International Journal of Chemical Studies

**P-ISSN: 2349–8528**
**E-ISSN: 2321–4902**
www.chemijournal.com
IJCS 2021; 9(2): 893-897

Received: 04-01-2021
Accepted: 14-02-2021

**SB Chavan**
M.Sc. Agriculture, Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

**DK Patil**
Sr. Scientist, Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

**VS Pawar**
M.Sc. Agriculture, Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

**MG Pawar**
M.Sc. Agriculture, Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

**Corresponding Author:**
**SB Chavan**
M.Sc. Agriculture, Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

# Combining ability studies for yield and yield contributing traits in Mungbean (*Vigna radiata* (L.) Wilczek)

**SB Chavan, DK Patil, VS Pawar and MG Pawar**

**DOI:** https://doi.org/10.22271/chemi.2021.v9.i2m.11932

**Abstract**
The present study on was conducted during *Kharif* 2017. Combining ability in respect of following characters *viz.*, days to 50% flowering, days to maturity, plant height (cm), number of clusters per plant, number of pods per cluster, number of pods per plant, number of seeds per pod, 100 seed weight (g), pod length (cm), seed yield per plant (g) and protein per cent, involving four lines and five testers and their 20 hybrid combinations with one standard check. The experiment comprised of four female and five male parents and their 20 F$_1$s hybrid was conducted in randomized block design with two replications. Mean data of genotypes was analyzed as per line x tester mating design while mean data of 30 genotypes (including check and promising hybrids) was used for the estimation of combining ability. The parents showed high GCA can be used for the future hybridization programmes. The GCA estimates of lines and testers emphasized the importance of lines BPMR 145 and tester SML 832, BWUC 10.1.1.21.1 for their use as a desirable parents for enhancing the yield potential through assembling the favourable genes for yield and yield components. The crosses which showed high SCA effect could be used for the hybrid development. The crosses BM 4 x BWUC 8-1-1 found to be the superior for cluster per plant and number of pods per plant. Should be further tested across the different environment for their stability performance.

**Keywords:** Tester, GCA, SCA, genes and yield

## Introduction
The word legume is derived from the word 'lerge' which means 'to gather' because the pods have to be gathered or picked by hands, as distinct from reaping the cereal crops. Pulses, best known as "poor man's meat", constitute the major source of dietary protein of the large section of vegetarian population of the world. On an average, pulses contain 20 to 30 per cent protein, which is almost 2.5 to 3.0 times more than the value normally found in cereals. 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). 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).
Mungbean *Vigna radiata* L. Wilczek, also known as green gram, is an important short duration grain legume with wide adoptability. It is considered to be originated from *Vigna sublobata.* The origin of green gram is supposed to be India (De candolle, 1886; Vavilov, 1926; and Zukoveskij 1962) [8, 9]. Green gram is one of the most important pulse crop extensively grown in India. Among pulses it ranks third after Bengal gram and Red gram. In Maharashtra state, it is second important *kharif* crop grown after Red Gram. Mungbean is well suited to a large number of cropping system and constitutes an important source of cereal based diet. It is mainly utilized in making *dhal*, curries, soup, sweets and snacks. The germinated seed have nutritional value compared with *Asparagus* or mushroom. During sprouting, there is an increase in thiamine, niacin and ascorbic acid concentration. The food values of mungbean lie in its high and easily digestible protein.
India is the largest producer and consumer of pulses in the world accounting for 33 per cent of world area and 22 per cent of world production. In case of Maharashtra area under production is 453.1000 ha (*Kharif* + *Rabi*) Production is about 164.M ha.

There is big gap between pulses production and requirement of growing population. The line × tester technique has been extensively used in almost all the major field crops to estimate GCA and SCA variances and effects and to understand the nature of gene action involved in the expression of various quantitative traits. This technique measures the GCA and SCA variances and effects and the genetic components of variance. It however, fails to detect and estimate the epistatic variance.

The present yield potential of improved varieties is not enough to attract the farmers because of relatively smaller seed size, low yield potential and susceptibility to diseases. Study of combining ability in mungbean is an important for the plant breeder to find out the superior crosses in first generation itself.

## Material and Methods

The present investigation was carried out during *Kharif* 2017 at experimental field of Agricultural Research Station, Badnapur.

