Assessment of combining ability for growth and survivability traits in mulberry using line × tester analysis

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Abstract
Combining ability in mulberry was assessed by using Line x Tester mating design. In the present study, five lines viz., MI-0543, MI-0615, MI-0651, MI-0685, MI-0718 and three testers' viz., V1, G4, MI-0663 were crossed to obtain fifteen F1 progenies. Growth and survivability traits were evaluated for the F1 crosses through Analysis of variance (ANOVA), General combining ability (GCA) and Specific combining ability (SCA) for the parameters such as germination per cent, survivability per cent, plant height, number of leaves per branch, internodal distance and leaf moisture content. Among the eight parental genotypes MI-0543 (female) and V1 (male) were the best combiners and MI-0685 x V1 was the best cross for growth and survivability traits. Hence, both non-additive and additive gene actions are important for the mulberry improvement.

Keywords: Mulberry, line x tester analysis, combining ability, superior hybrids

Introduction
Mulberry is a cross pollinated heterozygous perennial plant of the family Moraceae. Sustainability and profitability of sericulture utterly depends on the quality and quantity of mulberry leaves, because of the monophagous nature of silkworm. Mulberry exhibits high plasticity and acclimatize itself to various climatic conditions (Ashiru, 2002) [3]. Environmental conditions in India are most favourable for mulberry growth and development throughout the year.

Mulberry is a dioecious or sometimes monoecious plant. It exhibits different sex expressions, identifying the differences in sex expressions in mulberry is an enigmatic process. Since, sex of particular mulberry species is not static, it varies from season to season based on the environmental fluctuations, cultural practices and soil factors (Tikader et al., 1995) [29]. Genotype x Environment interaction complicates the screening of superior genotypes (Doss et al., 2012) [9].

New hybrids are produced by using various breeding techniques. Development of new hybrids with novel and desirable traits might be boosting Sericultural economy (Bedi, 1999). Selection of compatible parents is a pre-requisite for all breeding programs. Based on their phenotypic performance and intrinsic genetic values, parental genotypes should be selected for breeding programs (Bhalodiya et al., 2019). Among the various approaches, line x tester analysis is the fruitful approach for screening superior progenies and best combining parental genotypes. This method was introduced by Kemptrone (1957) [16]. Line x Tester analysis provides the information of general combining ability of parents and specific combining ability of the F1 progenies and also additive, non-additive gene actions (Yehia and EI-Hashash, 2019) [35]. The ultimate goal of mulberry breeding is to develop high productive hybrids with superior leaf quality at less possible time and reasonable cost of production. Present study was designed to assess the combining ability for mulberry and to identify the suitable crosses through Line x Tester mating design.

Materials and Methods
Mulberry accessions were procured from CSGRC, Hosur and combining ability studies were carried out at Department of Sericulture, Forest College and Research Institute, Mettupalayam.
Aruna et al., (2018) [2] screened twenty-four mulberry genotypes based on propagation parameters. Among the screened accessions some genotypes were used as parents for the current study. Five lines viz., MI-0543, MI-0615, MI-0651, MI-0685, MI-0718 and three testers viz., V₁, G₄ and MI-0663 were used for line x tester analysis. Crossing was successfully done through several preliminary steps such as pruning, bagging and pollination. After a week, fully matured fruits were harvested from lines and seeds were extracted from matured fruits by soaking it in the water for overnight. Floating seeds were removed and sunken seeds were selected for sowing after shade drying (Mbora et al., 2008) [19]. Completely Randomized Design (CRD) with three replications was used for planting the F₁ progenies. Seeds were sown in polybags filled with Soil: Sand: FYM in 1:1:1 ratio. Observations pertaining to growth and survivability traits of mulberry were recorded on 60th, 75th and 90th day after sowing.

Survivability traits
Germination per cent (%)
Germination per cent was calculated from 10th day after sowing. Seed bags were maintained under greenhouse condition with regular watering. It was calculated using the formula:

\[ \text{Germination per cent} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds sown}} \times 100 \]

Survival per cent (%)
The survival per cent of seedlings was estimated by counting the available seedlings on 60th day after sowing in each tray.

\[ \text{Survival per cent} = \frac{\text{Number of survived seedlings 60th DAS}}{\text{Total number of sowed seeds}} \times 100 \]

Growth parameters
Plant height (cm)
Plant height was measured on 60th, 75th and 90th day after sowing and expressed in cm.

