Electronic Journal of Plant Breeding, 5(3): 385-393 (Sep 2014)
ISSN 0975-928X

Research Article

Combining ability effects for fruit characters in brinjal (*Solanum melongena* L.)

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(Received: 12 Apr 2014; Accepted:08 Sep 2014)

Abstract
Brinjal var.Pant Rituraj showed the best general combining ability *(gca)* effects for fruit diameter, average fruit weight and number of infested fruits/plant whereas, Pant Samrat for number of healthy fruits/plant, total number of fruits/plant and yield/plant and *S. aethiopicum* L. (2n=24) for the traits number of healthy fruits/plant, total number of fruits/plant and weight of infested fruits/plant whereas. BARI was found best general combiner for fruit length, average fruit weight, weight of healthy fruits/plant and yield/plant. PB-71 gave significant *gca* effect for fruit diameter, average fruit weight and yield/plant. The cross BARI x PB-66, BARI x Pant Rituraj and BARI x Pant Samrat were found highest specific combining ability (*sca*) effect for most of the characters studied. Other good specific combiners were PB-66 x PR, PB-66 x PS, BARI x PB-71 and *S. aethiopicum* x BARI. These parents and specific combinations could be utilized for further breeding programme of brinjal improvement.

Key words:
Brinjal, combining ability, diallel, fruit character.

Introduction:

Brinjal (*Solanum melongena* L., 2n=24) is an important *Solanaceous* vegetable crop of India. It is also a popular vegetable in China and other Asian countries and now cultivated worldwide. Its immature fruits are generally used as vegetable and other culinary preparations with locally preferred fruit characters. In respect of very high local preferences for colour, shape and taste, there are specific genotypes suited for specific localities. It is not possible to have one common cultivar to suit different localities and local preferences. It is therefore, required to improve the locally preferred cultivars with certain fruit characters along with high yield and adaptation. Now a day's development of new variety/hybrid with specific fruit characteristic is most desirable traits for the breeders of brinjal in India as well as in the world. For an effective breeding programme in brinjal, one need to have information about genetic architecture and general combining ability of parents and specific combining ability of the crosses for important traits equally contributed for effective improvement programme in brinjal.

In this investigation eight diverse genotypes of brinjal were taken to estimate the combining ability effects for important fruit characters. Similar investigation were carried out in brinjal by various workers at different places *viz.*, Ahmad *et al*. (2008), Biradar *et al*. (2005), Das and Baruha (2001), Kumar and Pathania (2003), Panda *et al.* (2004), Quamruzzaman *et al*. (2007), Singh *et al*. (2002a and 2002b), Singh and Maurya (2003 & 2004) and Suneetha *et al*. (2005). The information generated in this process is used to understand the combining ability and this knowledge helps in the selection of parental lines for the improvement of brinjal genotypes for different fruit characters.

Material and methods

The experimental materials consisted of eight promising genotypes of brinjal (*Solanum melongena* L.2n=24) *viz., Solanum aethiopicum* L. (2n=24), BARI, PB-66, Pant Rituraj, WB-1, PB-67, PB-71 and Pant Samrat which were selected for making crosses in diallel fashion (without reciprocals) and generated a set of 28 F_1 hybrids. Crosses were made during 2009-10 and 2010-11 for the evaluation of F_1s during two subsequent years *viz.,* 2010-11 and 2011-12, respectively. Evaluation of all 36 genotypes (8 parents + 28 F_1s) was done during both the years of experimentation. One month old seedlings were transplanted at the spacing of 75 cm x 60 cm in rows of 6 meter length consisting of 10 plants each row. Recommended package of practices were followed for raising the normal seedlings and crop. The genotypes were evaluated for nine important fruit characters *viz.,* fruit length (cm), fruit diameter (cm), average fruit weight (g), number of healthy fruits per plant, number of infested fruits (damaged by *Leucinodes orbonalis*) per plant, total number of fruits per plant, weight of healthy fruits per plant (kg), weight of infested fruits (damaged by *Leucinodes orbonalis*) per plant (kg) and yield per plant (kg). The data were subjected to appropriate statistical analysis. The combining ability analysis was carried out according to Griffing's (1956) Method 2 Models I (fixed effect).

Results and discussion

Analysis of variances for combining ability: The analysis of variances of combining ability was done for all nine fruit characters separately and results are presented in Table 1. The mean squares were partitioned into three parts *viz.*, mean squares due to *gca*, *sca* and error. The result revealed that the general combining ability (*gca*) mean squares were highly significant for all characters during both the years (2010 & 2011), except number of primary branches per plant in the second year, which was non-significant. The mean squares of specific combing ability (*sca*) were also highly significant for all the characters during both the years.

Estimate of general combining ability (*gca*) effects: The estimates of general combing ability (*gca*) effects of the parents for various characters are presented in the Table 2. The results on the estimates of *gca* of parents for both the years are described for each character separately as follows: In the first year, all eight parents showed significant *gca* effects for fruit length, ranging from -9.46 (*S. aethiopicum*) to 7.78 (PR), where four were in negative direction and rest four in positive direction. In the second year, similar results were observed, ranging from -9.50 (*S. aethiopicum*) to 7.34 (BARI), where four were in negative direction & four in positive direction. The four good combiners for this trait were BARI, PB-66, PB-67 and PS. These findings indicated that to increase the fruit length of brinjal, the long fruited parents should be involved in crossing programme and vice-versa. Similar results have been reported by Biradar *et al*, (2005), Panda *et al*, (2004), Singh *et al*. (2002a) and Babu and Thirumurugan (2001).

