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Genetic analysis of yield and other quantitative characters in mungbean

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ABSTRACT

Genetic analysis of yield and other quantitative traits was done through generation mean analysis. Simple additive-dominance model was found inadequate in all the crosses for most of the characters indicating importance of non-allelic interactions. Both additive and dominance gene effects were significant in most of the cases but magnitude of dominance component was more in general and negative, hence, decreasing the expression of characters. In addition, epistasis was also important in most of the characters in different crosses. Thus, to exploit all the three types of gene actions present in most of the cases, recurrent selection has been suggested. Epistasis was mostly of duplicate type which will reduce variation in F_2 and subsequent generations and hinder the pace of progress through selection.

Key Words : Genetic analysis, Mungbean, Quantitative characters, *Vigna radiata*

Mungbean (*Vigna radiata* (L.) Wilczek) also known as greengram is an important pulse crop of *kharif* season. It is also grown during spring/summer season in northern and during *rabi* season in southern parts of India. The choice of breeding method to be adopted depends upon the type of gene action involved in the inheritance of any character. Grain yield is a complex character and for its improvement, genetic characterization of the variability present in the crop is required for understanding the nature of the gene action involved in the inheritance of yield and its component traits.Analysis of generation means has proved to be simple and useful for finding the nature and the magnitude of gene effects involved in expression of quantitative traits. Keeping all these facts in view, the present study was carried out to assess the type of gene action involved in the expression of yield and its components in mungbean and to suggest suitable breeding strategy for improvement.

MATERIALS AND METHODS

The field experiments were conducted during 2002-2004 in the Experimental Area of Department of Plant Breeding, Genetics & Biotechnology, Punjab Agricultural University, Ludhiana. Four crosses were made using MUL 81 and LM 51 as male parents and Pusa 9972 and ML 1191 as female parents during *kharif* 2002. During summer 2003, F_1s were backcrossed to both the parents keeping F_1 as ovule parent to develop B_1 and B_2 generations of all the crosses. The F_1s were grown to generate F_2 generation of all the crosses. Fresh F_1s were also attempted during summer 2003.

The experimental material comprised of six basic generations(P_1, P_2, F_1, B_1, B_2 and F_2) derived from four crosses. The experiment was laid out in randomised block design with three replications. P_1, P_2, F_1, B_1 and B_2 each were accommodated in single row plots whereas F_2 was planted in four row plots for each cross in each replication. The row to row and plant to plant spacings were kept at 45 and 10 cm, respectively. The number of plants for taking observations for various characters were 5 for P_1, P_2 and F_1; 10 for B_1 and B_2 and 20 for F_2 in each replication. The observations were recorded on single plant basis with respect to morphological traits *viz.*, days to 50 per cent flowering, days to maturity, plant height (cm), branches per plant, clusters per plant, pods per plant, seeds per pod, grain yield per plant (g) and 100-seed weight (g). The generation means were worked out by taking the average over all the plants used for each generation in a replication.To test the adequacy of additive - dominance model, scaling tests of Mather (10) were applied and components of generation means were estimated through Hayman's approach (5).The inferences for additive and dominance gene effects were drawn from best-fit model when the non-allelic interactions were significant but from additive-dominance model when the interactions were absent.

RESULTS AND DISCUSSION

The genetic effects of all the nine characters for four crosses are presented in Table 1 alongwith scales and joint scale test as follows :

Days to 50% flowering : For days to 50% flowering, the scaling tests were significant in all the four crosses indicating the inadequacy of simple additive-dominance model and presence of epistasis. Significant joint scaling test further confirmed the results. Additive component [d] is significant in all the four crosses. However, dominance component [h] was significant and was more than additive [d] component in two crosses, Pusa 9972 x MUL 81 and Pusa 9972 x LM 51 but with negative sign. It indicated that dominance component was responsible for decreased days to flowering. Additive x additive [i] epistasis was significant in all the four crosses, additive x dominance interaction [j] in three crosses, except in Pusa 9972 x LM 51 and dominance x dominance interaction was significant in all the crosses. The results indicated the importance of additive, dominance and epistatic effects in the expression of days to flowering. Similar results were also reported by Brar (1), Chhabra and Singh (2) and Rahul (14). Duplicate type of epistasis was detected in two crosses, Pusa 9972 x MUL 81 and Pusa 9972 x LM 51 with [h] and [l] components exhibiting opposite signs. Brar (1) also reported similar observations.