Number of branches per plant
Average number of branches per plant was calculated by using the formula;

\[ \text{Number of branches per plant} = \frac{\text{Total number of branches}}{\text{Number of plants}} \]

Number of leaves per branch
Leaves in the individual branch of seedling were counted and average number of leaves per branch was calculated by using the formula;

\[ \text{Number of leaves per branch} = \frac{\text{Total number of leaves}}{\text{Number of branches}} \]

Internodal distance (cm)
Space between two nodes of the plant was recorded by using meter scale and expressed in cm.

Single leaf area (cm²)
It was calculated by factor method and expressed in cm²:

\[ \text{Single leaf area} = L \times B \times 0.69 \]

Where,
L= Length, B = Breadth, 0.69 = correction factor.
Mean correction factor for mulberry was reported by Singhal et al., (2003) [20]

Fresh leaf weight (g)
Fresh leaves were collected from three different portions viz., bottom, middle and top of the seedlings and weight was recorded using electronic weighing balance immediately and expressed in grams.

Leaf moisture content (%)
The moisture content of the leaf was estimated on dry weight basis. Leaves were collected in the morning and weighed immediately by using electronic weighing balance. The leaves were then dried in hot air oven at 60°C for 48 hours till the constant weight was obtained (Sivashankar, 2015) [27]. Leaf moisture content calculated as per the following formula:

\[ \text{Moisture content} (%) = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Fresh weight}} \times 100 \]

Moisture retention capacity (%)
It is the capacity of leaves to retain moisture after six hours from harvest which varies among the F₁ progenies. Fresh leaf samples were kept at room temperature and weighed after six hours of harvest to determine moisture retention capacity.

\[ \text{Moisture retention capacity} (%) = \frac{\text{Weight after 6 hours} - \text{Dry weight}}{\text{Fresh weight} - \text{Dry weight}} \times 100 \]

The recorded data were uploaded to the software viz., TNAUSTAT for estimating the combining ability among the mulberry genotypes. This package was developed by Manivanan (2014) [18]. Results showed variance among the parents and progenies (ANOVA), general combining ability of the parents (GCA) and specific combining ability of the F₁ progenies (SCA).

Results and Discussion
The results of the present study revealed that development of mulberry hybrids with novel desirable traits is much possible through systematic breeding programs. Most of the breeding studies were carried out on the development of pest and diseases resistant varieties, salt and drought tolerant varieties (Kumar et al., 1999, Vijayan et al., 2008, Gnanaraj et al., 2011) [17, 34, 11]. So far, only few studies in growth and yield related traits (Vijayan et al., 2004) [33]. Parental genotypes were crossed through line x tester mating design (Kempthorne, 1957) [16]. This method was used successfully in many other Agricultural crops like cotton (Bilwal et al., 2018) [5], barley (Prasad et al., 2013) [22], wheat (Gowda et al., 2010, Jain and Sastry, 2012) [12, 14], maize (Mohammad et al., 2013, Akhi et al., 2018, Zhou et al., 2018) [20, 1, 36] etc.

ANOVA
Results pertaining to analysis of variance for combining ability indicated that the mean squares due to testers were highly significant for number of branches per plant (11.8746), number of leaves per branch (199.4302), leaf moisture content (59.9772) and moisture retention capacity (240.3950) whereas significant variances among lines were recorded only for fresh leaf weight (0.6438). At the same time variances in line x tester interaction were observed to be highly significant for most of the parameters viz., germination per cent (382.6361), plant height (188.4747) and single leaf area (696.0493). The results revealed that all the mulberry genotypes showed variations with respect to the studied traits. Hence, there is a significant difference among the lines, testers and their interactions. And it shows the possibility to compute general combining ability for parents and specific combining ability
for hybrids. (Vijayan et al., 1997, Mohammed et al., 2013)\textsuperscript{31}. The proportional contribution of lines, testers and their interactions to the total variance for the parameters under study are given in Table 2. Contribution of lines was higher compared to the contribution of testers for most of the traits. Lines contributed more for number of leaves per branch (39.5\%) and testers contributed more for number of branches per plant (46.5\%). Whereas, line x tester interaction contribution of crosses was found to be high for all the traits except number of leaves per plant and number of branches per plant. Among the traits, interactions contributed more to single leaf area (84.43\%) and internodal distance (75.06\%). Hence, lines and interactions afforded maximum contribution to the total variance (Table 2).