With respect to fruit diameter in the first year, estimate of *gca* effects revealed that two parents showed significant effect i.e. *S. aethiopicum* (-1.98) and Pant Rituraj (1.69). In the second year, all eight parents showed highly significant *gca* effects, ranging from -1.79 *(S. aethiopicum)* to 1.86 (PR), where four were in positive direction i.e. Pant Rituraj (1.86), PB-71 (0.59), PB-66 (0.26) and WB-1 (0.15). Thus, Pant Rituraj was the best general combiner to increase the fruit diameter. This result is similar to the results of Panda *et al.* (2004), Singh *et al.* (2002a), Prasath *et al*. (2000) and Singh *et al.* (2002b). Analysis of *gca* effects for average fruit weight revealed that seven parents showed significant effect in the first year, ranging from -100.06 (*S. aethiopicum*) to 39.11 (PR), where five were in desired positive direction. In the second year, all eight parents exhibited significant *gca* effects, ranging from -100.78 (*S. aethiopicum*) to 40.97 (PR), where six were in positive direction. Three parents showed consistent significant *gca* effects over both the years i.e. PR, BARI and PB-71. This indicates that these genotypes are good general combiners for the increase of average fruit weight in brinjal, which is in agreement with the findings of Babu and Thirumurugan (2001), Quamruzzaman *et at.*(2007), Biradar e*t al*. (2005 and Das and Baruha (2001).

For the number of healthy fruits per plant in the first year, seven parents exhibited significant estimates, ranging from -4.88 (PR) to 17.71 *(S. aethiopicum)*, where two were in desired positive direction i.e. *S. aethiopicum* (17.71) and Pant Samrat (1.22). Similar results were observed in the second year, where same parents showed significant estimates with positive values i.e. *S. aethiopicum* (17.42) and Pant Samrat (1.09). Thus, *S. aethiopicum* and Pant Samrat were best general combiners for this trait, which showed significant estimates in desired positive direction during both the years. This result is similar to the reports of Singh and Maurya (2004) and Babu and Thirumurugan (2001).

As regards with the number of infested fruits per plant three parents showed significant effect in the first year, where two were in desired negative direction i.e. PR (-0.78) and WB-1 (-0.85). In the second year, five parents exhibited significant estimates, ranging from -1.28 (PR) to 2.53 (*S. aethiopicum*), where four were in negative direction i.e. PR (-1.28), WB-1 (-0.56), PB-66 (-0.44) and PB-71 (-0.37). Thus PR and WB-1 showed consistent results in desired negative direction over both the years and established as good general combiners for this trait. Similar reports were corresponded by Singh and Maurya (2004) and Babu and Thirumurugan (2001).

Seven parents showed significant *gca* effects for total number of fruits per plant in the first year, ranging from -5.65 (PR) to 2003 (*S. aethiopicum*), where two were in desired positive direction. i.e. *S. aethiopicum* (2003) and PS (1.33). In the second year, similarly seven parents showed significant *gca* effect ranging from -6.95 (PR) to 19.95 (*S. aethiopicum*), where only two were in positive direction i.e. *S. aethiopicum* (19.95) and Pant Samrat (1.35). Thus best parents for this trait were *S. aethiopicum* and Pant Samrat which showed significantly positive *gca* effects in both the year. This result was in agreement with the findings of Singh and Maurya (2004), Babu and Thirumurugan (2001) and Singh *et al.* (2002a).

All eight parents exhibited significant *gca* estimates for the weight of healthy fruits per plant in the first year, ranging from -1.09 (*S. aethiopicum*) to 0.43 (BARI), where six were in desired positive direction i.e. BARI (0.43), PB-67

(0.18), PS (0.15), PB-71 (0.14) and PB-66 (0.13). In the second year, six parents showed significant effect, ranging from -0.19 (*S. aethiopicum*) to 0.45 (BARI), where five were in positive direction i.e. BARI (0.45), PS (0.22), PB-71 (0.21), PB-67(0.14) and PB-66(0.13). Thus the positive *gca* effects showed by the genotypes BARI, PS, PB-67 and PB-66 were consistent over the years hence, established as good general combiners for this trait. Similar results were also reported by Singh and Maurya (2003 & 2004). For weight of infested fruits per plant, six parents exhibited significant *gca* estimates in the first year, ranging from -0.38 (*S. aethiopicum*) to 0.14 (BARI), where *S. aethiopicum* was in the desired negative direction. In the second year, seven parents showed significant *gca* estimates, ranging from -0.36 (*S. aethiopicum*) to 0.09 (BARI), where *S. aethiopicum* was in the negative direction, rest six were in positive direction. Thus, regarding this trait, *S. aethiopicum* was the best general combiners, which was in agreement with the results reported by Singh and Maurya (2003 & 2004). Yield is one of the most important traits for the improvement of brinjal. The general combing (0.22), PB-66(0.19), PB-71(0.16) and PR (0.13). In the second year, six parents showed significant effects where five were in positive direction i.e. BARI (0.54), PB-71 (0.27), PS (0.26), PB-67 (0.22) and PB-66 (0.18) and *S. aethiopicum* was in the negative direction (-1.54). The values given in the brackets were estimates of *gca* effects for yield per plant. Thus for the yield per plant, five parents were established as good general combiners *viz.*, BARI, PS, PB-71, PB-67 and PB-66, which showed consistent positive *gca* effects in both the years. This result was in consonance with the findings of Singh and Maurya (2004), Suneetha *et al*. (2005), Ashwani and Khandelwal (2005) and Das and Baruha (2001).

