Plant Archives Vol. 24, No. 1, 2024 pp. 325-330 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.1.046

COMBINING ABILITY ANALYSIS FOR YIELD AND YIELD CONTRIBUTING TRAITS IN MUNGBEAN [*VIGNA RADIATA* (L.) WILCZEK]

Shagun Nehra[1]*, Atar Singh[1], Pooran Chand[1], L.K. Gangawar[1], Vaishali[2], Gaurav Sharma[2] and Vivek Kumar[2]

[1]Department of Genetics and Plant Breeding, Sardar Vallabhbhai Patel University, Meerut, U.P., India.

[2]Department of Agricultural Biotechnology, Sardar Vallabhbhai Patel University, Meerut, U.P., India.

*Corresponding author E-mail : nehrashagun22@gmail.com

(Date of Receiving-15-10-2023; Date of Acceptance-22-01-2024)

ABSTRACT

The present investigation was carried out at C .R.C, Sardar Vallabhbhai Patel University, Meerut during *Kharif* seasons 2021and 2022. The material for the present investigation comprised ten parents as female and four as male which were crossed in Line x Tester fashion to estimate the combining ability for yield and yield attributing traits in mungbean. Analysis of variance revealed significant differences among genotypes, crosses, lines, testers and line x tester interactions for most of the traits. The parents showed high GCA can be used for the future hybridization program. The GCA estimates of lines and testers emphasized the importance of lines IPM-99-123, IPM-2-3, Pusa-9531, PDM-139, IPM-512-1, IMH-521 and tester Kanika for their use as desirable parents for enhancing the yield potential through assembling the favorable genes for yield and yield components. The crosses, which showed high SCA effect could be used for the hybrid development. The high yielding crosses *viz*., IPM-2-3 X Versha, PDM-139 X Versha, IPM2-14 X Kanika were found to be the superior for seed yield and yield component and should be further tested across the different environment for their stability performance.

Key words : GCA, SCA, Tester, Combining ability, Variance.

Introduction

Mungbean [*Vigna radiata* (L.) Wilczek] is also known as greengram, an important short duration grain legume with wide adoptability. There are 3 subgroups of *Vigna radiata*, one is cultivated (*Vigna radiata* subsp. *radiata*) and two are wild (*Vigna radiata* subsp. *sublobata*) and (*Vigna radiata* subsp. *glabra*). Mungbean is one of the most widely grown edible legumes in Asia, plays an important roles in the improvement of agricultural cultivation system as well as human diets. Mungbean is an annual crop that is highly branched and is about 60-76 cm tall (Oplinger *et al.*, 1990) with a slight tendency of twinning in upper branches. It is a tiny circular shaped bean in green color widely cultivated throughout Asia, including India, Pakistan, Bangladesh, Srilanka, Thailand, Laos, Cambodia, Vietnam, Indonesia, Malaysia, South China. The origin of mungbean is supposed to be India (Decandole, 1886; Vavilov, 1926 and Zukoveshij, 1962). Mungbean is a source of high quality protein, which can be consumed as whole grains, dhal, or sprouted form and is an excellent complement to rice in respect to balanced human nutrition. Besides their high nutritional value, they have a unique characteristic of maintaining and restoring soil fertility through biological nitrogen fixation and thus play a vital role in sustainable agriculture (Asthana, 1998). Among pulses mungbean is capable of tolerating moderate drought and heat stress and has a significant role in rainfed agriculture across arid and semi arid areas (Pratap *et al*., 2019). Because of low yield potential, relatively smaller seed size and susceptibility to diseases, the present yield potential of improved varieties is not satisfying to meet the need of farmers. There is a need to increase production and productivity for food and nutritional security, which requires efforts to enhance genetic yield potential of the existing varieties. Hence the Line × Tester analysis was adopted in present study

to gather information on GCA (general combining abilities) and SCA (specific combining abilities) of parents and simultaneously estimating various types of gene effects involved in the expression of seed yield and related attributes in greengram. Study of combining ability in mungbean is an important for the plant breeder to find out the superior crosses in first generation itself.