### Experimental material

The parent for experiment included five genotypes of mungbean (*Vigna radiata* L. Wilczek) as males and four varieties *viz*. BM 4, BM 2002-1, BM 2003-2 and BPMR 145 as females. Each female was crossed with five selected male genotypes. The testers (males) chosen for study along with their characteristic features are listed in Table. 1

**Table 1:** List of testers used in the present study with their salient features

| Testers | Characteristics of testers |
|---|---|
| SML 832 | PM resistant and suitable for Summer |
| SML 668 | PM Resistant and suitable for Summer |
| BWUC 10-1-1-2-1-1 | Derivatives of interspecific cross. *V. radiata XV. Sylvestis* |
| BWUC1-1-1 | Derivatives of interspecific cross. *V. radiata XV. Sylvestis* |
| BWUC 8-1-1 | Derivatives of interspecific cross. *V. radiata XV. Sylvestis* |

### Crossing programme

During summer 2017 parental material was planted to undertake crossing programme as per line x tester mating design. Each female line was crossed with each male line and the seed of 20 $F_1$ hybrids was obtained. The seed of four female lines and five male parent lines was also produced. Finally seeds of 30 entries were utilized for subsequent experiment to be carried out during *Kharif* 2017.

### Testing of parents and hybrids

During *kharif* 2017, the hybrids and parental lines with one check were planted in randomised block design with two replications to study the combining ability, gene action and heterosis.

## Results and Discussion

### Analysis of variance for combining ability

Line x tester analysis of 20 crosses obtained by crossing 4 lines with 5 testers was carried out and the total variance due to crosses was partitioned into portions attributable to females (lines), males (testers), interaction of females vs. males (lines vs. testers) and error sources. Analysis of variance for combining ability is presented in table 2. From the analysis of variance; it is observed that mean squares of GCA and SCA effect were highly significant for all the characters. Except days to maturity, number of clusters per plant, number of pods per cluster, and these traits shows significant effects either for GCA or SCA. This indicates the presence of significant difference between males and females for these traits.

**Table 2:** ANOVA for combining ability in mungbean

| Source of variation | d.f. | Days to 50% flowering | Days to maturity | Plant height | No. of cluster/ plant | No. of pods/ cluster | No. of pods/ plant | No. of seeds/pod | Pod length | 100 seed weight | Yield /plant | Protein % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GCA | 8 | 7.13** | 4.63 | 156.73** | 1.01 | 0.73 | 32.16** | 2.77** | 1.70 | 1.03** | 2.95 | 4.82 |
| SCA | 19 | 14.52** | 7.33** | 92.89** | 3.71** | 0.43* | 44.12** | 1.99** | 10.86** | 2.10** | 10.61** | 13.77** |
| Error | 28 | 1.47 | 2.63 | 22.30 | 0.51 | 0.17 | 7.67 | 0.48 | 0.33 | 0.24 | 1.31 | 0.59 |

* and ** indicates significance at 5 and 1 per cent level respectively

### A) General combining ability effects of parents

The estimates of general combining ability effects of the female and male parents are presented in Table 3. Character wise GCA effects of female and male parents are presented as under.

### 1) Days to 50% flowering

Among the females BM 2003-2 showed highest negative significant GCA effects (-1.16). Among the male parents SML668 (-1.57) recorded highest significant negative GCA effects for days to 50% flowering. From the male SML 832 (1.05) and from female BM 4 (2.30) showed positively significant effects for the character days to 50% flowering.

### 2) Days to maturity

Among females, none of female showed significant negative GCA effects.BM 4 (1.70) line shows significant positive GCA effects. Among the male parents, none of the male parent showed negative GCA effects. However SML 832 (1.32) recorded positive GCA effects.