Estimate of specific combining ability effects: The estimates of specific combining ability (*sca*) effects of 28 crosses with their corresponding standard errors for each character are presented in Table 3. Nineteen crosses exhibited significant *sca* effects for fruit length in the first year, ranging from -8.86 (*S. aethiopicum* × BARI) to 3.68 (PB-66 × PB-67), where nine were in positive direction and ten crosses in negative direction. The crosses, PB-66 × PB-67(3.68), BARI × PB-66 (3.31) and WB-1 × PB-71 (2.78) showed highest positive *sca* effects and the crosses, *S. aethiopicum* × BARI (-8.86), *S. aethiopicum* x PB-67 (-3.16), *S. aethiopicum* × PS (-2.73) and *S. aethiopicum* x PB-66 (-2.32) showed highest negative *sca* effects. In the second year, twelve crosses exhibited significant *sca* estimates, where six crosses showed positive *sca* estimates and another six showed negative estimates. The highest significant positive *sca* estimates was observed in the crosses PR × PS (1.73) followed by *S. aethiopicum* × PR (1.64) and BARI × PB-66 (1.70) and the crosses *S. aethiopicum* × BARI (-8.58), *S. aethiopicum* × PB-67 (-2.92), *S. aethiopicum* × PB-66 (-2.56), and *S. aethiopicum* × PS (-2.43) showed highest negative significant *sca* effects. The crosses, *S. aethiopicum* × PR, BARI × PB-66 and PR x PS exhibited significantly positive *sca* effects consistent over both the years and the crosses *S. aethiopicum* × BARI, *S. aethiopicum* × PB-67 and *S. aethiopicum* × PS were consistent negative *sca* effects in both the years. In brinjal similar trends were also observed by Panda *et al.* (2004) and Singh *et al.* (2002a). For fruit diameter, seventeen crosses exhibited significant *sca* estimates in the first year, where eight showed positive and nine crosses showed negative effects. The highest positive significant *sca* estimates were observed in the crosses, *S. aethiopicum* × PR (-2.09), *S. aethiopicum* × PB-71 (-1.29), BARI × PB-66 (-1.12), PR × WB-1 (-0.96) and *S. aethiopicum* × WB-1 (-0.95).

In the second year twenty two crosses exhibited significant *sca* estimates, where seven crosses showed positive values and fifteen crosses showed negative *sca* effects. The highest values of positive significant *sca* effects was found in the crosses, *S. aethiopicum* × BARI (0.91) followed by BARI × PR (0.63), BARI × PR (0.63), PB-66 × PS (1.09), and PR × PB-71 (0.84) and highest negative significant *sca* effects showed in the crosses, *S. aethiopicum* × PR (-2.22) followed by *S. aethiopicum* × PB-71 (-1.12), PR × WB-1 (-1.10), PR × PB-67 (-1.05) and WB-1 × PB-71 (-1.06). Thus estimates of *sca* effects indicated that the crosses exhibiting consistent positive estimates in both years were *S. aethiopicum* × BARI, BARI × PR and PB-66 × PS with higher values. Some of the earlier worker also reported similar combining ability like Singh *et al.* (2002a). Fourteen crosses exhibited significant *sca* estimates for average fruit weight in the first year, where seven were with positive values and ten with negative estimates. The highest positive significant *sca* estimates was found in the crosses, BARI × PR (45.26) followed by WB-1 × PS (52.40), PB-66 × PR (29.76) and BARI × PS (27.53). The highest negative significant *sca* effects was observed in the crosses, *S. aethiopicum* × PR (-50.67) followed by *S. aethiopicum* × PB-71 (-38.60), *S. aethiopicum* × BARI (-21.24), *S. aethiopicum* × PB-67 (-20.30) and PR × PS (-16.24). In the second year, twenty one crosses exhibited significant *sca* estimates, where ten crosses with positive values and eleven crosses exhibited negative values. The highest positive significant estimates shown in the cross, BARI × PR (62.09) followed by WB-1 × PS (47.89), PB-66 × PR (30.06) and BARI × PS (28.19). The highest negative significant estimates found in the cross, *S. aethiopicum* × PR (-50.84) followed by *S.*

aethiopicum × PB-71 (-38.11) and BARI × PB-66 (-26.11). Thus four crosses viz. BARI × PR, BARI × PS, PB-66 × PR and WB-1 × PS showed consistent positive significant estimates over the years and established as good specific combinations for average fruit weight. These results are in agreement with the findings of Ponnuswami and Irulappan (1992) and Babu and Thirumurugan (2001).

