SHORT COMMUNICATION Legume Research- An International Journal, Volume 43 Issue 1: 151-154 (February 2020)

Combining ability analysis for yield and yield components in mungbean [*Vigna radiata* (L.) Wilczek]

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10.18805/LR-4063

ABSTRACT

Combining ability analysis for yield and yield components of mungbean [*Vigna radiata* (L.) Wilczek] was attempted using an 8 x 8 diallel mating system both in F_1 and F_2 generations. Both gca and sca mean squares were significant for all the eleven characters in F_1 and F_2 generations, former being more pronounced for clusters per plant, pods per cluster, pods per plant, pod length, seeds per pod, 100-seed weight and seed yield per plant in F_1 and for all the characters except days to maturity, seeds per pod and 100-seed weight in F_2. The parent K 851 was a good general combiner for seed yield per plant, days to maturity, plant height, primary branches per plant, clusters per plant, pods per plant and seeds per pod in both generations, while Pant-M 4 was good general combiner for seed yield per plant, plant height, pods per cluster and pods per plant over generations. Parents RMG 62 and Asha were the best combiners for early flowering. GM 4 had good general combining ability for seed yield in F_1, but for pod length and 100-seed weight in F_1 and F_2. The crosses showing high sca effects for seed yield also had significant and positive effects for at least two important yield components.

Key words: Combining ability, Diallel, Heterosis, Mungbean.

Mungbean is an excellent and cheap source of high quality and easily digestible protein. It is also a short duration legume widely grown in south and Southeast Asia. It is cultivated under both irrigated and rainfed condition in India. Information on gene effects controlling various characters is of utmost importance in deciding efficient breeding plans over time and space. Combining ability analyses, besides yielding this information, identify the desirable parents and crosses for further exploitation. Since very scanty information on simultaneous evaluation of homogenous and heterogeneous populations is available, this study was planned.

An 8 × 8 diallel cross was made without reciprocals during summer season using eight mungbean parents. These parents, their 28 F_1s and 28 F_2s were sown in randomized block design replicated thrice at Junagadh Agricultural University, Junagadh during summer 2015. In each replication, parents and F_1s were grown in 4.0 m long single row and F_2s in two row plots with 45 x 10 cm spacing. Observations for eleven characters (Table 1) were recovered on five randomly selected plants of the parents and F_1 and 20 plants in each F_2 populations. The character means were subjected to combining ability analysis following Model-I, method 2 of Griffing 1956.

The mean squares due to general combining ability (gca) and specific combining ability (sca) were highly significant in F_1 and F_2 generations for all the eleven characters *viz*., days to flowering, days to maturity, plant height (cm), primary branches per plant, clusters per plant, pods per cluster, pods per plant, pod length (cm), seeds per pod, 100-seed weight (g) and seed yield per plant (g) (Table 1), suggesting that both additive and non-additive gene effects were involved in the expression of these characters in both the generations. As regards their magnitude of variance, the specific combining ability was relatively higher than the general combining ability for all the characters which suggested predominance of non-additive gene action for the inheritance of these traits. These results are further supported by σ^2gca/σ^2sca with less than one value for all the characters in both F_1 and F_2 generations. The present findings were in close agreement with earlier reports of Patil *et al.,* (2011); Kujur and Lavanya, (2011); Narasimhulu *et al.*, (2014); Khaimichho *et al.*, (2016); Purohit *et al.*, (2016); Nath *et al.*, (2017); Zuge Sopan *et al.*, (2018); Swarn Latha *et al.*, (2018) and Reddy *et al.*, (2019).

The estimates of gca effects (Table 2) revealed K 851 and Pant-M 4 as good general combiners for seed yield per plant over generations, while GM 4 was recognised as good general combiner in F_1 generation only. Based on higher positive and significant gca effects, parent K 851 was identified as the best general combiner for seed yield per

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How to cite this article: Rathod V., Pithia, M.S. and Solanki, H.V. (2020). Combining ability analysis for yield and yield components in mungbean [*Vigna radiata* (L.) Wilczek]. Legume Research. 43(1): 151-154.

Submitted: 20-07-2018 **Accepted:** 16-03-2019 **Published:** 14-08-2019

Table 1: Analysis of variance for combining ability in F_1 and F_2 generations of mungbean.