Days to maturity : Scaling tests and joint scaling test were significant in all the crosses except in Pusa 9972 x LM 51 for which additive-dominance model was adequate. Additive [d] gene effects were significant in all the four crosses but dominance [h] component was of higher magnitude and significant in the three crosses. It showed importance of dominance component but additive gene effects were also important for expression of this trait. Mukar (11) also reported the importance of dominance gene effects for days to maturity. Negative value of [h] component indicated that dominance decreased the expression of days to maturity. Additive x additive [i] epistasis was significant in three crosses and was negative in all the crosses, additive x dominance interaction [j] in two crosses, ML 1191 x MUL 81 and ML 1191 x LM 51 and dominance x dominance interaction[l] was significant in one cross (Pusa 9972 x MUL 81) only. The results indicated the importance of additive, dominance and epistatic effects for the expression of the trait. Presence of both additive and non-additive gene effects were also observed by Chhabra and Singh (2) and Rahul (14). Duplicate epistasis was noticed in one cross Pusa 9972 x MUL 81. Brar (1) also reported similar results regarding duplicate epistasis.

Plant height : Epistasis was detected in all the four crosses as indicated by significance of scaling tests and joint scaling test. Predominance of dominance gene effects was observed in three crosses except in cross Pusa 9972 x MUL 81. Additive gene effects were also significant in three crosses except in ML 1191 x LM 51. Additive x additive interaction was significant in two crosses, while additive x dominance and dominance x dominance interactions were significant in three crosses. This indicated the importance of both additive and non-additive gene effects in the expression of plant height. Godhari *et al* (4), Malik and Singh (9) also reported the importance of additive and non-additive gene effects. Duplicate epistasis was observed for two crosses, ML 1191 x MUL 81 and Pusa 9972 x LM 51.

Branches per plant : Simple additive-dominance model was found adequate for two crosses, ML 1191 x MUL 81 and ML 1191 x LM 51. In both these crosses, additive component was significant whereas dominance component was significant in cross ML 1191 x LM 51. For remaining two crosses, both additive and dominance gene effects were significant but dominance component was of higher magnitude. Additive x additive interaction was significant in cross Pusa 9972 x LM 51 and dominance x dominance interaction was significant in crosses Pusa 9972 x MUL 81 and Pusa 9972 x LM 51. It indicated the importance of both additive and dominance effects, except in in cross ML 1191 x MUL 81, where only additive gene effects in were important. Involvement of both additive and non-additive gene effects in inheritance of branches per plant has also been reported by Saxena and Sharma (15) and Jahagirdar (6). Duplicate epistasis was reported in crosses Pusa 9972 x MUL 81 and Pusa 9972 x LM 51. Similar results were also reported by Brar (1) and Thimmapa (17).

Clusters per plant : Scaling tests and joint scaling test were significant in three crosses and non-significant for the cross Pusa 9972 x LM 51. For this cross, additive-dominance model was found adequate. Additive [d] gene effects were significant in all the four crosses and dominance gene effects were significant in three crosses except Pusa 9972 x LM 51. Additive x additive type interaction was significant in only one cross ML 1191 x MUL 81. Additive x dominance interaction was significant in crosses Pusa 9972 x MUL 81 and ML 1191 x LM 51. Dominance x dominance interaction was significant for crosses, Pusa 9972 x MUL 81 and ML 1191 x MUL 81. Duplicate epistasis was observed for crosses, Pusa 9972 x MUL 81 and ML 1191 x MUL 81. Kalita and Hazarika (7) and Patil *et al* (13) also noticed duplicate epistasis for clusters per plant. Both additive and non-additive gene effects were found to be important in the expression of number of clusters per plant in three crosses. Similar observations were recorded by Thimmappa (17) and Saxena and Sharma (15).