In the first year, fourteen crosses exhibited significant *sca* estimates for the number of healthy fruits per plant, where eight crosses showed positive values i.e. *S. aethiopicum* × BARI (17.37) followed by *S. aethiopicum* × PB-66 (6.43), *S. aethiopicum* × PR (6.36), BARI × PB -66 (3.40), PB-66 x PB-67 (4.87), PR x WB-1 (2.94), WB-1 x Pb-67 (3.16) and PB-71 × PS (3.50). In the second year, twelve crosses exhibited significant estimates, where seven crosses showed positive values i.e. *S. aethiopicum* × BARI (17.68), *S. aethiopicum* × PB-66 (7.33) , *S. aethiopicum* × PR (5.38), BARI × PB-66 (6.15), PB-66 × PB-67 (4.09), PR × WB-1 (4.87) and PB-71 × PS (5.07). Thus six crosses exhibited consistent positive significant estimates over both the years were *S. aethiopicum* × BARI, *S. aethiopicum* × PB-66, *S. aethiopicum* × PR, BARI × PB-66, PB-66 × PB-67 and PB-71×PS. Similar results were reported by Singh and Maurya (2004), Kumar and Pathania (2003) and Babu and Thirumurugan (2001). Ten crosses exhibited significant *sca* estimates for number of infested fruits per plant in the first year, where six crosses showed negative values i.e. *S. aethiopicum* × BARI (-1.67), *S. aethiopicum* × PB-71 (-1.00), BARI × PB-67 (-1.32), PB-66 × PS (-1.02), PR × PB -71 (-0.93) and PR × PS (-1.47).In the second year, twelve crosses exhibited significant *sca* estimates, where seven showed negative values. i.e. *S. aethiopicum* × BARI (-1.96), *S. aethiopicum* × PB-71 (-0.87), *S. aethiopicum* × PS (-1.14), PB-66 × PR (-1.07), PB-66 ×PS (-1.78), PR × PS (-1.05) and PB-67 ×PS (-1.70).Thus four crosses viz. *S. aethiopicum*. × BARI, *S. aethiopicum*. × PB-71, PB-66 × PS and PR × PS showed consistent values over both the years in negative direction. Padmanabhan and Singh (1996) and Ramesh *et al*. (1996) also reported similar effects in different crosses of brinjal for this character. For total number of fruits per plant, fifteen crosses exhibited significant *sca* estimates in the first years, where eight showed positive values i.e. *S. aethiopicum*. × BARI (15.70), *S. aethiopicum* × PB-66 (8.53), *S. aethiopicum* × PR (4.47), BARI × PB-66 (4.94), PB-66 × PB-67 (3.55), PR × WB-1 (2.68), WB-1 × PB-71 (2.86) and PB-71 × PS (4.78). In the second year, fifteen crosses exhibited significant *sca* estimates, where eight showed positive values, out of which seven crosses showed consistent over both the years, i.e. *S. aethiopicum* × BARI (15.73), *S. aethiopicum* × PB-66 (9.73), *S. aethiopicum* × PR (6.78), BARI × PB-66 (8.21), PB-66 × WB-1 (3.87), PR × WB-1 (3.66) and PB-71 × PS (7.24). Thus these seven crosses established as good specific combinations for number of fruits per plant. Similar results were also observed by Aswani and Khandelwal (2005) and Das and Baruha (2001).

Twenty crosses exhibited significant estimates for weight of healthy fruits per plant in the first year, ranging from -0.52 (*S. aethiopicum* x BARI) to 0.82 (BARI x PB-66), where eleven showed positive values. The maximum values of *sca* estimates showed in the cross, BARI x PB-66 (0.82) followed by BARI x PR (0.75), PB-71 x PS (0.68), PB-66 x PB-67 (0.43), BARI x PB-71 (0.39) and PB-66 x WB-1 (0.40). In the second year, ten crosses exhibited significant estimates, ranging from -0.54 (*S. aethiopicum* x BARI) to 0.93 (BARIxPB-66), where five showed positive values, i.e. BARI x PB-66 (0.93), BARI x PR (0.70), PB-71 x PS (0.64), PB-66 x WB-1 (0.36) and BARI x PB-71 (0.35). Thus BARI x PB-66, BARI x PR, PB-71 x PS, PB-66 x WB-1, and BARI x PB-71 were consistent over both the years with positive estimates and these crosses were established as good specific combiners for this trait. Similar results were reported by Padmanabhan and Singh (1996), and Ramesh *et al*. (1996).

For weight of infested fruits per plant, twelve crosses exhibited significant *sca* estimates in the first year, ranging from -0.17 (*S. aethiopicum* x BASRI), to 0.26 (BARI x PS), where five crosses showed negative values i.e. *S. aethiopicum* x BARI (0.17), S. *aethiopicum* x PB-66 (-0.12), S. *aethiopicum* x PS (-0.12), WB-1 x PS (-0.13), and PB-67 x PS (-0.14). In the second year, fifteen crosses exhibited significant estimates, ranging from -0.25 (PB-66 x PR) to 0.33 (BARI x PB-66), where nine crosses with negative value i.e. PB-66 x PR (-0.25), BARI x PB-67 (-0.17), PB-67 x PS (-0.10), *S. aethiopicum* x BARI (-0.12), *S. aethiopicum* x PB-66 (-0.09), *S. aethiopicum* x WB-1 (-0.07), *S. aethiopicum* x PB-67 (-0.11), *S. aethiopicum* x PB-67 (-0.09), *S. aethiopicum* x PB-71 (-0.09) and *S. aethiopicum* x PS (-0.08). The crosses *S. aethiopicum* x BARI, *S. aethiopicum* x PB-66, *S. aethiopicum* x PS and PB-67 x PS showed consistent significant estimates over both the years and gave negative values. These results are in agreement with those of Padmanabhan and Singh (1996) and Ramesh *et al.* (1996) as they reported significant *sca* effect in different crosses for this character. In the first year, twenty one crosses exhibited significant *sca* estimates for yield per plant, ranging from -0.70 (*S. aethiopicum* x BARI) to 1.02 (BARI x PB-66), where eleven crosses showed positive values. The highest positive value shown in the cross BARI x PB-66 (1.02) followed by BARI x PR (0.91), PB-71 x PS (0.87), BARI x PS (0.50), PB-66 x PB-67 (0.48), PB-66 x WB-1 (0.42) and BARI x PB-71 (0.31). In the second year, eleven crosses exhibited significant estimates, ranging from -0.73 (PB-66 x PR) to 1.27 (BARI x PB-66), where five showed positive values i.e. BARI x PB-66 (1.27), BARI x PR (0.95), BARI x PB-71 (0.34), PB-66 x WB-1 (0.50) and PB-71 x PS (0.64).Thus these five crosses showed consistent significant estimates over both the years and proved as good specific combinations for yield per plant. These results are in agreement with the results of Babu and Thirumurugan (2001), Ahmad *et al*. (2008) and Singh and Maurya (2003).