Materials and Methods

The parent for experiment included four genotypes of mungbean [*Vigna radiata* (L.) Wilczek)] as males (Tester) Versha, Kanika, Vasudha, IPM-2057. Ten varieties as females are IPM-05-2-8, Pusa-9531, IPM-0219, IMH-521 IPM-2-3, PDM-139. IPM99-123, IPM-512-1, IPM-2-14, IPM409-4. Each female were crossed with four selected male genotypes in L X T mating system at C.R.C, Sardar Vallabhbhai Patel University Meerut during *Kharif* seasons 2021 and 2022. All the genotypes (Fourteen parent and 54 F_1's) were evaluated in Randomized Block Design with three replication during kharif, 2021. Each F_1s were planted in two row and parents in five rows. The length of the rows was kept 3 meter and spacing between the row to row 30 cm and plant to plant distance was maintained 10 cm by proper thinning. Recommended agronomic and plant protection package of practice were followed to raise healthy crop. Data were recorded on five randomly selected competitive plants in each genotype and replication. Mean value on per plant basis were recorded for the characters, *viz*., days to 50% flowering, days to maturity, plant height, number of branches per plant, number of secondary branches, number of pod per plant, number of cluster per plant, number of pods per cluster, pod length, single pod weight, number of seeds per pod, biological yield per plant (g), total weight of pods (g), harvest index, 100-seed weight, seed yield per plant.

Results and Discussion

Analysis of Variance for combining ability was performed based on F_1's and the results are presented in Table 1.

The variance among lines with respect to gca was showed significant differences for all the characters under study *viz*; days to 50% flowering, days to maturity, plant height, number of branches per plant, number of secondary branches per plant, number of pods per plant, number of cluster per plant, number of pod per cluster, pod length, single pod weight, number of seeds per pod, biological yield per plant, total weight of pods, harvest index, 100-seed weight, seed yield per plant. Variance among testers with respect to gca was also observed significant for all the characters. Variances among crosses

Table 1 : Analysis of variance for combining ability of seed yield and its components in Mungbean.

Characters	df	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches per plant	No. of secondary branches	No. of pods per plant	No. of cluster per plant	No. of pods per cluster
Rep.	2	3.03	9.16	13.79	0.02	1.08	9.78	1.43	0.27
Crosses	39	22.08**	40.49**	171.10**	2.03**	10.74**	23.17*	9.90**	3.53**
Lines	9	80.39**	107.39**	658.28**	8.38**	42.85**	84.62***	29.83**	11.96**
Testers	3	11.08**	131.34**	178.21**	0.12**	1.98**	10.25**	12.35**	5.57**
LxT	27	3.87**	8.10**	7.92**	0.12**	1.00**	4.13**	2.99**	0.49**
Error	78	0.80	0.79	0.54	0.00	0.02	0.33	0.02	0.08
Total	119	7.81	13.94	56.66	0.67	3.55	7.98	3.28	1.21

Table 1 continued....

Table 1 continued....

Characters	df	Pod length (cm)	Single pod weight (g)	No of seeds per pod	Biological yield (g/plant)	Total weight of pods (g/plant)	Harvest index (%)	100 seed weight	Seed yield per plant (g)
Rep.	2	0.03	0.0000	1.36	16.16	0.76	3.83	0.17	5.05
Crosses	39	2.43**	0.0095**	3.54**	43.85**	4421.15**	22.83**	0.95**	6.56**
Lines	9	8.00**	0.0403**	14.24**	115.94**	15710.16**	79.67**	4.06**	27.13**
Testers	3	4.18**	0.0012**	2.68**	35.78**	717.56**	5.65**	0.06**	1.15**
L × T	27	0.38**	0.0001**	0.06**	20.72**	1069.65**	5.79**	0.01	0.31
Error	78	0.01	0.0000	0.02	0.35	0.58	0.75	0.01	0.19
Total	119	0.80	0.0031	1.19	14.87	1449.34	8.03	0.32	2.36

due to interaction between lines × tester's genotypes with respect to sca were exhibited significant difference for all the traits except 100-seed weight and seed yield per plant showed its existence among the tester and hybrid population respectively for these sixteen traits. This indicated the presence of significant differences between males and females.

