Genetic Analysis Involving Selected Powdery Mildew Resistant Lines in Mungbean (Vigna radiata (L.) Wilckzek)

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Abstract

The present investigation on genetic analysis involving 12 parents and 20 crosses in mung bean indicated that VC–1, TARM–18, TARM–1 and Vaibhav were the good general combiners based on the overall score across the traits in desirable direction. The cross combination Chinamung×VC–1 exhibited significant sca effects for traits viz., seed yield per plant, seed yield per plot, number of pod bearing cluster per plant, number of pods per plant, hundred weight and harvest index. Gene action study revealed that days to 50% flowering, days to maturity, number of pods per plant, hundred seed weight (g), total dry matter at harvest (g), harvest index (%), seed yield per plant (g) and seed yield per plot (g) in the present study were governed predominantly by additive genetic variation. Since all these characters were also under significant influence of epistatic variation, it appears that additive x additive epistatic variation may be playing a decisive role in the inheritance of these characters.

Keywords
Mungbean (Vigna radiata (L.) Wilckzek); Powdery Mildew; Additive; Combining ability; Dominance; Epistatic genetic variation

Background

Identification of suitable parents for hybridization programme is an important step to meet the objective of breeding programme. Among several methods available for this purpose, combining ability analysis on the basis of line x tester system found to be most appropriate method to identify the best combiner that can be utilized for hybridization. The knowledge of various gene effects for the expression of yield and its component traits is prerequisite for deciding suitable breeding procedure for the development of superior and desirable genotypes. Hence an investigation was done to identify the best combiner and elucidate gene action for the expression of seed yield and other related attributes for improvement in green gram (Vigna radiata (L.) Wilckzek).

Results and Discussion

The analysis of variance for combining ability showed significant variation for parents and hybrids for most of the characters studied except for pod length in parents, indicating the presence of genetic diversity among parents and hybrids. The partitioning of hybrids mean sum of squares revealed that variance due to male, females and their interaction were significant for all traits except for days to 50% flowering indicating the manifestation of considerable genetic variability among parents and the hybrids. These findings are in accordance with Ayyangouda Patil et al (2003), Singh et al (2007), Khan et al (2007), Gawande et al (2005).

General combinability effect of the parents indicated that none of parents was good different parents found to be good combiner for all traits, among which TARM–1 ranked as top by exhibiting significant gca effects for five traits viz., number of pod bearing clusters per plant, number of pods per cluster, number of pods per plant, total dry matter at harvest and seed yield per plot. This was followed by TARM-18 which was a good combiner for four traits viz., number pods per plant, number of pod bearing clusters per plant, total dry matter at harvest and seed yield per plot. The VC–1 was also a good general combiner with good
mean performance for four traits viz., hundred seed weight, harvest index, seed yield per plant and seed yield per plot and all the three testers (TARM-18, TARM-1 and VC-1) were also resistant to powdery mildew disease.

Female parent Chinamung was good general combiner for five traits namely number pods per plant, number of pod bearing cluster per plant, total dry matter at harvest and seed yield per plant seed yield per plot with good per se performance than Pusa baisaki.

The study of sca effects across hybrids revealed that none of the hybrids showed significant positive specific combining ability effects for all the characters (Table 1). The cross, Chinamung×VC-1 exhibited significant sca effect for as many as five traits viz., Seed yield per plot (g), seed yield per plant (g), number of pod bearing clusters per plant, number or pods per plant and harvest index (%).