The ranking of genotypes/crosses were made as per the combining ability presented in the Table 4. Pant Rituraj (PR) was found to be the best general combiner for fruit diameter (cm), average fruit weight (g) and number of infested fruits/plant. Pant Samrat showed the good *gca* effects for number of healthy fruits/Plant, total number of fruits per plant, weight of healthy fruits/plant (kg) and yield/plant (kg). *S. aethiopicum* was the best general combiner for the traits number of healthy fruits/Plant, total number of fruits per plant and weight of infested fruits/plant (kg). BARI was the best general combiners for fruit length (cm), average fruit weight (g), weight of healthy fruits/plant (kg) and yield/plant (kg). PB-71 was found to be the good general combiner for fruit diameter (cm), average fruit weight (g) and yield per plant (kg). PB-66 showed best *gca* effects for fruit length, fruit diameter (cm) and weight of healthy fruits per plant (kg). The crosses BARI x PB-66, BARI x PR and BARI x PS recorded highest *sca* effect for most of the characters studied. Other good specific combiners were PB-66 x PR, PB-66 x PS, BARI x PB-71 and *S. aethiopicum* x BARI. Thus on the basis of this ranking best parents and best specific combination could be identified for further breeding programme for brinjal improvement.

Acknowledgements: Authors acknowledge with thanks to the Director Experiment Station, G. B. Pant University of Agriculture and Technology, Pantnagar-263145 for providing necessary facilities during the course of investigation. Leading author also extends his gracious gratitude to the Hon. Vice Chancellor, Birsa Agricultural University, Ranchi for granting study leave to pursue PhD Degree under faculty development scheme.

References

Ahmad, E., A.M. Ansari, A. Sah, B.K. Bhagat and M.N. Ali. 2008. Combining ability estimation for fruit yield and its components in brinjal (*Solanum melongena* L.). *Green Farming,* **2**(2): 83-86.

Ashwani, R.C. and R.C. Khandelwal. 2003. Hybrid vigour in brinjal (*Solanum melongena* L.). *Annals of Agrl. Res.,* **24**(4): 833-837.

Babu, S. and T. Thirumurugan. 2001. Selection of parents to develop hybrids through combining ability analysis in brinjal (*Solanum melongena* L.). *J. Ecobiol*., **13**(2): 97-101.

Biradar, A.B., A.D. Dumbre and P.A. Navale. 2005. Combining ability studies in brinjal *(Solanum melongena* L.). *J. Maharastra Agril. Univer.,* **30**(3): 342-344.

Das, G. and N.S. Baruha. 2001. Heterosis and combining ability for yield and its components in brinjal. *Annals of Agril. Res.,* **22**(3): 399-403.

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

Kumar, V. and N.K. Pathania.2003. Combining ability studies in brinjal (*Solanum melongena* L.). *Veg. Sci.,* **30**(1): 50-53.

Padmanabhan, V. and C.A. Jagdish. 1996. Combining ability studies on yield potential of round fruited brinjal. *Indian J. Genet.,* **56**(2): 141-146.

Panda, B., Y.V. Singh and H.H. Ram. 2004. Combining ability studies for yield and yield attributing traits in round fruited eggplant (*Solanum melongena* L.) under *tarai* condition of Uttaranchal, India. *Capsicum-and-Eggplant-Newsletter,* **23**: 137-140.

Ponnuswami, V. and I. Irulappan. 1992. Combining ability studies in *Solanum melongena* L. *South Indian Hort.,* **40**(5): 261-265.

Prasath, D., S. Natarajan and S.Thamburaj. 2000. Line x tester analysis for heterosis in brinjal. *The Orissa J. Hort.,* **28**(1): 59-64.

Quamruzzaman, K.M., M.A. Rashid, S. Ahmad, M. Rahman, Mashiur and N.A. Sultana. 2007. Combining ability estimates in nine eggplant varieties. *Pak. J. Sci. Indus. Res*., **50**(1): 55-59.

Ramesh Kumar, D.N. Singh, K.K. Prasad and R. Kumar. 1996. Combining ability analysis in brinjal (*Solanum melongena* L.). *J. Res. Birsa Agric. Univ*., **8**(1): 45-49.

Singh, A.K., Rai Mathura, R.S. Pan and V.S.R.K. Prasad. 2002a. Combining ability of quantitative characters in brinjal. *Veg. Sci.,* **29**(2): 127-130.