On the basis of overall performance both general combining ability effects and per se performance (Table 2) among the parents the line namely, IPM-99-123 was identified as good general combiner for maximum 12 characters namely plant height (cm), no of branches per plant, no of secondary branches, no of pods per plant, no of cluster per plant, no of pods per cluster, no. of seeds per pod, pod length, biological yield (g/plant), total weight of pods (g/plant), 100 seed weight, seed yield (g/plant). IPM-2-3 for 8 characters namely plant height (cm), no of secondary branches, no of pods per plant, no of cluster per plant, no of pods per cluster, total weight of pods, harvest index (%), seed yield (g/plant). Pusa-9531, PDM-139, IPM-512-1 are the good combiners for seven characters. IMH-521 and tester Kanika have good combining ability for about 5 characters, while among the tester Versha exhibited combining ability for about 9 characters.similar results were reported by Jahagirdar (2001), Kute *et al*. (1999), Aher *et al.* (1999), Singh (2005), Barad *et al*. (2008), Patil *et al*. (2011) and Surashe *et al.* (2017). These diversified parents may be handled in suitable breeding programme to incorporate the genetic potential to combine for production of desirable recombinants and/or can be put in central gene pool for utilization in future breeding programme.

Out of the 40 F_1's, only three crosses IPM-2-3 X Versha, PDM-139 X Versha, IPM2-14 X Kanika (Table 3) showed significant and positive specific combining ability effects indicated that these combinations were found to be as good specific combiners for seed yield per plant. The cross IPM-2-3 X Versha had high sca effect for characters; no of pods per plant, no of cluster per plant, no of pods per cluster, total weight of pods, harvest index, seed yield per plant. Hybrid PDM-139 X Versha shows high sca effect for pod length, Biological yield while the cross combination IPM2-14 X Kanika had high sca and significant effect for characters harvest index, seed yield. These results are in agreement with the findings of Natarajan *et al*. (1990), Aher *et al*. (2001), Singh and Dixit (2003), Patel *et al*. (2008). Aperusal of the GCA status of the parents involved in these crosses showed High × High and High × low parental combinations. High × High combinations indicates the involvement of additive or A X A gene interaction which

Table 2 : Estimate of GCA effects and per se performance of parents for seed yield and its components in Mungbean.

S. no.	Parents	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches per plant	No. of secondary branches	No. of pods per plant	No. of cluster per plant	No. of pods per cluster
	Line								
1	IPM-05-2-8	-3.15 **	-1.50 **	2.56 **	-0.30 **	-0.46 **	2.93 **	1.80 **	-0.45 **
2	PUSA -9531	-1.32 **	-1.00 **	-5.48 **	1.46 **	3.27 **	0.72 **	0.51 **	0.56 **
3	IPM-0219	0.43	-1.58 **	-6.52 **	-0.60 **	-0.66 **	-1.82 **	-0.91 **	-0.45 **
4	IMH-521	5.10 **	4.75 **	-5.79 **	-0.17 **	-3.00 **	1.92 **	0.60 **	0.98 **
5	IPM-2-3	0.10	4.25 **	10.85 **	-0.24 **	0.09 *	2.68 **	1.74 **	1.32 **
6	PDM-139	3.93 **	3.67 **	-0.63 **	1.42 **	2.64 **	-2.64 **	-1.42 **	-0.27 **
7	IPM99-123	-0.82 **	-1.83 **	11.89 **	0.41 **	1.02 **	3.67 **	2.33 **	1.44 **
8	IPM 512-1	-1.15 **	-3.42 **	-8.12 **	-0.47 **	-0.30 **	-3.09 **	-1.48 **	-1.25 **
9	IPM 2-14	-1.73 **	-1.42 **	5.87 **	-0.57 **	-0.88 **	-1.64 **	-1.68 **	-0.70 **
10	IPM 409-4	-1.40 **	-1.92 **	-4.62 **	-0.94 **	-1.72 **	-2.73 **	-1.49 **	-1.17 **
	Tester								
11	VERSHA	0.58 **	2.32 **	2.92 **	-0.07 **	-0.29 **	0.37 **	0.51 **	0.44 **
12	KANIKA	0.42 *	1.22 **	0.85 **	0.01	0.16 **	-0.83 **	-0.78 **	-0.19 **
13	VASUDHA	-0.28	-1.92 **	-1.03 **	0.08 **	0.27 **	0.00	-0.27 **	-0.51 **
14	IPM-2057	-0.72 **	-1.62 **	-2.74 **	-0.02 *	-0.13 **	0.45 **	0.54 **	0.25 **
	SE(gca line)	0.259	0.257	0.211	0.013	0.038	0.166	0.042	0.082
	SE(gca tester)	0.164	0.162	0.134	0.008	0.024	0.105	0.027	0.052
	SE(bet gca line)	0.366	0.363	0.299	0.019	0.053	0.235	0.060	0.116
	SE(bet gca tester)	0.231	0.230	0.189	0.012	0.034	0.149	0.038	0.073