| Sl no. | Character               | Crosses                      | Mean     | sca effects |
|-------|-------------------------|------------------------------|----------|-------------|
| 1     | Plant height (cm)       | Nil                          | 46.67    | -2.37**     |
| 2     | Days to 50% flowering   | PB×MEHA                      | 46.00    | -2.20*      |
| 3     | Day to maturity         | PB×TARM-1                    | 73.33    | -4.47**     |
| 4     | Number of cluster per plant | CM×MEHA                 | 76.67    | -3.53**     |
| 5     | Number of pods per cluster | PB×TARM-1                | 5.60     | 1.41**      |
| 6     | Number of pods per plant | CM×VC-1                     | 11.83    | 3.07**      |
| 7     | Pod length (cm)         | CM×TARM-18                   | 33.05    | 4.53**      |
| 8     | Hundred seed weight (g) | PB×MEHA                      | 26.00    | 4.25*       |
| 9     | Total dry matter at harvest (g) | CM×TARM-18        | 32.40    | 6.26**      |
| 10    | Harvest index (%)       | CM×VC-1                     | 18.00    | 4.29**      |
| 11    | Seed yield per plant (g) | CM×TARM-18                  | 15.53    | 6.14**      |
| 12    | Seed yield per plot (g)  | CM×VC-1                     | 287.67   | 93.07**     |

Note: CM: Chinamung; PB: Pusa baisaki; * and ** indicates significance at 5% and 1% probability levels, respectively.
yield per plot (g), total dry matter at harvest and harvest index (%).

These crosses which exhibited significant sca effects for six to eight attributing traits can be further advanced through conventional breeding methods such as bi parental mating, and or diallele selective mating, there after followed by pedigree method of selection for improvement of productivity. For traits like plant height, pod length and hundred seed weight none of the crosses exhibited any significant sca effects.

The best crosses mainly Chinamung×VC-1, Pusa baisaki×TARM-1, Chinamung×TARM-2 and Chinamung×TARM-18 (Table 1) had desirable and significant sca effects with high per se performance for seed yield per plot. The present study clearly indicated that breeder must give proper attention to a systematic breeding approach by using selected promising crosses having significant high sca value as well as high per se performance for seed yield. Such promising combinations are expected to produce desirable transgressive sergeants to achieve higher seed yield.

On the other hand an attempt was made to obtain a generalized picture of the type of gene action involved in the inheritance of the 12 characters by using two methods of analysis, viz., line x tester analysis providing estimates of variance of general combining ability (additive gene action) and specific combining ability (non-additive gene action) and estimation of D (additive) and H₁ (dominance) components of genetic variation by the method of Jinks et al (1969).

The analysis revealed that the absence for epistasis in plant height, pod length and hundred seed weight traits (Table 2) but further analysis indicated that the characters viz., days to 50 % flowering, days to maturity, number of pods per plant, hundred seed weight (g), total dry matter at harvest (g), harvest index (%), seed yield per plant (g) and seed yield per plot (g) were predominantly governed by additive genetic component than dominant component of variation (Table 3; Table 4). Since all these characters were also under significant influence of epistatic variation role of additive x additive epistatic variation in the inheritance of these characters. Significance of H₁ (dominant genetic variation) and non-significant correlation co-efficient between sum and difference for plant height (cm) and number of clusters per plant traits (Table 3) suggested that there was greater dominant contribution to the variation but dominance was bidirectional, i.e. increasing and decreasing alleles being dominant and recessive to the same extent for these traits. Similar observations were also made by Ayyagouda Patil and Kajjidoni (2005), Sing et al (2007), Barad et al (2008), Dethe et al (2008).

On the basis of present study, additive, dominance and epistatic gene effects contributing significantly in the inheritance of the characters, it can be suggested that improvement may be expected by exploiting the additive genetic variance first through pedigree method of selection and at the same time retaining the non-additive genetic variance in population. It is suggested to give enough weightage to individual yield components while selecting by pedigree method. The use of recurrent selection method and diallele selective mating can help in utilizing the all the three type of gene effects (additive, dominant and epistatic).
Table 3 Analysis of variance for sums and differences in respect of 12 characters in greengram (*Vigna radiata* (L.) Wilczek)