**Table 3:** Estimation of general combining ability with respect to eleven characters in Mungbean (*Vignaradiate* L. Wilczek)

| Genotypes | Days to 50% flowering | Days to maturity | Plant height | No. of clusters per plant | No. of pods per cluster | No. of pods per plant | No. of seeds per pod | Pod length | 100 seed weight | Seed yield perplant | Protein percent |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Testers** | | | | | | | | | | | |
| SML 832 | 1.050* | 1.325* | -1.135 | -0.420 | -0.368 | -2.480* | -0.336 | -0.748** | -0.069 | -0.572 | 0.540 |
| SML 668 | -1.570** | -0.550 | -1.048 | -0.001 | -0.280 | -1.310 | -0.086 | -0.324 | 0.336 | -0.522 | 1.036* |
| BWUC10-1-1-2-1-1 | -0.825 | -1.300 | 2.103 | -0.013 | 0.334* | 3.27** | 0.018 | -0.724** | 0.421* | 1.711** | -0.841** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BWUC1-1-1 | -0.075 | 0.075 | -0.172 | -0.490 | 0.214 | -0.760 | -0.311 | 2.373** | -0.818 | -0.973 | -0.765* |
| BWUC 8-1-1 | 1.420** | 0.450 | 0.253 | 0.924* | 0.101 | 1.288 | 0.414 | -0.577* | 0.131 | 0.356 | 0.029 |
| S.E ± | 0.4298 | 0.574 | 1.660 | 0.254 | 0.147 | 0.979 | 0.2463 | 0.2032 | 0.1734 | 0.4049 | 0.2722 |
| C.D. at 5% | 0.8996 | 1.200 | 3.490 | 0.5321 | 0.307 | 2.04 | 0.5155 | 0.4253 | 0.3628 | 0.8474 | 0.5696 |
| C.D. at 1% | 1.229 | 1.640 | 4.777 | 0.7273 | 0.420 | 2.80 | 0.7047 | 0.5813 | 0.496 | 1.158 | 0.7786 |
| **Lines** | | | | | | | | | | | |
| BM 4 | 2.350* | 1.700* | 0.813 | -0.056 | 0.240 | 0.930 | -0.356 | -1.648 | -1.304 | -2.44* | 0438 |
| BM 2002-1 | -0.250 | -0.500 | 0.062 | -0246 | -0.052 | -2.620 | -0.506 | 1.120* | 0.358 | -0.56 | -0.609* |
| BM 2003-2 | -1.160* | -1.200 | -6.478* | -1.042* | -0.137 | -2.980 | 0.197 | 0.904 | 0.483* | 0.459 | -1.261 |
| BPMR145 | -0.450 | 0.000 | 5.600** | 1.540* | -0.052 | 4.670** | 0.064 | -0.337 | 0.463** | 2556** | 1.432** |
| S.E ± | 0.384 | 0.5137 | 1.49 | 0.2724 | 0.1315 | 0.875 | 0.220 | 0.1817 | 0.1551 | 0.3621 | 0.2434 |
| C.D. at 5% | 0.8046 | 1.07 | 3.12 | 0.475 | 0.2753 | 1.83 | 0.4611 | 0.3804 | 0.3245 | 0.7579 | 0.5095 |
| C.D. at 1% | 1.09 | 1.46 | 4.27 | 0.655 | 0.4207 | 2.505 | 0.6306 | 0.52 | 0.4436 | 1.036 | 0.6964 |

* and ** indicates significance at 5 and 1 percent level respectively

**3) Plant height**

The study revealed that among females, BM 2003-2(6.47) showed negative significant GCA effects. Whereas BPMR 145 exhibited highest positive GCA effects (5.60). Among male parent none of the parents shows positive as well as negative GCA effects. Tester BWUC 10-1-1-2-1-1 showed highest positively value (2.10)

**4) Number of clusters per plant**

Among the female parents, BPMR145 (1.54) had highest significant positive GCA effects for this trait, however other female BM 2003-2 (-1.02) shows negative significant GCA effects. Among male parents, BWUC 8-1-1 (0.92) showed the highest positive significant GCA effects and hence was the best general combiner among the male parent, from other males BWUC 1-1-1 showed highest positively value (0.21).

**5) Number of pods per cluster**

Among the female parents none of female showed significant positive effects. But for this trait female line BM 4 (0.24) showed highest positively value. Among the male parents BWUC 10-1-1-2-1-1 (0.33) expressed highest positive significant GCA effects for this trait.

**6) Number of pods per plant**

The study revealed that among female parents BPMR145 (4.67) recorded highest positive significant GCA effects. Among the male parents, BWUC 10-1-1-2-1-1 (3.27) showed significant positive GCA effects. Whereas SML 832 (-2.48) shows negative GCA effects.

**7) Number of seeds per pod**

Among the female parents, none of the female exhibits positive GCA effects but female line BM2003-2 (0.19) showed highest positively effects. Among males, none of the parent exhibited significant positive GCA effects. Tester BWUC8-1-1 (0.41) showed highest positively correlated value for this trait.