Pods per plant :Simple additive dominance model was found sufficient for cross Pusa 9972 x LM 51, as indicated by non-significance of scaling tests and joint scaling test. Dominance component [h] was higher in magnitude than additive component in all the crosses except cross ML 1191 x LM 51. It indicated decreased expression of pods per plant by dominance and therefore, selection should be done during later generations. Additive x additive [i] gene interaction was significant in three crosses and was negative, indicating prevalence of dissociated gene pairs. Additive x dominance [j] interaction was significant in two crosses Pusa 9972 x MUL 81 and ML 1191 x MUL 81. Dominance x dominance type epistasis was also more important in two crosses ML 1191 x MUL 81 and ML 1191 x LM 51. It indicated that dominance gene effects were more predominant than additive effects, but additive effects were also significant in all the crosses. Importance of non-additive gene effects was also reported by Deshmukh and Manjare (3). All this indicated the importance of both additive and non-additive gene effects for the expression of pods per plant. Saxena and Sharma (15) also reported similar results.

Seeds per pod : Scaling tests and joint scaling test indicated the presence of epistasis in three crosses Pusa 9972 x MUL 81, ML 1191 x MUL 81 and Pusa 9972 x LM 51. For the cross ML 1191 x LM 51, additive-dominance model was found adequate to explain variation between generations. Additive

Table 1. Components of generation mean based on best fit model for yield and other quantitative characters in mungbean