| Source                                      | Sum   | Differences | Error | $\sigma^2$ M | $\sigma^2$ ML | E2 |
|---------------------------------------------|-------|-------------|-------|--------------|---------------|----|
| D.F                                         | 9     | 9           | 62    | -            | -             | -  |
| Plant height (cm)                           | 19.36 | 22.93       | 21.39 | -0.33        | 0.25          | 21.39 |
| Days to 50% flowering                       | 15.77** | 5.33    | 2.67  | 2.18         | 0.44          | 2.67 |
| Days to maturity                            | 57.52** | 20.27   | 14.08 | 7.24         | 1.11          | 14.08 |
| No. of pod bearing cluster per plant        | 9.66** | 17.45**    | 0.15  | 1.58         | 2.88          | 0.15 |
| No. of pods per cluster                     | 2.82  | 1.9        | 3.24  | -0.06        | -0.22         | 3.24 |
| No. of pods per plant                       | 195.22** | 42.48** | 0.14  | 31.99        | 6.54          | 3.23 |
| Pod length (cm)                             | 0.78  | 1.03       | 0.61  | 0.028        | 0.06          | 0.61 |
| 100-seed weight (g)                         | 0.49  | 0.37       | 0.25  | 0.04         | 0.02          | 0.25 |
| Total dry matter at harvest (g)             | 15.37** | 38227.0** | 4.33  | 11.77        | 9.87          | 4.33 |
| Harvest index (%)                           | 493.30** | 76.68** | 17.53 | 79.29        | 9.85          | 17.53 |
| Seed yield per plant (g)                    | 22.27** | 12.57**   | 0.33  | 3.68         | 2.07          | 0.14 |
| Seed yield per plot (g)                     | 18302.81** | 11560.06** | 92.69 | 3035.02      | 1911.22       | 92.69 |

Note: *and** indicates significance at 5% and 1% probability levels, respectively

Table 4 Estimates of genetic parameters, dominance ratio and correlation co-efficient of sums and differences of 12 characters in greengram (*Vigna radiata* (L.) Wilczek)

| Source of variability                      | D     | H1   | F     | E2   | $\sqrt{H1/D}$ | r/sumdiff. |
|--------------------------------------------|-------|------|-------|------|---------------|------------|
| Plant height (cm)                          | -1.35 | 1.02 | -68.145 | 21.39 | @             | 0.004      |
| Days to 50% flowering                      | 8.7   | 1.77 | -45.33 | 2.67  | 0.45          | 0.0149     |
| Days to maturity                           | 28.96 | 4.45 | -244.26 | 14.08 | 0.39          | 0.005      |
| No. of pod bearing Cluster per plant       | 6.34  | 11.53 | -269.34 | 0.15  | 1.32          | 0.04       |
| No. of pods per cluster                    | -0.27 | -0.88 | -39.36 | 3.24  | 1.78          | 0.2        |
| No. of pods per plant                      | 127.99 | 26.54 | -1912.77 | 3.23  | 0.45          | 0.006      |
| Pod length (cm)                            | 0.11  | 0.27 | -6.92  | 0.61  | 1.57          | 0.23       |
| 100-seed weight (g)                        | 0.16  | 0.08 | -6.53  | 0.25  | 0.7           | 0.99       |
| Total dry matter at harvest (g)            | 47.1  | 39.51 | -1416.32 | 4.53  | 0.91          | 0.008      |
| Harvest index (%)                          | 317.18 | 39.48 | -39260 | 17.52 | 0.35          | 0.028      |
| Seed yield per plant (g)                   | 14.75 | 8.29 | -399.57 | 0.14  | 0.74          | 0.039      |
| Seed yield per plot (g)                    | 12140 | 7644.91 | -344720 | 92.69 | 0.793         | 0          |