Singh, H.V., S.P. Singh, Major Singh and Satyendra Singh. 2002b. Genetic analysis of quantitative traits in brinjal (*Solanum melongena* L.). *Veg. Sci*., **29**(1): 84-86.

Singh, Rajaneesh and A.N. Maurya. 2003. Combining ability studies in aubergine (*Solanum melongena* L.). *Res. on Crops,* **4**(3): 400-405.

Singh, Rajaneesh and A.N. Maurya. 2004. Combining ability studies for number and weight of marketable fruits in brinjal (*Solanum melongena* L.). *Prog. Hort*., **36**(2): 350-355.

Suneetha, Y., K.B. Kathira, P.K. Kathira and T. Srinivas. 2005. Combining ability for yield, quality and physiological characters in summer grown brinjal. *Veg. Sci.,* **32**(1): 41-43.

Electronic Journal of Plant Breeding, 5(3): 385-393 (Sep 2014)
ISSN 0975-928X

Table 1: Analysis of variance for general and specific combining ability for various characters over the years

Source of variation	d. f.	Fruit Length (cm)		Fruit Diameter (cm)		Average Fruit Weight (g)		Number of Healthy Fruits/ Plant	
		2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
GCA	7.00	238.96**	227.45**	11.18**	10.82**	18288.13**	18624.34**	552.17**	541.40**
SCA	28.00	10.51**	9.73**	0.85**	0.97**	865.63**	958.91**	28.60**	35.56**
Error	70.00	0.45	0.27	0.03	0.02	64.68	21.46	1.67	3.12

Table 1. Contd..

Source of variation	d. f.	Number of Infested Fruits/ Plant		Total number of Fruits/ Plant		Weight of Healthy Fruits/ Plant (kg)		Weight of Infested Fruits/ Plant (kg)		Yield/ Plant (kg)	
		2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
GCA	7.00	9.87**	12.55**	707.97**	714.32**	2.09**	2.49**	0.25**	0.21**	3.79**	4.14**
SCA	28.00	1.05**	1.50**	31.01**	40.46**	0.20**	0.19**	0.02**	0.02**	0.30**	0.32**
Error	70.00	0.22	0.20	1.93	3.63	0.00	0.03	0.00	0.00	0.01	0.03

*Significant at 0.05 probability
**Significant at 0.01 probability

Table 2: Estimates of general combining ability effects of eight parents for various characters of brinjal over the years

Parents	Fruit Length (cm)		Fruit Diameter (cm)		Average Fruit Weight (g)		No. of Healthy Fruits/ Plant	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
S. aethiopicum	-9.46**	-9.50**	-1.98**	-1.79**	-100.06**	-100.78**	17.71**	17.42**
BARI	7.78**	7.34**	-0.51	-0.61**	20.34**	20.29**	-0.56	0.04
PB-66	2.23**	2.39**	0.01	0.26**	9.17**	7.32**	-3.32**	-3.28**
PR	-2.09**	-1.66**	1.69*	1.86**	39.11**	40.79**	-4.88**	-5.67**
WB-1	-1.23**	-1.08**	0.52	0.15**	2.14	2.92*	-4.47**	-3.80**
PB-67	1.81**	1.72**	-0.25	-0.20**	11.74**	11.36**	-2.57**	-2.64**
PB-71	-0.69*	-0.64**	0.66	0.59**	24.04**	24.06**	-3.14**	-3.16**
PS	1.64**	1.43**	-0.15	-0.28**	-6.49*	-5.97**	1.22*	1.09*
S. E. (g_i)	0.199	0.154	0.52	0.039	2.379	1.370	0.383	0.522
S. E. (g_i-g_j)	0.301	0.232	0.079	0.058	3.597	2.072	0.578	0.790

Table 2. Contd..

Parents	No. of Infested Fruits/ Plant		Total No. of Fruits/ Plant		Weight of Healthy Fruits/ Plant (kg)		Weight of Infested Fruits/ Plant (kg)		Yield/Plant (kg)	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
S. aethiopicum	2.32**	2.53**	20.03**	19.95**	-1.09**	-1.19**	-0.38**	-0.36**	-1.46**	-1.54**
BARI	-0.06	-0.22	-0.62	-0.19	0.43**	0.45**	0.14**	0.09**	0.57**	0.54**
PB-66	-0.29	-0.44**	-3.61**	-3.73**	0.13**	0.13*	0.07**	0.05**	0.19**	0.18**
PR	-0.78**	-1.28**	-5.65**	-6.95**	0.09**	0.07	0.04*	0.01	0.13**	0.08
WB-1	-0.85**	-0.56**	-5.32**	-4.36**	-0.03	-0.03	-0.02	0.03**	-0.05	0.00
PB-67	-0.26	0.08	-2.83**	-2.55**	0.18**	0.14**	0.07**	0.08**	0.25**	0.22**
PB-71	-0.20	-0.37**	-3.33**	-3.53**	0.14**	0.21**	0.01	0.06**	0.16**	0.27**
PS	0.11	0.26	1.33*	1.35*	0.15**	0.22**	0.07**	0.04**	0.22**	0.26**
S. E. (g_i)	**0.139**	**0.131**	**0.410**	**0.564**	**0.018**	**0.050**	**0.015**	**0.009**	**0.025**	**0.052**
S. E. (g_i-g_j)	**0.210**	**0.198**	**0.621**	**0.852**	**0.027**	**0.076**	**0.022**	**0.014**	**0.038**	**0.079**