Cross	Scale				Components						
	A	B	C	χ^2(3)	m	[d]	[h]	[i]	[j]	[l]	Epistasis
Days to 50% flowering											
Pusa 9972 x MUL 81	-3.67 **± 0.72	-0.07±0.67	12.53**±1.35	231.17**	52.53±1.15	1.87**±0.25	-36.67** ±2.75	-16.27** ±1.12	-3.60**± 0.79	20.00** ±1.81	D
ML 1191 x MUL 81	-9.53 **± 0.72	6.33**±0.60	24.13**±0.98	668.56**	46.62±0.23	0.47*±0.22	-	-7.59** ±0.34	3.32**± 0.88	-8.77** ±0.35	-
Pusa 9972 x LM 51	2.93*±0.51	2.13**±0.52	16.27**±1.95	93.50**	47.12±1.96	0.82**±0.15	-17.84** ±4.13	-11.13** ±1.94	-	6.05* ±2.25	D
ML 1191 x LM 51	3.80**±0.54	1.33*±0.56	7.93**±1.33	72.55**	41.43±0.27	1.17**±0.17	-	-3.52** ±0.34	2.47**± 0.73	-1.36** ±0.37	-
Days to maturity											
Pusa 9972 x MUL 81	-2.53**±0.56	-1.53*±0.59	8.53**±1.13	116.81**	84.73±1.20	1.68**±0.18	-33.28** ±2.84	-12.62** ±1.18	-	16.74** ±1.78	D
ML 1191 x MUL 81	1.67*±0.68	5.80**±0.44	15.13**±0.76	46.95**	75.92±0.34	2.63**±0.16	-8.86** ±0.47	-7.56** ±0.38	-4.09**± 0.70	-	-
Pusa 9972 x LM 51	-0.87±0.64	0.60±0.52	2.53±1.26	7.77	70.35±0.15	1.92**±0.15	0.07±0.25	-	-	-	-
ML 1191 x LM 51	2.13**±0.51	0.73±0.58	3.80**±0.97	23.92**	71.35±0.45	1.20**±0.15	-5.05** ±0.64	-1.99** ±0.48	1.53* ±0.67	-	-
Plant height											
Pusa 9972 x MUL 81	11.46**±2.06	18.13** ±1.60	36.66**±2.76	259.51**	54.93±0.68	4.71**±0.52	-	-11.30** ±0.90	-7.44** ±2.45	-15.50** ±0.93	-
ML 1191 x MUL 81	12.40**±1.81	-3.99±2.50	9.13*±3.87	55.02**	55.87±0.59	2.00** ±0.59	5.88* ±2.82	-	16.30** ±2.83	-8.68** ±2.83	D
Pusa 9972 x LM 51	-20.93**±2.43	-7.80**±1.75	-28.20**±2.90	128.40**	49.80±0.48	8.67**±0.48	-26.80** ±2.30	-	-12.97** ±2.49	28.40** ±2.65	D
ML 1191 x LM 51	-6.93*±0.26	-9.20**±2.94	-33.40**±4.88	47.62**	42.21±2.35	0.94±0.61	14.33** ±3.48	16.67** ±2.43	2.33 ±3.32	-	-
Branches per plant											
Pusa 9972 x MUL 81	1.42**±0.35	0.46±0.37	-2.04**±0.55	23.47	4.09**±0.07	0.44**±0.08	-1.56** ±0.40	-	-	1.86** ± 0.42	D
ML 1191 x MUL 81	-0.07±0.47	-0.53±0.48	0.73±0.70	3.82	3.46±0.14	0.36*±0.15	0.08±0.24	-	-	-	-
Pusa 9972 x LM 51	-0.35±0.42	0.66*±0.31	-1.75**±0.65	15.93**	2.37±0.71	1.01**±0.08	5.59** ±1.72	2.34** ±0.71	-	-2.98** ±1.10	D
ML 1191 x LM 51	0.20±0.47	0.40±0.50	0.80±0.71	1.44	2.96±0.11	0.27*±0.11	0.60* ±0.23	-	-	-	-
Clusters per plant											
Pusa 9972 x MUL 81	1.87±1.16	-0.33±1.03	6.33**±1.84	15.40**	11.27* ±0.34	0.87*±0.34	4.78** ±1.46	-	2.58 ±1.37	-3.58* ±1.51	D
ML 1191 x MUL 81	-0.07±0.95	-0.73±0.85	5.40**±1.66	14.50**	17.75 ±1.74	1.37**±0.26	-12.58** ±4.21	-6.13** ±1.71	-	6.90* ±2.61	D
Pusa 9972 x LM 51	-1.40±1.14	-0.80±1.07	-2.87±1.63	3.57	12.00±0.24	1.08**±0.24	-0.37 ±0.50	-	-	-	-
ML 1191 x LM 51	2.28**±0.60	1.45**±0.49	3.22±2.15	27.65**	13.05 ±0.12	1.72** ±0.12	5.65** ±0.18	-	3.61** ± 0.73	-	-
Pods per plant											
Pusa 9972 x MUL 81	12.87**±2.22	6.73**±1.99	35.20**±3.05	135.75**	49.33±1.21	2.53**±0.85	-20.72** ±1.56	-17.67** ±1.52	6.00* ±2.87	-	-
ML 1191 x MUL 81	-2.06±1.67	4.46*±2.02	16.40**±3.51	33.26**	49.20±3.44	4.67**±0.52	-23.67** ±8.33	-14.00** ±3.40	-6.53** ±2.24	11.60* ±5.31	D
Pusa 9972 x LM 51	3.44±1.76	-1.80±1.78	-1.87±3.11	6.88	35.45±0.43	1.81**±0.42	2.14* ±0.90	-	-	-	-
ML 1191 x LM 51	7.60**±1.83	8.60**±1.67	20.93**±3.48	52.08**	41.34±0.75	2.11**±0.64	-	-7.63** ±1.07	-1.31 ±2.23	-7.08** ±1.23	-
Seeds per pod											
Pusa 9972 x MUL 81	1.21**±0.33	-0.39±0.31	2.27**±0.53	34.27**	10.21±2.43	0.04±0.09	-1.24** ±0.36	-1.12** ±0.26	1.61** ±0.40	-	-
ML 1191 x MUL 81	0.71*±0.32	0.28±0.38	2.31**±0.55	20.67**	10.61±0.24	0.29**±0.10	-1.22** ±0.39	-1.18** ±0.27	-	-	-
Pusa 9972 x LM 51	-0.71*±0.29	-0.45±0.28	-0.68±0.36	8.55*	9.91±0.06	0.22**±0.06	-0.87** ±0.30	-	-0.26±0.38	0.85* ±0.32	D
ML 1191 x LM 51	-0.01±0.22	-0.25±0.29	-0.72±0.51	2.30	10.80±0.05	0.55**±0.05	0.53** ±0.02	-	-	-	-
Grain yield per plant											
Pusa 9972 x MUL 81	5.00**±0.91	-1.66*±0.71	-3.35*±1.51	34.25**	13.34±0.15	3.57**±0.15	-5.87** ±0.99	-	-3.00** ±1.09	5.44** ±1.04	D
ML 1191 x MUL 81	-5.21**±0.69	1.83*±0.73	-3.59*±1.33	83.22**	13.67±0.13	3.84**±0.13	-2.93** ±0.85	-	7.04** ±0.84	3.46** ±1.04	D
Pusa 9972 x LM 51	3.48**±0.58	-1.14±0.80	9.25**±0.16	70.08**	17.64±0.64	0.47**±0.14	-5.32** ±0.76	-3.85** ±0.67	4.15** ±0.91	-	-
ML 1191 x LM 51	1.03±0.54	-0.21±0.47	3.67**±0.96	19.61**	13.78±0.43	1.40**±0.14	-2.27** ±0.57	-1.65** ±0.46	1.39* ±0.65	-	-
100 grain weight											
Pusa 9972 x MUL 81	3.01**±0.22	-1.87**±0.15	-4.96**±0.38	314.70**	4.48±0.07	1.23**±0.23	-4.43** ±0.29	-	-1.15** ±0.23	4.90** ±0.28	D
ML 1191 x MUL 81	-1.56**±0.14	-0.47**±0.12	-3.30**±0.44	148.79**	3.11±0.07	0.62**±0.05	-	0.99** ±0.09	-1.10** ±0.14	1.09** ±0.13	-
Pusa 9972 x LM 51	1.00**±0.28	0.65*±0.30	2.74**±0.50	43.36**	4.77±0.13	0.71**±0.05	-	0.50** ±0.14	0.33 ±0.40	-1.45** ±0.14	-
ML 1191 x LM 51	-0.58**±0.18	-0.56**±0.14	-0.45±0.34	22.41**	4.66±0.34	0.62**±0.04	-3.01** ±0.78	-0.68* ±0.34	-	1.82** ±0.48	D