Source	Gene-ration	d. f.	Mean squares										
			Days to flowering	Days to maturity	Plant height	Primary branches per plant	Clusters per plant	Pods per clusters	Pods per plant	Pod length	Seeds per pod	100-seed weight	Seed yield per plant
gca	F_1	7	2.70 **	12.70 **	322.92 **	0.40**	69.52**	0.27**	417.75**	0.94**	1.90**	1.61**	28.66**
	F_2	7	6.03 **	7.37 **	39.75 **	0.28**	43.99**	0.40**	229.35**	0.41**	1.71**	0.76**	15.96**
sca	F_1	28	7.46 **	15.89 **	734.03 **	0.41**	40.67**	0.16 *	270.13**	0.45**	1.14**	0.28**	25.07**
	F_2	28	5.86 **	16.04 **	26.42 **	0.14**	14.82**	0.14**	151.82**	0.38**	1.74**	1.19**	13.69**
Error	F_1	70	0.16	0.92	124.38	0.41	2.79	0.08	26.88	0.02	0.31	0.02	0.55
	F_2	70	0.41	0.73	1.42	0.05	1.56	0.06	12.51	0.02	0.31	0.01	0.48

*, ** Significant at 5% and 1% levels, respectively.

Table 2: General combining ability effects for eleven traits in F_1 and F_2 generations.

Parents	Days to flowering		Days to maturity		Plant height		Primary branches per plant		Clusters per plant		Pods per cluster	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
GM 4	-0.25 *	0.58 **	-0.74**	0.86**	0.99 *	-0.02	-0.26**	-0.23**	-2.78**	-1.92**	0.10	0.38 **
K 851	-0.18	0.92 **	-1.98**	-1.51**	3.16 **	2.45 **	0.28 **	0.20**	5.48**	4.55 **	0.008	-0.16 *
Vaibhav	0.08	0.42 *	0.66 *	1.26**	1.19 **	2.01 **	-0.26**	-0.20**	-2.68**	-0.65	-0.03	-0.13
RMG 62	-0.98**	-0.38 *	0.73 *	0.46	-1.51**	-2.55**	0.18 *	0.10	-0.02	0.18	-0.09	-0.19**
OUM 11-5	0.62 **	0.15	0.03	-0.48	-2.92**	-2.27**	-0.13	-0.07	0.02	-2.22**	-0.19 *	-0.13
CO 5	0.62 **	0.52 **	0.79 **	-0.14	0.56	0.83 *	0.04	-0.07	0.42	0.38	-0.06	-0.06
Asha	0.22	-1.18**	-0.91**	-0.28	-2.70**	-1.86**	0.008	0.07	-1.52**	-0.82 *	-0.09	0.11
Pant-M 4	-0.12	-1.02**	1.43 **	-0.18	1.22 **	1.40 **	0.14	0.20**	1.08 *	0.48	0.34 **	0.18 *

Table 2: Continue.....

Parents	Pods per plant		Pod length		Seeds per pod		100-seed weight		Seed yield per plant	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
GM 4	-5.73**	-0.91	0.40 **	0.26 **	0.17	-0.22	0.79 **	0.42**	0.75 **	0.28
K 851	12.00**	9.63 **	0.11 **	0.06	0.93**	0.98 **	-0.48**	-0.49**	3.49 **	2.39 **
Vaibhav	-6.90**	-2.91**	0.48 **	0.34 **	-0.30	-0.15	0.38 **	0.13**	-1.25**	-1.46**
RMG 62	-1.00	-1.44	-0.13**	-0.07	-0.13	0.05	-0.035	0.03	-1.19**	-0.26
OUM 11-5	-0.63	-6.64**	-0.40**	-0.21**	-0.47**	-0.28	-0.29**	0.05	-0.59**	-1.50**
CO 5	1.57	1.53	-0.21**	-0.20**	-0.30	-0.12	-0.13**	0.04	-1.56**	0.08
Asha	-5.30**	-1.84	-0.12**	-0.10 *	-0.03	-0.02	-0.12**	0.11**	-0.69**	0.40
Pant-M 4	6.00 **	2.59 *	-0.12**	-0.08 *	0.13	-0.25	-0.11**	-0.29**	1.05 **	0.87 **

*, ** Significant at 5% and 1% levels, respectively.

plant, days to maturity, plant height, primary branches per plant, clusters per plant, pods per plant and seeds per pod in both generations. Another Parent Pant-M 4 has also positive and significant gca effects for seed yield per plant, plant height, pods per cluster and pods per plant over generations. GM 4 had good general combining ability for seed yield in F_1 only, but for pod length and 100-seed weight in both the generations. Parent RMG 62 possessed favourable genes for early flowering as it had negative and significant gca effects in F_1 and F_2. Desirable gca effect for plant height was observed in Vaibhav in both the generations along with K 851 and Pant-M 4 but in CO 5 in F_2 only. For early maturity, good general combiners identified were GM 4 and Asha in F_1 only. Though none of the parents was a good general combiner for all the characters, however, the breeding material generated using the parents K 851, Pant-M 4 and GM 4 would be promising for isolation of high yielding lines. It was observed that none of the parents showed good general combiner for all the characters. These results were getting support from earlier studies by Patel *et al.* (2008); Patil *et al.* (2011); Narasimhulu *et al.* (2014); Vaidya *et al.* (2015); Bhavani *et al.* (2016); Nath *et al.* (2017); Nath *et al.* (2018); Swarn Latha *et al.* (2018) and Kakde *et al.* (2019).