**8) Pod length**

Among the female parents, BM 2002-1 (1.20) was found to be the best general combiner for this trait which exhibited highest positive GCA effects. Among males, BWUC 1-1-1 (2.37) exhibited highest significant positive GCA effects. Other male showed negative significant value for this trait.

**9) Hundred seed weight**

Among the female parents, BM 2003-2 (0.48) and BPMR 145 (0.46) were showed positive significant value and to be the best general combiner for 100 seed weight. Among males, BWUC 10-1-1-2-1-1 (0.41) exhibited significant positive GCA effects.

**10) Yield per plant**

Among the female parents only one parent BPMR 145 (25.56) exhibited highest significant positive GCA effects in desirable direction and was identified as good general combiner for this trait. Among the male parents, only BWUC 10-1-1-2-1-1(1.71) recorded highest positive significant GCA effects for this trait.

**11) Protein content**

Among the female parents, BPMR 145 (1.43) was found to be the best general combiner for this trait which exhibited highest significant positive GCA effects. Among males, SML 668 exhibited highest significant positive GCA effects (1.43).

**a. GCA effects**

Among female parents, BM 2003-2 exhibited significant GCA effects for days to 50% flowering (-1.60), plant height (-6.47) and test weight (0.48 g). The line BM 4 (1.70) exhibited positive significant GCA effects for days to maturity, while BM 2002-1 (1.12) was good general combiner for pod length. While the parent BPMR 145 found good for number of cluster per plant (1.54), number of pods per plant (4.67), seed yield per plant (5.56) and protein content (1.43).

Out of five males, the male tester BWUC 8-1-1 was a good general combiner for days to 50% flowering (1.42) and number of cluster per plant (0.92). BWUC 10-1-1-2-1-1 is better for number of pod per cluster (0.33), number of pods per plant (3.27), test weight (0.42) and seed yield per plant (1.71). Whereas male BWUC 1-1-1 was found good general combiner for pod length (2.37). Similar results were reported by Reddy and Sreeramulu (1982) [20], Choudhary (1986) [26], Halkunde *et al.*, (1996), Dasgupta *et al.*, (1998) [7], Jahagirdar (2001) [13], Aher *et al.*, (1999) [1, 2, 12], Singh (2005) [22, 23], Barad *et al.*, (2008) [4], Patil *et al.*, (2011) [18, 19].

**B) Specific combining ability effect of crosses**

The estimates of specific combining ability (SCA) effects of 20 crosses are presented in Table 4.The character wise SCA effects of the 20 crosses are presented as under.

**Table 4:** Estimates of specific combining ability with respect to eleven characters in Mungbean (*Vigna radiata* L. Wilczek)