### Table 1: Analysis of variance for Line x Tester in mulberry

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>DF</th>
<th>G.P (%)</th>
<th>S.P (%)</th>
<th>P.H (cm)</th>
<th>No. of leaves/branch</th>
<th>No. of branches/plant</th>
<th>LD (cm)</th>
<th>SLA (cm(^2))</th>
<th>FLW (g)</th>
<th>LMC (%)</th>
<th>MRC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>2</td>
<td>7.1650</td>
<td>22.3857</td>
<td>2.1770</td>
<td>0.5686</td>
<td>0.0093</td>
<td>0.0603</td>
<td>90.0184</td>
<td>0.0059</td>
<td>43.6605</td>
<td>10.5757</td>
</tr>
<tr>
<td>Crosses</td>
<td>14</td>
<td>297.2438</td>
<td>1796.9104</td>
<td>152.1357</td>
<td>92.8321</td>
<td>0.5739</td>
<td>0.9201</td>
<td>471.1171</td>
<td>0.5152</td>
<td>48.8274</td>
<td>117.4816</td>
</tr>
<tr>
<td>Lines</td>
<td>4</td>
<td>253.1413</td>
<td>1919.9339</td>
<td>121.0818</td>
<td>128.3751</td>
<td>0.3245</td>
<td>0.3617</td>
<td>248.7799</td>
<td>0.6438</td>
<td>35.8481</td>
<td>89.2494</td>
</tr>
<tr>
<td>Testers</td>
<td>2</td>
<td>43.8795</td>
<td>844.0959</td>
<td>68.8877</td>
<td>199.4302</td>
<td>1.8746</td>
<td>0.8827</td>
<td>16.0627</td>
<td>0.0862</td>
<td>59.9772</td>
<td>240.3950</td>
</tr>
<tr>
<td>L x T</td>
<td>8</td>
<td>382.6361</td>
<td>1973.6022</td>
<td>188.4747</td>
<td>48.4110</td>
<td>0.3770</td>
<td>1.2086</td>
<td>696.0493</td>
<td>0.5582</td>
<td>52.5295</td>
<td>100.8693</td>
</tr>
<tr>
<td>Error</td>
<td>28</td>
<td>11.2014</td>
<td>5.9935</td>
<td>8.4415</td>
<td>2.0733</td>
<td>0.0066</td>
<td>0.0348</td>
<td>22.0555</td>
<td>0.0126</td>
<td>6.8933</td>
<td>14.0458</td>
</tr>
<tr>
<td>SED</td>
<td></td>
<td>2.7327</td>
<td>1.9989</td>
<td>2.3723</td>
<td>1.1757</td>
<td>0.0662</td>
<td>0.1523</td>
<td>3.8345</td>
<td>0.0917</td>
<td>2.1437</td>
<td>3.0600</td>
</tr>
<tr>
<td>CD (5%)</td>
<td></td>
<td>5.6020</td>
<td>4.0978</td>
<td>4.8632</td>
<td>2.4101</td>
<td>0.1336</td>
<td>0.3123</td>
<td>7.8608</td>
<td>0.1879</td>
<td>4.3946</td>
<td>6.2731</td>
</tr>
<tr>
<td>CD (1%)</td>
<td></td>
<td>7.5422</td>
<td>5.5170</td>
<td>6.4575</td>
<td>3.2449</td>
<td>0.1826</td>
<td>0.4204</td>
<td>10.5833</td>
<td>0.2530</td>
<td>5.9167</td>
<td>8.4457</td>
</tr>
</tbody>
</table>