As regards sca effects, 17 crosses, in F_1 and 13 in F_2 generation gave significantly sca effects for seed yield, which was reflected through significant and desirable sca effects in at least three component characters (Table 3). All the

Table 3: Best crosses exhibiting maximum sca effect for seed yield and other characters, gca effects of parents involved and heterosis for seed yield.

Crosses	sca effect	gca effect		Heterosis		Components with significant sca effects
		P_1	P_2	BP	SV	
F_1 generation						
GM 4 x K 851	1.52**	0.75**	3.49**	35.91**	35.91**	DF, PC, SW
GM 4 x Vaibhav	2.36**	0.75**	-1.25**	79.43**	3.69	DM, PH, CP, PP, SP
GM 4 x RMG 62	1.95**	0.75**	-1.19**	62.77**	0.83	DM, PH, PBP, PC, PL, SW
GM 4 x OUM 11-5	4.00**	0.75**	-0.59**	112.33**	22.70*	DM, CP,PP, SP
GM 4 x Asha	0.39**	0.75**	-0.69**	59.29**	-7.95	DM, PC, SW
GM 4 x Pant-M 4	2.55**	0.75**	1.05**	29.37**	24.24**	DF, PH, PBP, CP, PP, PL
K 851 x RMG 62	1.56**	3.49**	-1.19**	21.44*	20.31*	DM, PBP, PC, PP, PL
K 851 x OUM 11-5	13.11**	3.49**	-0.59**	122.61**	120.53**	DF, DM, PH, PBP, CP, PP, PL
K 851 x Asha	3.49**	3.49**	-0.69**	41.58**	40.26**	DM, PH, PBP, CP, PP, PL, SP
Vaibhav x OUM 11-5	4.05**	-1.25**	-0.59**	152.18**	6.66	DM, PH, PBP, CP, PC, PP, PL, SP, SW
Vaibhav x CO 5	0.37**	-1.25**	-1.56**	14.51	-31.81**	DF, DM, PBP, CP, PL, SP, SW
Vaibhav x Asha	8.88**	-1.25**	-0.69**	200.17**	45.62**	PBP, CP, PP, PL
RMG 62 x CO 5	0.46**	-1.19**	-1.56**	5.29	-30.46**	DF, PBP, CP, PC, PP, PL
RMG 62 x Pant-M 4	0.10**	-1.19**	1.05**	-8.28	-11.92	PBP, PC, PP
OUM 11-5 x Asha	0.31**	-0.59**	-0.69**	65.74**	-19.59*	PBP, CP, PC, PP
CO 5 x Asha	0.47**	-1.56**	-0.69**	27.52	-26.31**	PH, PC, PP, PL, SP
CO 5 x Pant-M 4	10.97**	-1.56**	1.05**	81.86**	74.66**	PH, PBP, CP, PC, PP
F_2 generation						
GM 4 x K 851	2.99**	0.28	2.39**	-	-	PBP, PC, PP, SW
GM 4 x RMG 62	7.76**	0.28	-0.26	-	-	PBP, CP, PC, PL, SW
GM 4 x OUM 11-5	3.52**	0.28	-1.50**	-	-	DF, PH, CP, PC, PP, PL, SP, SW
K 851 x Vaibhav	5.35**	2.39**	-1.46**	-	-	PBP, CP, PP
K 851 x Pant-M 4	4.30**	2.39**	0.87**	-	-	DM, PH, PBP, CP
Vaibhav x OUM 11-5	1.38**	-1.46**	-1.50**	-	-	DF, PH, PBP, CP, SW
Vaibhav x Asha	4.00**	-1.46**	0.40	-	-	DF, PL, SW
Vaibhav x Pant-M 4	0.85**	-1.46**	0.87**	-	-	PH, PC, PL, SP
RMG 62 x OUM 11-5	5.36**	-0.26	-1.50**	-	-	DM, PH, PBP, CP, PC, SW
OUM 11-5 x Asha	0.16**	-1.50**	0.40	-	-	PBP, CP, PP
CO 5 x Asha	5.17**	0.08	0.40	-	-	DF, PH, PC, PP, PL, SP
CO 5 x Pant-M 4	3.15**	0.08	0.87**	-	-	DF, PH, CP, PC, PP
Asha x Pant-M 4	0.64**	0.40	0.87**	-	-	PBP, CP, PC, PP

*, ** Significant at 5% and 1% levels, respectively.

