from 55.22% for yield per plant to 99.02% for weight of 50 seeds (Table 4). Since the heritability values were above 50%, it can be concluded that the characters under study are genetically influenced (Table 4). The values for genetic advance varied from 3.67 for weight of 50 seeds to 55.89 for number of pods per plant. The genetic gain is a measure of the genetic advance expressed as a percentage of the mean values. Consequently, selection based on characters with high genetic gain values will be effective. In the present study, these characters include: number of nodules per plant (86.65%), number of seeds per pod (83.57%), dry weight per plant (131.57%), dry weight of 50 seeds (105.86%), heights of plants (154.10%), number of pods per plant (181.92%) and yield per plant (103.89%). Characters with relatively low genetic gain values include: number of days to maturity (14.75%) and number of seeds per plant (14.57%).

Correlation coefficients among yield characters in mung beans: Six yield characters were evaluated for the interrelationship among their phenotypic traits (Table 5). The correlation coefficient values ranged from r = -1.000 to r = 0.978. Number of days to maturity correlated positively with number of branches per plant (r = 0.717) and yield (r = 0.508). Similarly, number of branches correlated positively with number of pods per plant (r = 0.850), seeds per plant (r = 0.889) and yield (r = 0.965), pods per plant versus seeds per plant (r = 0.997) and pods per plant versus yield (r = 0.959), Number of seeds per plant and yield (r = 0.978). There was negative correlation between number of branches and weight of 50 seeds (r = -0.879), number of pods per plant and weight of 50 seeds (r = -0.998), weight of 50 seeds and seed yield/plant (r = -0.973) as well as number of seeds per plants and weight of 50 seeds (r = -1.000).

DISCUSSION

The mung beans genotypes were observed to grow to and this is in line with studies by Shephens [9], who reported that mung beans different heights. The highest values of plant height was recorded by TVm15 (52.7 cm) generally grow to height of 45-90 cm. Plant height was found to correlate positively with number of nodules per plant Thus taller plants had higher number of nodules as against those with shorter heights. Number of days to maturity was similar for TVm1 and TVm11, but differed significantly for TVm15, It was observed that TVm1 had the least number of branches, followed by TVm11, while TVm15, having the highest number of branches (Table 1). Number of seeds per pod varied for the different genotypes, with TVm1 recording the highest number and TVm11 the least number of 6. This is in line with the work of Imrie and Lawn [10], where they reported that mung bean pods contain between 8 and15 seeds.

It was revealed in this study, that the number of pods per plant and number of seeds per pod, which determine the number of seeds per plant, followed similar trends of variability and may be mutually influenced by the same genetic factors. The number of pots/plant was not significantly different from each other contrary to earlier reports by Nag *et al* [11].However the number of pods/plant was positively correlated to seed yield. The number of seeds per plant was not significantly different for the genotypes, indicating that the three genotypes under study performed equally well on the Esan Plateau of Edo State in Mid-West Nigeria. The number of seeds per pod showed significant differences between TVm1 versus TVm11; and TVm1 versus TVm15 while there was no significant difference was found between TVm11 and TVm15. Protein content in the seeds of three mung bean genotypes is different, it ranged from the lowest content (13.11%) at TVm1 to the highest content (17.73%) in TVm11 and could be a source of rich protein if adapted in the diet of the local communities. These values are slightly lower compared to previous reports [12]. The mung bean is the legume of choice because the protein quality of most legumes is limited by sulphur containing amino acids (methionine and cysteine). Mung bean however has higher methionine content compared to other legumes [13].

Ten characters of mung beans were evaluated for coefficient of variation for the three genotypes in order to further access the extent of variability among the genotypes. High values for coefficient of variation revealed variability of genes within the genotypes thus the genetic makeup of individual genotypes differ to a large extent with respect to the characters under investigations. Such characters which had high coefficient of variation include: height of plants, number

of nodules per plant, number of pods per plant, dry weight per plant and yield per plant.

Characters with high estimates of heritability and genetic gain are under the control of additive genes A combined study of heritability and genetic gain has been suggested to be more reliable in predicting the effect of selection (3) In the present study, high values were recorded for heritability and genetic gain for characters like: height of plants, number of branches per plant, number of nodules per plant, number of pods per plant, number of seeds per plant, dry weight per plant, number of days to maturity and yield per plant. Selection based on these characters would make a breeding programme successful in this locality. Similar results of high variability, heritability and genetic gain estimates on phenotypic performance have been reported by Backiyarani *et al.* [14] for pods per plant, pod length, seeds per pod and seeds per plant in cowpea.

Also, heritability studies carried out by Fernandez and Miller [15] showed that number of nodules per plant is heritable and may be used as criteria for selection in improvement programmes. Findings in this study substantiated this claim and therefore may be used in mung bean research to improve the performance of the crop in different environments.