G.P-Germination Per cent; S.P-Survivability Per cent; FLW-Fresh Leaf Weight; SLA-Single Leaf Area; P.H-Plant Height; LMC-Leaf Moisture Content; LDM-Internodal Distance; MRC-Moisture Retention Capacity

### Table 2: Proportional contributions (%) of lines, testers and their interactions for total variance

<table>
<thead>
<tr>
<th>S.No</th>
<th>Characters</th>
<th>Lines</th>
<th>Testers</th>
<th>Line x Tester</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Germination per cent (%)</td>
<td>24.33</td>
<td>2.11</td>
<td>73.56</td>
</tr>
<tr>
<td>2</td>
<td>Survival per cent (%)</td>
<td>30.53</td>
<td>6.71</td>
<td>62.76</td>
</tr>
<tr>
<td>3</td>
<td>Plant height (cm)</td>
<td>22.74</td>
<td>6.47</td>
<td>70.79</td>
</tr>
<tr>
<td>4</td>
<td>Number of leaves/branch</td>
<td>39.51</td>
<td>30.69</td>
<td>29.80</td>
</tr>
<tr>
<td>5</td>
<td>Number of branches/plant</td>
<td>16.10</td>
<td>46.50</td>
<td>37.40</td>
</tr>
<tr>
<td>6</td>
<td>Internodal distance(cm)</td>
<td>11.23</td>
<td>13.71</td>
<td>75.06</td>
</tr>
<tr>
<td>7</td>
<td>Single leaf area(cm(^2))</td>
<td>15.09</td>
<td>0.49</td>
<td>84.43</td>
</tr>
<tr>
<td>8</td>
<td>Fresh leaf weight (g)</td>
<td>35.70</td>
<td>2.39</td>
<td>61.90</td>
</tr>
<tr>
<td>9</td>
<td>Leaf moisture content (%)</td>
<td>20.98</td>
<td>17.55</td>
<td>61.48</td>
</tr>
<tr>
<td>10</td>
<td>Moisture retention capacity (%)</td>
<td>21.71</td>
<td>29.23</td>
<td>70.79</td>
</tr>
</tbody>
</table>

### General combining ability effects

The estimates of GCA effects of parents for all the characters are given in Table 3. Among the parents the highest GCA effect were exhibited by the lines MI-0685 and MI-0615 (5.31 and 5.21 respectively) for germination per cent. Among the testers V1 showed significant and positive GCA effect (5.31 and 5.21 respectively) for germination per cent. Among the lines, MI-0685 and MI-0615 exhibited significant and positive GCA effect (3.14 and 3.05 respectively) (Table 3). MI-0651 and V1 were found to have highly significant and negative GCA value (-0.24 and -0.27 respectively). These results are similar to the findings of Rita Banerjee et al. (2007)\textsuperscript{23}, Ghosh et al. (2009)\textsuperscript{10} and Peris Nderitu et al. (2014)\textsuperscript{21}. Short internodal distance has been considered as desirable trait because less internodal distance would increase the number of leaves per unit length of the shoot. From the results, it is concluded that, MI-0651 and V1 are desirable genotypes for growth related traits. For single leaf area, MI-0615 showed highly significant and positive GCA effect (6.65), at the same time MI-0543 showed negative GCA value (-7.85).

Out of five lines, MI 0543 was found to be exhibit highly significant and positive GCA effect for fresh leaf weight (0.44). It is an important character from yield point of view. Among the testers, V1 showed positive significant GCA value (0.08). Similarly, Ghosh et al. (2009)\textsuperscript{10}, reported positive correlation between fresh leaf weight and leaf yield/plant. Leaf moisture is an essential parameter for mulberry. Based on the moisture content present in the leaves, it should be categorized and feed to different stages of silkworms. Among the lines, MI-0615 had highly significant and positive GCA effect (2.44) whereas, MI-0718 showed highest negative GCA value (-2.49). While, MI-0543 showed highly significant positive GCA followed by G4 and V1 (3.14, 2.34 and 2.28 respectively) for moisture retention capacity.
Jolly and Dandin (1986) [15] opined that tropical crossing the parents with low x high, high x low, high x high was suitable for leaf yield traits or not. MI-0685 x V1 (4.93), of leaves per branch indicated whether the particular genotype to the characters like height of the plant, number of shoots, could bear only few number of leaves per branch. showed negative and highly significant SCA (-5.66), which observed that plant height was an important character and significant at 5% level (\(P < 0.05\)); **significant at 1% level (\(P < 0.01\))