*Significant at 0.05 probability
**Significant at 0.01 probability

Electronic Journal of Plant Breeding, 5(3): 385-393 (Sep 2014)
ISSN 0975-928X

Table 3. Estimates of specific combining ability effects of diallel crosses for various characters over the years

Hybrids	Fruit Length (cm)		Fruit Diameter (cm)		Average Fruit Weight (g)		No. of Healthy Fruits/ plant	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
S. aeth. x BARI	-8.86**	-8.58**	0.81**	0.91**	-21.24**	-24.67**	17.37**	17.68**
S. aeth. x PB-66	-2.32**	-2.56**	-0.25	-0.39**	-15.07*	-13.71**	6.43**	7.33**
S. aeth. x PR	2.03**	1.64**	-2.09**	-2.22**	-50.67**	-50.84**	6.36**	5.38**
S. aeth. x WB-1	0.11	-0.06	-0.95**	-0.42**	-16.37*	-16.64**	-1.98	-1.82
S. aeth. x PB-67	-3.16**	-2.92	-0.25	-0.27*	-20.30**	-19.07**	0.38	2.68
S. aeth. x PB-71	-1.36*	-1.36*	-1.29**	-1.12**	-38.60**	-38.11**	-3.65**	-3.79*
S. aeth. x PS	-2.73**	-2.43**	-0.62**	-0.49**	-7.40	-7.74	-3.01*	-0.04
BARI x PB-66	3.31**	1.70**	-1.12**	-0.58**	-14.80	-26.11**	3.40**	6.15**
BARI x PR	-1.64*	-1.82	0.47**	0.63**	45.26**	62.09**	0.82	-0.50
BARI x WB-1	-1.62*	-2.10*	0.17	-0.43**	8.90	8.29	-2.18	-2.13
BARI x PB-67	-1.67*	-0.90	0.00	-0.12	-4.04	-10.14*	-2.19	-3.17
BARI x PB-71	-0.30	-0.67	-0.30	-0.93**	17.00*	13.83**	-0.68	-1.81
BARI x PS	-0.77	-0.80	-0.03	-0.07	27.53**	28.19**	-0.88	-2.46
PB-66 x PR	-1.62*	0.16*	-0.69**	-0.24	29.76**	30.06**	-4.95**	-5.25**
PB-66 x WB-1	2.26**	2.85	0.02	-0.10	-3.27	-0.41	1.74	2.02
PB-66 x PB-67	3.68**	2.58	-0.18	-0.25*	23.80**	21.16**	4.87**	4.09*
PB-66 x PB-71	0.85	0.01	0.35*	-0.10	1.50	1.79	-3.49**	-5.75**
PB-66 x PS	-0.95	-0.29**	0.69**	1.09**	8.70	10.16*	-6.58**	-6.50**
PR x WB-1	1.91**	1.40	-0.96**	-1.10**	-6.54	-8.87*	2.94*	3.14
PR x PB-67	0.46	1.10	-0.73**	-1.05**	17.20*	22.69**	-0.30	-0.16
PR x PB-71	-1.70**	-1.33	0.14	0.84**	14.90	18.33**	0.07	4.87**
PR x PS	1.83**	1.73*	0.51**	0.30*	-16.24*	-13.31**	0.24	-5.05**
WB-1 x PB-67	1.54*	2.25	0.41*	0.36**	-2.50	-1.11	-1.71	0.81
WB-1 x PB-71	2.78**	1.88	0.08	-1.06**	5.20	6.19	3.16*	3.23
WB-1 x PS	-0.82	-1.12	0.58**	-0.46**	52.40**	47.89**	-0.10	-0.19
PB-67 x PB-71	-0.53	-1.11	-0.63**	-0.51**	-9.40	-7.24	1.36	-1.07
PB-67 x PS	1.87**	0.75**	0.08	-0.05	6.13	9.46*	-3.20*	-3.22
PB-71 x PS	-0.76	1.41**	0.51**	0.54**	-10.50	-14.91**	3.50**	5.07**
S.E.(S_{ij})	0.610	0.471	0.161	0.118	7.293	4.201	1.173	1.601
S.E.(S_{ij}-S_{ik})	0.902	0.697	0.238	0.175	10.790	6.215	1.735	2.369
S.E.(S_{ij}-S_{kl})	0.851	0.657	0.224	0.165	10.173	5.860	1.636	2.234

*Significant at 0.05 probability
**Significant at 0.01 probability

Table 3. Contd..