| Sr. No. | Crosses | Days to 50% flowering | Days to maturity | Plant height | Cluster/ plant | No. of pods/ cluster | No. of pods/ plant | No. of seed/pod | Pod length | 100 seed weight | Yield/ plant | Protein |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BM 4 x SML832 | -2.850* | -1.325 | -3.920 | 0.200 | -0.508 | -2.442 | -0.744 | -0.023 | 0.415 | -0.516 | -0.964 |
| 2 | BM 4 x SML668 | -0.225 | 0.050 | -10.760* | -1.710 | 0.497 | -3.522 | 0.356 | 0.800 | -0.340 | -1.161 | 3.642* |
| 3 | BM 4 x BWUC10-1-1-2-1-1- | -1.195* | -1.700 | 3.580 | 0.391 | 0.105 | -0.302 | -0348 | 0.440 | -0.425 | -0.749 | 0.432 |
| 4 | BM 4 x BWUC1-1-1 | 1.770 | 1.425 | 5.661 | -0.430 | 0.436 | 0.081 | 0.381 | -2.290 | 0.899* | 0.860 | -1.499* |
| 5 | BM 4 xBWUC8-1-1 | 3.275* | 1.550 | 5.431 | 1.551* | -0.302 | 6.231* | 0.356 | 0.800 | -0.550 | 1.611 | -1.422* |
| 6 | BM 2002-1 xSML832 | 4.450* | 3.375* | 5.751 | 0.272 | 0.708* | 0.307 | 1.200* | -0.481 | 0.388 | 1.681 | 2.570* |
| 7 | BM 2002-1 x SML668 | -1.625* | -0.250 | 7.881* | 0.853 | -0.230 | 5.63* | -0.094 | -1.911* | 0.238 | -0.399 | -6.141* |
| 8 | BM 2002-1 xBWUC10-1-1-2-1-1 | -0.875 | 0.000 | 1.732 | -0.081 | -0.444 | -0.155 | 0.600 | -1.77* | 0.138 | -0.402 | 3.196* |
| 9 | BM 2002-1 xBWUC1-1-1 | -0.625 | -1.875 | -5.882 | -0.261 | -0.274 | -2.318 | -2.461* | 5.131 | -1.003* | -0.248 | -0.491 |
| 10 | BM2002-1xBWUC8-1-1 | -1.625 | -1.250 | -9.132* | -0.771 | 0.239 | -3.461 | 0.751 | -0.961 | 0.228 | -0.632 | 0.866 |
| 11 | BM 2003-2 xSML832 | -0.350 | -0.425 | -3.385 | -0.380 | 0.043 | 1.561 | -0.442 | -0.575 | -0.707 | -0..811 | -2.055* |
| 12 | BM 2003-2 xSML668 | 0.777 | -0..500 | 3.522 | -0.330 | -0.420 | -2.301 | -0.292 | 0.751 | -0.362 | 0.584 | 0.636 |
| 13 | BM 2003-2 x BWUC10-1-1-2-1-1 | 0.250 | 0.200 | -4.523 | -0.520 | 0.542 | 0.701 | -0.483 | 0.151 | 0.788* | 0.781 | -0.078 |
| 14 | BM 2003-2 x BWUC1-1-1 | -0.225 | 0.325 | 1.153 | 0.101 | -0.139 | -1.051 | 1.323* | -1.961* | 0.0171 | -1.232 | 0.296 |
| 15 | BM 2003-2 x BWUC8-1-1 | -0.225 | 0.050 | 3.225 | 0.842 | 0.026 | 1.091 | 0.094 | 0.861 | 0.262 | 0.681 | 1.202* |

**Table 4:** Contd...

| Sr. No. | Crosses | Days to 50% flowering | Days to maturity | Plant height | Cluster/ plant | No. of pods/ cluster | No. of pods/plant | No. of seed/ pod | Pod length | 100 seed weight | Yield/ plant | Protein |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | BPMR145 XSML832 | -1.550 | -1.625 | 1.731 | -0.080 | -0.242 | 0.567 | -0.014 | 1.088 | -0.097 | -0.353 | 0.488 |
| 17 | BPMR145 XSML668 | 1.071 | 0.250 | -0.652 | 0.901 | 0.170 | 0.242 | 0.036 | 0.362 | 0.463 | 0.977 | 2.044* |
| 18 | BPMR145 XBWUC10-1-1-2-1-1 | 2.821* | 1.500 | 0.802 | 0.214 | 0.006 | -0.245 | 0.232 | 1.882* | -0.502 | 0.414 | -3.540* |
| 19 | BPMR145 XBWUC 1-1-1 | -0.925 | 0.125 | -0.927 | 0.590 | -0.024 | 3.291 | 0.761 | -1.912* | 0.087 | 0.623 | 1.694* |
| 20 | BPMR145 X8-1-1 | -1.425 | 0.250 | 0.648 | -1.62* | 0.089 | -3.85 | -1.014 | -0.712 | 0.0480 | -1.661 | -0.645 |
| | SE (+) | 0.8604 | 1.129 | 3.28 | 1.44 | 0.83 | 5.81 | 1.40 | 1.17 | 1.04 | 2.32 | 2.09 |
| | CD 5% | 2.48 | 3.26 | 9.49 | 1.94 | 1.12 | 7.83 | 1.88 | 1.58 | 1.14 | 3.13 | 15.5 |

* and ** indicates significance at 5 and 1 per cent level respective

### 1) Days to 50% flowering
Out of the 20 crosses, three crosses revealed significant negative SCA effects which are desirable for days to 50% flowering. The highest significant negative SCA effects showed by cross BM4 x SML832 (-2.85) followed by BM 4 x BWUC10-1-1-2-1-1(-1.19) and BM 2002-1 x SML668 (-.60). These finding are in agreement with earlier report made by Singh and Singh (1972a) [22, 23], Ahuja (1980) [3], Deshmukh and Manjare (1980) [10, 12, 17] and Jahagirdar (2001) [13].