Specific combining ability effects

SCA estimates indicated that, at least one parent with good combining ability was required to produce superior hybrids. \(F_1\) progenies with desirable SCA effects could be produced by crossing the parents with low x high, high x low, high x high GCA. Jolly and Dandin (1986) [15] opined that tropical mulberry varieties are good in sporulating. Among the fifteen crosses, five crosses showed highly positive significant SCA effects for germination per cent, MI-0718 x MI-0663 recorded highly significant and positive SCA (0.85) for intermodal distance. Genotypes with shorter intermodal distance were preferable because shoots with less nodal length contains more number of leaves.

Single leaf area of MI-0543 x V1 had positively significant SCA (20.98) and fresh leaf weight of MI-0685 x MI-0663 showed highly positive SCA (0.37), Chaluvachari and Bongale (1995) [6] reported that high leaf moisture content and its retention capacity are considered as the important leaf quality parameters for better growth and development of silkworms. The results denoted that, MI-0543 x V1 had high leaf moisture content. With respect to moisture retention capacity, MI-0685 x V1, MI-0615 x G4 and MI-0718 x MI-0663 had highly significant positive SCA effect (5.39, 4.71 and 4.48 respectively) whereas, MI-0718 x V1 showed significantly negative SCA for leaf moisture content (-5.25) and also for moisture retention capacity (-7.44).

Conclusion

Selection of compatible parents with desirable GCA and crosses with superior SCA effects has a vital role in all successful breeding programmes. In the present study, variations were observed in all the eight parental genotypes and fifteen \(F_1\) progenies of mulberry. Parents and crosses had significant amount of GCA and SCA respectively. Due to the variations, screening of better mulberry genotype is quite easy. Among the fifteen \(F_1\) crosses, MI-0685 x V1 was found to perform better than the remaining crosses and MI-0543 x V1 was found to be the best combiners. Hence, these parents and \(F_1\) progenies may be further used in breeding programs for mulberry crop improvement.