	No. of Infested Fruits/ Plant		Total No. of Fruits/ Plant		Weight of Healthy Fruits/ Plant (kg)		Weight of Infested Fruits/ Plant kg)		Yield/ Plant (kg)	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
S. aeth. x BARI	-1.67**	-1.96**	15.70**	15.73**	-0.52**	-0.54**	-0.17**	-0.12**	-0.70**	-0.66**
S. aeth. x PB-66	2.10**	2.39**	8.53**	9.73**	-0.18**	-0.20	-0.12*	-0.09**	-0.30**	-0.29
S. aeth. x PR	1.12*	1.41**	7.47**	6.78**	-0.19**	-0.19	-0.08	-0.06	-0.27**	-0.25
S. aeth. x WB-1	-0.01	-0.49	-2.00	-2.31	-0.11	-0.12	-0.02	-0.07*	-0.14	-0.20
S. aeth. x PB-67	0.27	-0.33	0.65	2.35	-0.30**	-0.29	-0.09	-0.11**	-0.40**	-0.40*
S. aeth. x PB-71	-1.00*	-0.87*	-4.65**	-4.67*	-0.28**	-0.36*	-0.07	-0.09**	-0.35**	-0.45**
S. aeth. x PS	-0.83	-1.14**	-3.84**	-1.18	-0.29**	-0.37*	-0.12*	-0.08**	-0.42**	-0.45**
BARI x PB-66	1.55	2.20**	4.94**	8.21**	0.82**	0.93**	0.20**	0.33**	1.02**	1.27**
BARI x PR	0.70	-0.15	1.52	-0.64	0.75**	0.70**	0.15**	0.25**	0.91**	0.95**
BARI x WB-1	0.10	1.09*	-2.09	-1.03	-0.31**	-0.22	0.16**	-0.05	-0.14	-0.27
BARI x PB-67	-0.82	-0.52	-3.01*	-3.67*	0.21**	0.05	0.00	-0.17**	0.21*	-0.12
BARI x PB-71	-0.75	-0.16	-1.44	-1.96	0.39**	0.35*	-0.09	-0.01	0.31**	0.34*
BARI x PS	1.61*	-0.70	0.73	-3.14	0.24**	0.16	0.26**	0.10**	0.50**	0.26
PB-66 x PR	-0.67	-1.07*	-5.62**	-6.30**	-0.49**	-0.48**	-0.05	-0.25**	-0.54**	-0.73**
PB-66 x WB-1	0.27	-0.19	2.01	1.84	0.40**	0.36*	0.02	0.17**	0.42**	0.53**
PB-66 x PB-67	-1.32**	-0.23	3.55**	3.87*	0.43**	0.27	0.04	0.02	0.48**	0.29
PB-66 x PB-71	-0.58	-0.09	-4.08**	-5.82**	-0.48**	-0.40*	0.01	-0.01	-0.48**	-0.41*
PB-66 x PS	-1.02*	-1.78**	-7.61**	-8.27**	-0.02	-0.30	-0.09	0.00	-0.11	-0.30
PR x WB-1	-0.25	0.52	2.68*	3.66*	0.26**	0.16	-0.08	0.00	0.18*	0.16
PR x PB-67	0.70	0.14	0.39	-0.03	-0.02	0.07	0.16**	0.00	0.14	0.08
PR x PB-71	-0.93*	-0.36	-0.87	4.50*	0.24**	0.18	-0.06	-0.04	0.18*	0.14
PR x PS	-1.47**	-1.05*	-1.23	-6.10**	0.06	-0.10	0.00	0.02	0.05	-0.08
WB-1 x PB-67	-0.70	-0.23	-2.41	0.57	-0.08	-0.02	0.05	-0.02	-0.03	-0.04
WB-1 x PB-71	-0.30	-0.82	2.86*	2.41	-0.18**	0.03	-0.01	0.03	-0.19*	0.06
WB-1 x PS	-0.07	-0.06	-0.17	-0.25	0.15*	0.21	-0.13**	-0.02	0.03	0.19
PB-67 x PB-71	0.32	0.50	1.67	-0.58	-0.01	-0.09	0.17**	0.14**	0.17*	0.06
PB-67 x PS	-0.39	-1.70**	-3.59**	-4.93**	-0.14*	-0.15	-0.14**	-0.10**	-0.28**	-0.26
PB-71 x PS	1.28**	2.17**	4.78**	7.24**	0.68**	0.64**	0.19**	0.23**	0.87**	0.87**
S.E.(S_{ij})	**0.426**	**0.402**	**1.258**	**1.728**	**0.055**	**0.154**	**0.045**	**0.028**	**0.077**	**0.160**
S.E.(S_{ij}-S_{ik})	**0.630**	**0.595**	**1.862**	**2.556**	**0.081**	**0.227**	**0.067**	**0.042**	**0.114**	**0.237**
S.E.(S_{ij}-S_{kl})	**0.594**	**0.561**	**1.755**	**2.410**	**0.077**	**0.214**	**0.063**	**0.039**	**0.107**	**0.224**

*Significant at 0.05 probability
**Significant at 0.01 probability

Table 4: Ranking of genotypes as per *gca* and *sca* effects

S. No.	Characters	Best general combiners	Best specific combination
1	Fruit length (cm)	BARI, PB-66,PB-67	BARI x PB-66,BARI x PS
2	Fruit diameter (cm)	PR, PB-71, PB-66	BARI x PR,PB-66 x PS
3	Average fruit weight (g)	PR, BARI, PB-71	BARI x PR, BARI x PS,PB-66 X PR
4	Number of healthy fruits/Plant	*S. aethiopicum*, PS	*S. aethi*. x PR, *S. aethi.* x PB-66
5	Number of infested fruits/plant	PR, WB-1	*S. aethi*. x BARI,*S. aethi* x PB-71
6	Total number of fruits/ plant	*S. aethiopicum*, PS	*S. aethi*. x BARI,*S. aethi* x PB-66
7	Weight of healthy fruits/plant (kg)	BARI, PS, PB-67, PB-66	BARI x PB-66, BARI x PR, BARI x PB-71
8	Weight of infested fruits/plant (kg)	*S. aethiopicum*	*S. aethi*. x BARI,*S. aethi* x PB-66
9	Yield/plant (kg)	BARI, PS, PB-71, PB-67	BARI x PB-66, BARI x PR, BARI x PB-71