DF= days to flowering, DM= days to maturity, PH= plant height, PBP= primary branches per plant, CP= clusters per plant, PC= pods per cluster, PP= pods per plant, PL= pod length, SP=seeds per pod, SW= 100-seed weight.

crosses exhibited significant heterosis over better parent except crosses Vaibhav x CO 5, RMG 62 x CO 5, RMG 62 x Pant-M 4 and CO 5 x Asha, while most the crosses also registered significant and positive heterosis over standard variety GM 4 except GM 4 x Vaibhav, GM 4 x RMG 62, GM 4 x Asha, Vaibhav x OUM 11-5, Vaibhav x CO 5, RMG 62 x CO 5, RMG 62 x Pant-M 4, OUM 11-5 x Asha and CO 5 x Asha suggesting that sca effects and heterotic response are related. On the other hand, the high x high combiners in the F_1 and F_2 for all the remaining crosses could be utilized for production of high yielding homozygous lines through straight selection as their significant sca effects are expressed due to additive and additive x additive gene effects, which are fixable.

REFERENCES

Bhavani, R.T., Chauhan, R.M., Patel, J.R., Patel Dixita K., Patel, R.A. (2016). Combining ability studies for grain yield and architectural traits in mungbean [*Vigna radiata* (L.) Wilczek]. Bioscan. 11: 1871-1876.

Griffing, B. (1956). Concept of general and specific combining ability in relation to diallel crossing systems. Aust. J. Biol. Sci. 9: 463-493.

Kakde, S.S., Gawate, A.B., Mandge, S.V. (2019). Estimation of combining ability effect in mungbean [*Vigna radiata* (L.) Wilczek]. Int. J. Curr. Microbiol. App. Sci. 8: 1668-1674.

Khaimichho, Elizabeth B., Hijam, Lakshmi, Sarkar, K.K., Mukherjee, S. (2016). Estimation of combining ability and heterosis for yield related characters with protein content in seed of mungbean. Electronic Journal of Plant Breeding. 7: 849-856.

Kujur, S.N. and Lavanya, G.R. (2011). Combining ability studies in mungbean. J. Fd. Legumes. 24: 239-241.

Narasimhulu, R., Naidu, N.V., Reddy, K.H.P., Naidu, G.N. (2014). Combining ability for yield attributes in greengram [*Vigna radiata* (L.) Wilczeck]. Bioscan. 9: 1667-1671.

Nath, Anamika, Maloo, S.R., Baudh, Bharti, Dubey, R.B., Verma, Rajani. (2017). Combining ability analysis in mungbean [*Vigna radiata* (L.) Wilczek]. Legume Res. 40: 1-7.

Nath, Anamika, Maloo, S.R., Nath, S., Yadav, G.S. (2018). Combining ability analysis for seed protein and methionine content in green gram [*Vigna radiata* (L.) wilczek]. Indian J. Agric. Res. 52: 34-39.

Patel, J.D., Naik, M.R., Chaudhari, K.O, Vaghela, K.O., Kodappully, V.C. (2008). Diallel analysis for yield contributing characters in green gram [*Vigna radiata* (L.) Wilczek]. Res. Crops. 9: 663-665.

Patil, A.B., Desai, N.C., Mule, P.N., Khandelwal, V. (2011). Combining ability for yield and component characters in mungbean [*Vigna radiata* (L.) Wilczek]. Legume Res. 34: 190–195.

Purohit, Y., Ravindrababu, Y., Gami, R.A., Patel, M.P., Patel, P.T., Patel, A.M. (2016). Combining ability analysis for seed yield, its component and protein content in mungbean [*Vigna radiata* (L.) Wilczek]. Bioscan. 11: 2981-2985.

Reddy, B.R.K., Reddy, K.H.P., Reddy, D.M., Sudhakar, P., Reddy, R.R. (2019). Combining ability analysis for yield, yield attributes and water use efficiency traits in mungbean. Int. J. Chem. Stud. 7: 1015-1019.

Swarna Latha V., Eswari, K. B., Kumar, S. (2018). Combining ability analysis for seed yield and its component characters in greengram [*Vigna radiata* (L.) Wilczek]. Int. J. Chem. Stud. 6: 237-242.

Vaidya, G.B., Chauhan, D.A., Narwade, A.V., Kale, B.H., Patil, A.B. (2015). Combining ability for yield and yield attributing characters in rabi mungbean [*Vigna radiata* (L.) Wilczek.]. IJBS, 2 l: 21-24.

Zuge Sopan S., Sao, A., Nanda, H. C., Nair, S. K. (2018). Combining ability analysis for seed yield, its contributing traits and protein content in Mungbean [*Vigna radiata* (L.) Wilczek]. Int. J. Chem. Stud. 6: 761-764.