### 2) Days to maturity
Out of the 20 crosses, none of the crosses revealed a significant negative SCA effect which is desirable for days to maturity. Whereas cross BM 2002-1 x SML832 (3.57) showed positive significant effects. Similar result was also reported by Jahagirdar (2001) [13].

### 3) Plant height
Out of the 20 crosses, one crosses revealed significant positive SCA effects. The cross combination BM 2002-1 x SML668 (7.81) recorded highest significant positive SCA effects. The cross BM 4 x SML668 (-10.76) exhibited highest negative significant SCA effects followed by BM2002-1 xBWUC8-1-1(-9.13). This result was in agreement with the findings of Manjare (1976) [10, 17], Shanthi priya *et al*. (2012) [21].

### 4) Number of clusters per plant
Only one cross *viz.*, BM4 x BWUC8-1-1(1.55) showed significant positive SCA effects for number of clusters per plant. For the number of clusters per plant BPMR 145 x BWUC 8-1-1(-1.62) showed negative SCA effects. Similar results were also reported by Manjare (1976) [10, 17], Shanthi priya *et al*. (2012) [21].

### 5) Number of pods per cluster
Out of 20 crosses, one cross reflected significant positive SCA effects for number of pods per cluster. The cross BM 2002-1 x SML832 (0.70) was the best specific cross combination which exhibited the highest significant positive SCA effect. None of the cross combinations showed negative SCA effects for this trait. This result was in agreement with the finding of Shanthi priya *et al*. (2012) [21].

### 6) Number of pods per plant
Out of 20crosses, two crosses reflected significant positive SCA effects for number of pods per plant. The cross BM 4 x BWUC8-1-1 (6.23) was the best specific cross combination which exhibited the highest significant positive SCA effects, followed by BM 2002-1x SML668 (5.63). None of the cross combination showed negative SCA effects for this trait. This result is in agreement with the finding of Manjare (1976) [10, 17], Ahuja (1980) [3], Shanthi priya *et al*. (2012) [21].

### 7) Number of seeds per pod
Out of 20 crosses, two crosses revealed significant positive SCA effects which are desirable for this trait. The cross BPMR145 xBWUC10-1-1-2-1-1 (1.32) exhibited the highest significant positive SCA effects followed by BPMR145 x SML 832 (1.08). Among remaining crosses BM2002-1 x BWUC 1-1-1(-2.46) showed negative GCA effects. These results are in confirmation with the previous work done by Jahagirdar (2001) [13], and Singh and Dikshit (2003) [22, 23].

### 8) Pod length
Out of 20 crosses, only one cross revealed significant positive SCA effects for pod length. The cross BPMR 145 x BWUC 10-1-1-2-1-1 (1.88) exhibited the best specific combination. For this trait four crosses showed negative significant SCA

effects. The cross combination BM 2002-1 x BWUC 1-1-1 (-1.03) showed highest negative SCA effects. Similar result has also been reported by Yadav and Lavanya Roopa (2011) [25].

**9) Hundred Seed weight**

Among 20crosses, two crosses exhibited significant positive SCA effects for the trait 100 seed weight. The cross BM 4 x BWUC 1-1-1(0.89 g) followed by BM 2003-2 x BWUC 10-1-1-2-1-1 (0.78 g).whereas one cross exhibited significant negative SCA effects for this character *viz*., BM2002-1 x BWUC1-1-1(-1.03 g). Similar result has also been reported by Katiyar (2015) [15] and Tiwari and Ramanujan (1974) [24].

**10) Yield per plant**

Out of 20 crosses, none of the crosses exhibited significant positive SCA effects. Among the crosses BM 4 x BWUC 8-1-1(1.68 g) gives highest positively correlated value for this trait followed by BM 2002-1 x SML 832(1.63 g). Similar result has also been reported by Barad *et al.* (2008) [4], Patil *et al.* (2011) [18, 19].