Note: @: The estimates of $\sigma^2$ ML was either zero or negative

Material and Methods

Two adopted varieties namely Chinamung and Pusa baisaki were crossed with ten selected diverse testers for powdery mildew viz., Vaibhav,TARM-1,TARM-2 and TARM-18 (resistant to powdery mildew from BARC, Mumbai) DMG-1030 (resistant) and Meha (susceptible from IIPR, Kanpur), KGS-83 (advance breeding line), BPMR-1 (tolerant) and VC-1 (resistant exotic line, AVRDC Taiwan) and BPMR-145 in a line x tester fashion and resulting 20 F1-s along with their parents were grown in randomised block design with three replications at Main Agriculture Research Station, College of Agriculture, University of Agricultural Science, Dharwad in 2009. Five competitive plants were randomly selected from each replication for recording the observations for seed yield and its 11 component traits (Table 5). The parents were also screened for
powdery mildew disease by growing them separately without any protection the data were subjected to analysis of variance (Panse and Sukhateme, 1976) and combining ability analysis (Kemphthorne, 1957) and nature of gene action was detected as additive, dominance and epistatic component as method suggested by Kersay and Jinks, (1968) and Jinks et al (1969).

Table 5 List of parents which exhibited significant gca effects with their per se performance

| Sl no | Characters                          | Parents          | Per se performance | gca effects |
|------|------------------------------------|------------------|--------------------|-------------|
| 1    | Plant height (cm)                  | Nil              | 51.00              | -2.67**     |
| 2    | Days to 50 % flowering             | Vaibhav          | 46.00              | -2.33**     |
| 3    | Day to maturity                    | BPMR-145         | 70.00              | -5.77**     |
|      |                                    | Pusa baisaki     | 78.00              | 1.13**      |
| 4    | Number of clusters per plant       | TAM-18           | 6.47               | 1.94**      |
|      |                                    | TARM-1           | 8.03               | 1.47**      |
|      |                                    | Vaibhav          | 7.40               | 1.29**      |
|      |                                    | TARM-2           | 4.87               | 0.99**      |
|      |                                    | Chinamung        | 3.47               | 0.78        |
| 5    | Number of pods per cluster         | TARM-1           | 3.05               | 1.07**      |
|      |                                    | DMG-1030         | 3.27               | 0.93**      |
|      |                                    | Meha             | 2.82               | 0.36*       |
|      |                                    | Pusa baisaki     | 3.10               | 0.25**      |
| 6    | Number of pods per plant           | TARM-1           | 24.50              | 8.12**      |
|      |                                    | TARM-18          | 22.20              | 6.48**      |
|      |                                    | Vaibhav          | 24.00              | 2.93*       |
|      |                                    | DMG-1030         | 28.40              | 2.42**      |
|      |                                    | Chinamung        | 8.53               | 1.10**      |
| 7    | Pod length (cm)                    | Pusa baisaki     | 8.89               | 0.67**      |
| 8    | Hundred seed weight (g)            | VC-1             | 3.33               | 0.53*       |
| 9    | Total dry matter at harvest (g)    | TARM-18          | 17.57              | 4.69**      |
|      |                                    | TARM-1           | 19.57              | 4.22**      |
|      |                                    | TARM-2           | 22.83              | 1.32**      |
|      |                                    | Chinamung        | 8.13               | 2.09**      |
| 10   | Harvest index (%)                  | VC-1             | 21.59              | 24.81**     |
| 11   | Seed yield per plant (g)           | VC-1             | 4.63               | 4.98**      |
|      |                                    | BPMR-1           | 3.57               | 0.48**      |
|      |                                    | Chinamung        | 2.60               | 0.44**      |
| 12   | Seed yield per plot (g)            | VC-1             | 121.67             | 141.00**    |
|      |                                    | BPMR-1           | 93.00              | 15.33**     |
|      |                                    | TARM-1           | 131.67             | 9.67*       |
|      |                                    | TARM-18          | 110.33             | 14.67**     |
|      |                                    | Chinamung        | 72.33              | 10.77**     |

Note: * and ** indicates significance at 5 % and 1 % probability levels respectively

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