Phenotypic correlation coefficients for yield characters showed both negative and positive association of characters ranging from r = -1.000 to r = 0.978. Number of pods per plant positively correlated with number of seeds per plants as well as the number of primary branches per plant and yield per plant. This observation substantiates earlier report by Xiong, *et al.*, [16], in barley and Raje and Rao [17] and Singh *et al.* [18] in mung beans. Number of branches per plant correlated negatively with weight of 50 seeds, implying that, the more the number of pods produced the smaller the seed size. There was also negative correlation between seed yield and 50 seed weight seed.

CONCLUSIONS

The present study revealed that significant differences exist between the genotypes for characters like, number of seeds per pod, number of days to maturity and weight of 50 seeds. From the yield and yield attributes of the three genotypes studied, it was concluded that the most suitable for the Esan Plateau in Mid-West Nigeria is TVm11. Furthermore, some characters were found to be controlled by additive genes, because of their high heritability and genetic gain values. For these characters, selection based on them will be effective for high yield. These characters include height of plants, number of nodules per plant, number of pods per plant, dry weight of plant, number of branches per plant and number of days to maturity.

Four phenotypic characters were found to correlate positively with seed yield thus improving on one of the characters would lead to an increase in seed yield. The characters are: Seeds per plant; branches per plant, pods per plant and days to maturity. In addition, these characters exhibited high coefficient of variation, heritability and genetic gain values and could be manipulated to increase seed yield.

REFERENCES

1. Muhammad, A., B. Ahmad, A.M. Haqqani and B. Muhammad, 2003. Genotype-Environment interaction for grain yield in chickpea (*Cicer arietinum* L.). Pak. J. Bot., 35: 181-186.
2. Tyagi, P.C., K. Nimal and M.C. Agawal, 2000. Genetic variability and association of components of character for seed yield in cowpea (*V. unguiculata* (L.) Walp). Legume Res., 23: 92-96.
3. Johnson, H.W., H.P. Robinson and R.E. Comstock, 1955. Estimation of genetic and environmental variability in soybeans. Agric. J., 147: 313-318.
4. Okeleye, K., J.O. Ariyo and I.V. Olowe, 1999. Evaluation of early and medium duration cowpea (*Vigna unguiculata* (L.) Walp). Cultivars for stability and performance in humid environment. Nig. Agric. J., 30: 12-17.
5. Anbuselvam, Y., N. Manivanan, S. Murugan, P. Thangavelu and J. Ganesan, 2000. Variability studies in cowpea (*Vigna unguiculata* (L.)). Legume Res., 23: 279-280.
6. Plummer, D.T., 1971. An introduction to practical Biochemistry. McGraw-Hill Book Company, pp: 150.
7. Allard, R.W., 1999. Principles of plant breeding. John Wiley and Sons Inc. 2nd Edn, pp: 44-69.
8. Steel, R.G.D. and J.H. Torrie, 1980. Principles and procedures of statistics. McGraw-Hill Book Company, New York, pp: 42-48.
9. Shephens, J., 1988. Minor vegetables. University of Florida Cooperative Extension Bulletin SP-40, pp: 123.
10. Imrie, B.C. and R.J. Lawn, 1991. Mung bean: The Australian experience. CSIRO Division of Tropical Crops and Pastures. St. Lucia, Queensland.

11. Nag, B., Alimur Rahman and M.A. Raman, 2000. Growth analysis and yield performance of blackgram varieties. Legume Res., 23: 146-150.
12. Savage, G.P. (1990). Nutritional value of sprouted beans. *Nutrition Today*. 2p
13. Tsou, S.C.S. and M.A. Hsu, 2000. Proc. First International Mungbean Symp. February 1978. AVRDC, Taiwan.
14. Backiyarani, S. and N. Nadarajar, 1996. Heritability in cowpea. In: Variability studies in cowpea. Legume Res., 23: 72-85.
15. Fernandez, G.C.J. and Jr.J.C. Miller, 1985. Estimation of heritability by parent-offsprings regression. Theor. App. Gen., 70: 650-654.
16. Xiong, S., F. Wen and R. Jie, 2001. Correlation Analysis of several quantitative characters of Barley. Agricultural Science Research Institute of Nan Chang huan, China, pp: 1-8.
17. Raje, R.S. and K.S. Rao, 2000. Genetic parameters of variation for yield and its components in mung bean (*Vigna radiata* (L.) Wilezek). Legume Res., 23:4: 211-212.
18. Singh, J., N. Marthur, S. Bohra, A. Bohra and A. Vyas, 2006. Comparative performance of mung bean (*Vigna radiata* L.) varieties under rain fed conditions in Indian Thar Desert. Am. Eurasian J., Agric. Env. Sci., 1: 48-50.