**11) Protein content**

Out of 20 crosses, six crosses reflected significant positive SCA effects for protein content. The cross BM4 x SML668 (3.64%) was the best specific cross combination which exhibited the highest significant positive SCA effect followed by BPMR145 x SML668 (2.04%) Among these crosses five crosses showed negative SCA effects for these trait. The Cross BM 2002-1 x SML 668 (-6.14%) showed highest negative SCA effects. This results are with confirmation with the result of Shanthi priya *et al.* (2012) [21].

**References**


1. Aher RP, Datur DV, Sonawane YP. Combining ability in mungbean. Crop Res 1999;18:256-260.
2. Aher RP, Dahat DV, Surve PP. Diallel analysis for yield contributing characters in mungbean. Legume Res 2001;24(2):124-126.
3. Ahuja SL. Diallel analysis in $F_2$ generation of mungbean, Thesis Abstact (NAU- Hissar) 1980;6(2):110-111.
4. Barad HR, Pithia MS, Vachhani JH. Heterosis and combining ability studies for economic traits in mungbean (*Vigna radiate* (L.) Wilczek). Legume Res., 2008;31((1):68-71.
5. Bhuiyan MSH, Islam MS, Roy TS, Karim MA, Munsur MAZA. Mungbean and weed growth as affected by potassium and weed control methods. Int. J Res. Agron. 2020;3(2):01-08.
6. Darwin C. Cross and self-fertilization in vegetable kingdom 1876.
7. Dasgupta T, Banik A, Das S. Combining ability in mungbean. Indian J Pulses Res 1998;11(1):28-32.
8. De Candolle AD. Origin of cultivated plants. Hafur publication Co. New York 1886.
9. De Candolle AD. Origin of cultivated plants. Hafur publication Co. New York 1886.
10. Deshmukh RB, Manjare MR. Combining ability in mungbean. Legume Res 1980;3(2):97-101.
11. Halakude IS. Heterosis and combining ability studies in greengram. M. Sc. (Agri.). Thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri 1992.
12. Halakunde IS, Aher RP, Deshmukh RB, Kute NS. Combi ning ability analysis in greengram. J Maharashtra Agric. Univ 1996;21(2):235-238.
13. Jahagirdar JE. Heterosis and combining ability studies for seed yield and yield components in mungbean. Indian J pulses Res 2001;14(2):141-142.
14. Jinks JL, Jones M. Estimation of components of heterosis. Genetics 1958;43:223-234.
15. Katiyar M, Amit Kumar. Genetics Analysis of yield and It's component Traits in Mungbean (*Vigna radiata* L. *Wilczek*). Internat. J of Innovative Res. And Development 2015;4(2):119-121.
16. Kelkar MA. Genetic analysis in mungbean. M. Sc. (Agri.). Thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri 1993.
17. Manjare MR. Studies on heterosis and combining ability in 8 × 8 diallel cross of mungbean. M. Sc. (Agri.). Thesis Mahatma Phule Krishi Vidyapeeth, Rahuri 1976.
18. Patil AB, Desai NC, Mule PN, Khandelwal V. Combining ability analysis in mungbean. Legume Res., 2011;34(3):190-195.
19. Patil AS. Heterosis and inbreeding depression studies in mungbean. M.Sc. (Agri.) Thesis. Mahatma Phule Krishi Vidyapeeth, Rahuri 1992.
20. Reddy PR, Sreeramulu C. Heterosis and combining ability for yield and its components in greengram. Genet. Agraria 1982;36(3/4):297-307.
21. Shanthi Priya M, Reddy KHP, Reddy DM, Rupesh Kuma r Reddy. Combining ability studies in greengram. (*Vignaradiata* (L.) Wilczek). Legume Res 2012;31(1):36-39.
22. Singh M. Study of combining ability for physiological traits in urdbean (*Vignamungo* (L.) Hepper). Legume Res 2005;28(2):107-110.
23. Singh TP, Singh KB. Combining ability in mungbean. Indian J Genet 1972a;32:66-72.
24. Tiwari AS, Ramanujan S. Partial diallel analysis of comb ining ability in mungbean. Z. Pflazucht 1974;73(1):103-111.
25. Yadav PS, Lavanya GR. Estimation of combining ability effect in mungbean (*Vigna radiata* (L.) *Wilczek*) crosses. Madras Agric. J 2011;98(7-9):213-215.
26. Choudhary RK. Combining ability for seed yield and its component in mungbean. Crop. Improv 1986;13(1):95-97.