Table 2 continued...

S. no.	Parents	Pod length (cm)	Single pod weight (g)	No. of seeds per pod	Biological yield per plant (g)	Total weight of pods per plant (g)	Harvest index (%)	100 seed weight (g)	Seed yield per plant (g)
	Line								
1	IPM-05-2-8	0.26 **	-0.05 **	-1.43 **	1.81 **	-38.65 **	-3.28 **	-0.53 **	-1.38 **
2	PUSA -9531	0.10 **	-0.04 **	1.20 **	-0.06	-15.73 **	2.30 **	-0.56 **	1.30 **
3	IPM-0219	-1.00 **	0.01 **	-0.66 **	-1.88 **	-31.65 **	-1.25 **	-0.40 **	-1.20 **
4	IMH-521	1.09 **	0.07 **	0.06	3.18 **	-19.82 **	-4.61 **	0.00	-1.86 **
5	IPM-2-3	-0.10 **	-0.05 **	-0.68 **	-4.10 **	3.02 **	2.96 **	-0.57 **	0.40 **
6	PDM-139	0.80 **	0.09 **	1.50 **	-0.80 **	5.27 **	-1.46 **	1.15 **	-1.02 **
7	IPM99-123	0.47 **	-0.04 **	0.86 **	4.47 **	68.77 **	1.31 **	0.71 **	2.16 **

Table 2 continued...

Table 2 continued...

8	IPM 512-1	0.60 **	0.04 **	1.15 **	1.69 **	56.27 **	2.72 **	0.27 **	2.04 **
9	IPM 2-14	-1.02 **	-0.07 **	-0.88 **	1.04 **	-0.73 **	0.61 *	-0.22 **	0.71 **
10	IPM 409-4	-1.20 **	0.04 **	-1.11 **	-5.36 **	-26.73 **	0.70 **	0.16 **	-1.14 **
	Tester								
11	VERSHA	0.35 **	-0.00 **	0.40 **	-1.18 **	2.90 **	0.59 **	0.05 *	-0.03
12	KANIKA	0.26 **	0.00 **	0.02	1.40 **	3.97 **	-0.39 *	-0.06 **	0.19 *
13	VASUDHA	-0.45 **	0.00 **	-0.31 **	0.21	0.03	0.06	-0.01	0.10
14	IPM-2057	-0.16 **	-0.01 **	-0.12 **	-0.43 **	-6.90 **	-0.26	0.02	-0.26 **
	SE(gca line)	0.021	0.001	0.040	0.170	0.220	0.250	0.029	0.125
	SE(gca tester)	0.014	0.001	0.025	0.108	0.139	0.158	0.019	0.079
	SE(bet gca line)	0.030	0.001	0.057	0.241	0.311	0.353	0.042	0.177
	SE(bet gca tester)	0.019	0.001	0.036	0.152	0.196	0.223	0.026	0.112

Table 3 : Estimate of SCA effects of F_1s and their per se performance for seed yield and its components in Mungbean.

S. no.	Crosses	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches per plant	No. of secondary branches	No. of pods per plant	No. of cluster per plant	No. of pods per cluster
1	IPM-2-3 × Versha	0.50	-0.15	-1.77 **	0.03	0.10	1.11 **	0.36 **	0.76 **
2	PDM-139 × Versha	0.33	-0.57	-0.82	-0.15 **	-0.38 **	-0.53	0.72 **	0.28
3	IPM2-14 × Kanika	-0.17	-1.72 **	0.95 *	-0.02	-0.01	0.94 **	1.31 **	0.70 **
	SE (sca effects)	0.517	0.513	0.423	0.026	0.075	0.333	0.084	0.163
	SE (bet sca effects)	0.732	0.726	0.598	0.037	0.106	0.471	0.119	0.231

Table 3 continued...