[d] component was significant in crosses ML 1191 x MUL 81, Pusa 9972 x LM 51 and ML 1191 x LM 51 indicating importance of additive gene effects. Dominance component was significant in all the crosses but higher in magnitude than additive component for crosses Pusa 9972 x MUL 81, ML 1191 x MUL 81 and Pusa 9972 x LM 51 and was negative.It also indicated that dominance gene effects also control the expression of number of seeds per pod. So, in the crosses with significant additive effects, line selection should be followed but in crosses with significant and negative [h] effects, the selection should be deffered to later generations.

For crosses Pusa 9972 x MUL 81 and ML 1191 x MUL 81, additive x additive [i] interaction was significant.Additive x dominance [j] epistasis was important for cross Pusa 9972 x MUL 81 only. Dominance x dominance [l] interaction was significant in cross Pusa 9972 x LM 51 only for which duplicate epistasis was detected. Srinives *et al* (16), Saxena and Sharma (15) and Naidu and Satyanarayana (12) also showed the importance of additive as well as non-additive gene effects.

Grain yield per plant : Epistasis was detected in all the four crosses as indicated by scaling and joint scaling tests. Additive and dominance gene effects were significant for all the four crosses but magnitude of dominance component [h] was higher than additive component [d] in all the crosses except in cross ML 1191 x MUL 81. The additive x additive [i] type interaction was significant for crosses Pusa 9972 x LM 51 and ML 1191 x LM 51 and dominance x dominance [l] type interaction was significant in crosses Pusa 9972 x MUL 81 and ML 1191 x MUL 81. Additive x dominance [j] interaction was significant for all the four crosses. It indicated that in addition to additive and dominance gene effects, grain yield is also influenced by epistatic effects. Similar observations were reported by Brar (1). Duplicate epistasis was observed for crosses Pusa 9972 x MUL 81 and ML 1191 x MUL 81. Malik and Singh (9), Brar (1) and Thimmappa (17) reported similar results from their studies on mungbean.

100-grain weight : For all the crosses, scaling and joint scaling tests were significant indicating the presence of non-allelic interactions. Additive gene effects were significant in all the four crosses and can be exploited through simple line selection. Dominance component was significant and of higher magnitude but was negative in crosses Pusa 9972 x MUL 81 and ML 1191 x LM 51. It indicated that dominance component was more important but its negative sign indicated that dominance decreased the expression and selection will be effective during later generations. The additive x additive [i] epistasis was significant in three crosses ML 1191 x MUL 81, Pusa 9972 x LM 51 and ML 1191 x LM 51, while additive x dominance[j] type epistasis was important and significant in crosses *viz.*, Pusa 9972 x MUL 81 and ML 1191 x MUL 81, and Pusa 9972 x LM 51. Dominance x dominance [l] gene interaction was significant for all the four crosses. All the three gene effects *viz.*, additive, dominance and epistatic were important for this trait. Importance of additive gene effects was also reported by Thimmapa (17) and Patil *et al* (13). Both additive and non-additive gene effects were reported important by Naidu and Satyanrayana (12) and Khattak *et al* (8). Duplicate epistasis was reported for cross Pusa 9972 x MUL 81 and ML 1191 x LM 51.