### Table 3: Estimation of General Combining Ability effects

<table>
<thead>
<tr>
<th>Parents</th>
<th>G.P (%)</th>
<th>S.P (%)</th>
<th>P.H (cm)</th>
<th>No. of leaves/branch</th>
<th>No. of branches/plant</th>
<th>LD (cm)</th>
<th>SLA (cm²)</th>
<th>FLW (g)</th>
<th>LMC (%)</th>
<th>MRC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI-0543 x V1</td>
<td>-2.78**</td>
<td>-0.47</td>
<td>2.67*</td>
<td>3.14**</td>
<td>0.17**</td>
<td>-0.07</td>
<td>-7.85**</td>
<td>0.44**</td>
<td>0.72</td>
<td>3.14*</td>
</tr>
<tr>
<td>MI-0615 x G4</td>
<td>5.21**</td>
<td>19.10**</td>
<td>2.28*</td>
<td>2.67**</td>
<td>-0.06</td>
<td>0.13*</td>
<td>1.20</td>
<td>-0.12**</td>
<td>2.44**</td>
<td>2.12</td>
</tr>
<tr>
<td>MI-0651 x G4</td>
<td>-0.74</td>
<td>0.87</td>
<td>-0.96</td>
<td>-1.85**</td>
<td>-0.11**</td>
<td>-0.24**</td>
<td>6.65**</td>
<td>0.04</td>
<td>-1.36</td>
<td>-1.72</td>
</tr>
<tr>
<td>MI-0685 x G4</td>
<td>5.31**</td>
<td>2.44**</td>
<td>2.04*</td>
<td>1.82**</td>
<td>0.22**</td>
<td>-0.09</td>
<td>1.29</td>
<td>-0.27**</td>
<td>0.90</td>
<td>1.06</td>
</tr>
<tr>
<td>MI-0718 x V1</td>
<td>-6.99**</td>
<td>-21.94**</td>
<td>-6.03**</td>
<td>-5.78**</td>
<td>-0.22**</td>
<td>0.27**</td>
<td>-1.29</td>
<td>-0.09**</td>
<td>-2.49**</td>
<td>-4.60**</td>
</tr>
<tr>
<td>SED</td>
<td>1.577</td>
<td>1.154**</td>
<td>1.3696</td>
<td>0.6788</td>
<td>0.0382</td>
<td>0.0879</td>
<td>2.2139</td>
<td>0.0529</td>
<td>1.2377</td>
<td>1.7667</td>
</tr>
<tr>
<td>CD (%)</td>
<td>3.234**</td>
<td>2.3659</td>
<td>2.0877</td>
<td>1.3915</td>
<td>0.0783</td>
<td>0.1803</td>
<td>4.5384</td>
<td>0.1085</td>
<td>2.5372</td>
<td>3.6218</td>
</tr>
<tr>
<td>MI-0615 x V1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MI-0543 x V1</td>
<td>-0.13</td>
<td>-2.88</td>
<td>6.08**</td>
<td>0.60</td>
<td>0.30**</td>
<td>0.61**</td>
<td>20.98**</td>
<td>-0.07</td>
<td>4.56**</td>
<td>4.44**</td>
</tr>
<tr>
<td>MI-0685 x V1</td>
<td>-6.5**</td>
<td>-8.45**</td>
<td>-6.82**</td>
<td>-3.50**</td>
<td>-0.39**</td>
<td>0.07</td>
<td>-0.45</td>
<td>-0.02</td>
<td>1.00</td>
<td>2.34**</td>
</tr>
<tr>
<td>MI-0651 x G4</td>
<td>-1.06</td>
<td>-6.61**</td>
<td>-0.09</td>
<td>-0.44</td>
<td>0.08**</td>
<td>0.20**</td>
<td>-0.74</td>
<td>-0.06**</td>
<td>-2.30**</td>
<td>-4.62**</td>
</tr>
<tr>
<td>MI-0615 x G4</td>
<td>1.2221</td>
<td>0.8939</td>
<td>1.0609</td>
<td>0.5258</td>
<td>0.0296</td>
<td>0.0681</td>
<td>1.7149</td>
<td>0.0410</td>
<td>0.9587</td>
<td>1.3865</td>
</tr>
<tr>
<td>CD (%)</td>
<td>2.5053</td>
<td>1.8326</td>
<td>2.1749</td>
<td>1.0779</td>
<td>0.0607</td>
<td>0.1397</td>
<td>3.5155</td>
<td>0.0840</td>
<td>1.9653</td>
<td>2.8054</td>
</tr>
<tr>
<td>MI-0543 x V1</td>
<td>-2.78*</td>
<td>-0.47</td>
<td>2.67*</td>
<td>3.14**</td>
<td>0.17**</td>
<td>-0.07</td>
<td>-7.85**</td>
<td>0.44**</td>
<td>0.72</td>
<td>3.14*</td>
</tr>
<tr>
<td>MI-0685 x V1</td>
<td>5.31**</td>
<td>2.44**</td>
<td>2.04*</td>
<td>1.82**</td>
<td>0.22**</td>
<td>-0.09</td>
<td>1.29</td>
<td>-0.27**</td>
<td>0.90</td>
<td>1.06</td>
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<tr>
<td>MI-0718 x V1</td>
<td>-6.99**</td>
<td>-21.94**</td>
<td>-6.03**</td>
<td>-5.78**</td>
<td>-0.22**</td>
<td>0.27**</td>
<td>-1.29</td>
<td>-0.09**</td>
<td>-2.49**</td>
<td>-4.60**</td>
</tr>
<tr>
<td>SED</td>
<td>1.577</td>
<td>1.154**</td>
<td>1.3696</td>
<td>0.6788</td>
<td>0.0382</td>
<td>0.0879</td>
<td>2.2139</td>
<td>0.0529</td>
<td>1.2377</td>
<td>1.7667</td>
</tr>
<tr>
<td>CD (%)</td>
<td>3.234**</td>
<td>2.3659</td>
<td>2.0877</td>
<td>1.3915</td>
<td>0.0783</td>
<td>0.1803</td>
<td>4.5384</td>
<td>0.1085</td>
<td>2.5372</td>
<td>3.6218</td>
</tr>
</tbody>
</table>