S. no.	Crosses	Pod length (cm)	Single pod weight (g)	No. of seeds per pod	Biological yield per plant (g)	Total weight of pods per plant (g)	Harvest index (%)	100 seed weight (g)	Seed yield per plant (g)
1	IPM-2-3 × Versha	-0.06	0.00	-0.01	-2.15 **	6.02 **	2.68 **	-0.07	0.65 *
2	PDM-139 × Versha	0.24 **	0.00	0.08	3.82 **	-21.23 **	-0.94	-0.11	0.55 *
3	IPM2-14 × Kanika	-0.17 **	-0.01 **	0.03	-1.38 **	-21.30 **	1.54 **	0.07	0.50 *
	SE (sca effects)	0.043	0.002	0.080	0.341	0.439	0.499	0.059	0.250
	SE (bet sca effects)	0.060	0.002	0.113	0.482	0.621	0.706	0.083	0.354

* Significance at 5% level, ** Significance at 1% level.

is fixable in nature. These combinations may arise due to involvement of diverse parents of geographical origin.

References

Aher, R. P., Dahat D.V. and Sonawane V.P. (1999). Combining ability studies in mungbean. [*Vigna radiata* (L.) Wilczek]. *Crop Res*., **18**, 256-260.

Aher, R.P., Dahat D.V. and Surve P.P. (2001). Diallel analysis for yield contributing characters in mungbean. *Legume Res*., **24(2)**, 124-126.

Asthana, A.N. (1998). Pulse crop research in India. *Indian J. Agricult. Sci.*, **68(8)**, 448-452.

Barad, H.R., Pithia M.S. and Vachhani J.H. (2008). Heterosis and combining ability studies for economic traits in mungbean [*Vigna radiate* (L.) Wilczek]. *Legume Res*., **31(1)**, 68-71.

De Candolle, A.D. (1886). *Origin of cultivated plants*. Hafur publication Co., New York.

Jahagirdar, J.E. (2001). Heterosis and combining ability studies for seed yield and yield components in mungbean. *Indian J Pulses Res*., **14(2)**, 141-142.

Kute, N.S., Deshmukh R.B., Sarode N.D. and Mamjal M.R. (1999). Combining ability for yield and its components in mungbean [*Vigna radiata* (L.) Wilczek]. *Madras Agric. J*., **86**, 210-212.

Natarajan, C., Thiyagarajan K. and Rathinasamy R. (1990). Combining ability in green gram [*Vigna radiata* (L.) Wilczek]. *Madras Agric. J*., **77**, 15-19.

Oplinger, E.S., Hardman L.L. and Kaminski A.R. (1990). Mungbean. In : *Alternativ feedcrop manual*. Madison, W1:University of Wisconsin.

Patel, M.B., Patel B.N., Savaliya J.J. and Tikka S.B.S. (2008). Heterosis and genetic architecture of yield, yield contributing traits and yellow mosaic virus in mung bean. *Legume Res*., **32**, 260-264.

Patil, A.B., Desai N.C., Mule P.N. and Khandelwal V. (2011). Combining ability analysis in mungbean. *Legume Res*., **34(3)**, 190-195.

Pratap, A., Gupta S., Basu P.S., Tomar R., Dubey S., Rathore M., Prajapati U.S., Singh P. and Kumari G. In: *Genomic Designing of Climate-Smart Pulse Crops.* pp. 235–264.

Singh, M. (2005). Study of combining ability for physiological traits in urdbean [*Vigna mungo* (L.) Hepper]. *Legume Res*., **28(2)**, 107-110.

Surashe, S.M., Patil D.K. and Gite V.K. (2017). Combining Ability for Yield and Yield attributes Characters in Greengram [*Vigna radiate* (L.) Wilczek]. *Int. J. Curr. Microbiol. App. Sci*., **6(11)**, 3552-3558.