From above mentioned results it is suggested that for a particular cross for which additive [d] component was significant, simple line selection can be useful. But due to higher magnitude of dominance component and its negative sign, the selection should be defered to later generations. Presence of duplicate epistasis will decrease variation in F_2 and subsequent generations. So, for the improvement of yield and its components by exploiting all the three types of gene effects, the breeding strategies like recurrent selection *i.e.* selection following hybridization and intermating of superior selects in segregating generations will be useful. It will help in breaking gene constellations and will lead to release of free variability for effective selection.

LITERATURE CITED

1. Brar, J.S. 1985. Genetic architecture of grain yield and its components in mungbean (*Vigna radiata* (L.) Wilczek). Ph.D. thesis Punjab Agricultural University, Ludhiana.

2. Chhabra, A.K. and Singh, V.P. 1988. Genetics of phenological and yield attributes in mungbean. *Indian Journal of Pulses Research* 1: 77-79.

3. Deshmukh, R.B. and Manjare, M.R. 1980. Combining ability in mungbean (*Vigna radiata* (L.) Wilczek). *Legume Research* 3: 97-101.

4. Godhari, P.R., Jasani, B.G. and Patil, G. J. 1979. Epistatic and genetic variances in greengram. varieties. *Gujarat Agricultural University Research Journal* 4: 1-6.

5. Hayman, B.I. 1958. The separation of epistatic from additive and dominance variation in generation means. *Heredity* 12: 371-390.

6. Jahagirdar, J.E. 2001. Heterosis and combining ability studies for seed yield components in mungbean. *Indian Journal of Pulses Research* 14: 141-142

7. Kalita, T. and Hazarika, G.N. 1997. Inheritance of yield attributing traits in mungbean. *Indian Journal of Pulses Research* 10 : 49-52.

8. Khattak, G.S.S., Ashraf, M., Haq, M.A. and Srinives, P. 2002. Genetic architecture of seed yield and yield components in mungbean (*Vigna radiata* (L.) Wilczek) *Tropical Agriculture* 79: 260-264.

9. Malik, B.P.S. and Singh, V.P.1983. Genetics of some metric traits in green gram. *Indian Journal of Agricultural. Sciences* 53: 1002-1005.

10. Mather, K. 1949. *Biometrical Genetics*. Dover Publication Inc New York

11. Mukar, H.S.1987. Inheritance of quantitative characters in summer mung [*Vigna radiata* (L.) Wilczek]. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.

12. Naidu, N.V. and Satyanarayana, A. 1993. Heterosis and combining

ability in mungbean. [*Vigna radiata* (L.) Wilczek]. *Indian Journal of Pulses Research* 6: 38-44.

13. Patil, V.S., Deshmukh, R.B. and Patil, J.V. 1996. Genetic analysis of quantitative characters in mungbean. *Indian Journal of Pulses Research* 9: 132-136.

14. Rahul, K. 2003. Generation mean analysis of yield and yield attributes in mungbean. In : National Symposiium on "Pulses for Crop Diversification and Natural Resource Management" IIPR Kanpur, Abstract pp. 81.

15. Saxena, S.D. and Sharma, R.K. 1993. Combining abilities for yield in greengram (*Vigna radiata* (L.) Wilczek). *Legume Research* 16: 13-16.

16. Srinives, P., Tangbuoutivong, W. and Griffing, B.1991. Genetic study of yield components in mungbean (*Vigna radiata* (L.) Wilczek) grown in dry and wet seasons. *Journal of National Research Council, Thiland* 23: 1-13.

17. Thimmappa, A.S. 1987. Genetic analysis of quantitative traits in greengram. *Mysore Journal of Agricultural Science* 21: 94-96.