### Table 4: Estimation of Specific Combining Ability effects

<table>
<thead>
<tr>
<th>S.no</th>
<th>Crosses</th>
<th>G.P (%)</th>
<th>S.P (%)</th>
<th>P.H (cm)</th>
<th>No. of leaves/branch</th>
<th>No. of branch/plant</th>
<th>LD (cm)</th>
<th>SLA (cm²)</th>
<th>FLW (g)</th>
<th>LMC (%)</th>
<th>MRC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MI-0543 x V1</td>
<td>-0.13</td>
<td>-2.88</td>
<td>6.08**</td>
<td>0.60</td>
<td>0.30**</td>
<td>0.61**</td>
<td>20.98**</td>
<td>-0.07</td>
<td>4.56**</td>
<td>4.44**</td>
</tr>
<tr>
<td>2</td>
<td>MI-0615 x V1</td>
<td>-6.5**</td>
<td>-8.45**</td>
<td>-6.82**</td>
<td>-3.50**</td>
<td>-0.48**</td>
<td>-0.54**</td>
<td>-10.86**</td>
<td>0.35**</td>
<td>-1.65</td>
<td>-5.01**</td>
</tr>
<tr>
<td>3</td>
<td>MI-0651 x V1</td>
<td>7.76**</td>
<td>15.26**</td>
<td>-0.75</td>
<td>3.62**</td>
<td>0.08</td>
<td>-0.20</td>
<td>-8.85**</td>
<td>0.27**</td>
<td>1.05</td>
<td>2.63</td>
</tr>
<tr>
<td>4</td>
<td>MI-0685 x V1</td>
<td>10.82**</td>
<td>21.43**</td>
<td>-0.51</td>
<td>4.93**</td>
<td>0.41**</td>
<td>-0.21</td>
<td>-4.40</td>
<td>0.36**</td>
<td>1.28</td>
<td>5.39**</td>
</tr>
</tbody>
</table>
5 MI 0718 x V1 -11.95** -25.36** 1.99 -5.66** -0.31** 0.35** 3.13 0.33** -5.25** -7.44**
6 MI 0543 x G1 9.73** 27.46** -4.50* -1.58 -0.17** 0.54** 11.68** 0.07 -1.16 0.22
7 MI 0615 x G1 9.78** 16.84** 5.09** 1.24 0.06 0.42** 16.83** 0.30** -5.10** -5.85*
8 MI 0651 x G1 -6.58** -32.99** -1.51 -0.17 0.42** 0.11* 0.29* 16.83** 0.30** -5.10** -5.85*
9 MI 0615 x G1 10.75** 18.57** -8.27** -11.19** 2.22* 0.09 -0.51** 2.60 -0.46** 2.97 4.48*
10 MI 0718 x G1 -2.18 7.26** 9.20** 3.44** 0.22** 0.16 -0.53 0.13 2.28 2.96
11 MI 0685 x G1 -10.75** -18.57** -8.27** -1.97* -0.22** -0.63** -13.86** -0.73** 1.45 -2.05
12 MI 0651 x G4 -6.58** -32.99** -1.51 -1.13 0.11* 0.29* 16.83** 0.30** -5.10** -5.85*
13 MI 0615 x G4 -3.28 -8.39** 1.73 2.26* 0.42** -0.17 1.63 0.12 -0.89 0.29
14 MI 0685 x G4 -2.18 7.26** 9.20** 3.44** 0.22** 0.16 -0.53 0.13 2.28 2.96
15 CD (1%) 7.5422 5.5170 6.5475 3.2449 0.1826 0.4204 10.5833 0.2530 5.9167 8.4457
16 CD (5%) 5.6020 4.0978 4.8632 2.4100 0.1253 0.3123 7.8608 0.1879 4.3946 6.2731
17 SED 2.7327 1.9989 2.3723 1.1757 0.0662 0.1523 3.8345 0.0917 2.1437 3.0600

*significant at 5% level (P<0.05); **significant at 1% level (P<0.01)

References