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Combining ability studies for quantitative and qualitative traits in brinjal (*Solanum melongena* L.)

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Abstract
Six diverse brinjal lines were crossed in a full diallel fashion (Including reciprocals) to study the combining ability of important horticultural traits. Significant differences were observed among the genotypes for most of the traits. The parent Sevanthampatti local and Seetipulam local were identified as good general combiners for earliness (Days to first flowering, and harvesting) individual fruit weight and ascorbic acid content. Whereas, Karungal local was identified as good combiner for number of branches per plant, fruit length, number of fruits per plant, total sugars and yield per plant. The highest specific combining ability effects in desirable direction were observed in a cross Sevanthampatti local x Seetipulam local for plant height, days to first flowering and fruit length. Manaparai local x Karungal local showed positive sca for 1000 seed weight, number of fruits per plant, yield per plant while Spiny local x Marthandam local for days to first harvest, carbohydrate content and protein content.

Keywords: Brinjal, full diallel, qualitative and quantitative traits

Introduction
Brinjal (*Solanum melongena* L.) is one of the major and principle vegetable crop widely grown in tropical regions of the globe. It is a adaptable crop to adapted the diverse agro-climatic regions and can be cultivate throughout the year. Brinjal is cultivated extensively in different parts of India and considered to be one of the most remunerative vegetables (Pramanik *et al.*, 2012) [14]. Brinjal originated in India and major brinjal growing states in India are Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Orissa, Bihar, Uttar Pradesh, Gujarat and West Bengal. The fruits of brinjal are widely consumed in various culinary preparations and are rich source of protective nutrients (Hedges and Lister, 2007) [8]. In the face of increasing population, there is a need for increased production and productivity of brinjal. To achieve the nutritional security through vegetables, brinjal play a vital role. However, the contemporary production and productivity of brinjal is not adequate enough to meet the nutritional security of cumulative population. Earlier, eggplant breeding was relied both on mass selection and pureline selection from land races for the development of improved varieties. It is a fact that choice of parents on the basis of their presentation does not necessarily lead to desired results. Therefore, devising a sound breeding strategy to improve the yield of this crop is of supreme importance. The combining ability analysis help breeders in choosing suitable genotypes as parents for hybridization and superior cross combinations through general combining ability (GCA) and specific combining ability (SCA) studies, respectively. Hence, present investigation was undertaken to study the combining ability in brinjal for important horticultural traits.

Materials and Methods
The experiment was carried out during Rabi 2018 at college orchard, Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu) India. The experimental material consisted of six parents namely, Sevanthampatti local, Marthandam local, Seetipulam local, Manaparai local, Spiny local and Karungal local and their 30 hybrids derived from 6 x 6 full diallel (including reciprocal) mating design. The hybrids and parents were evaluated along with the checks VRM-1 in a randomized block design with two replications. Each plot consisted of ten plants in a row at 60 x 60 cm^2 inter and intra row spacing. All the recommended package of practices are adopted for growing a healthy crop. Five randomly selected plants, excluding the border ones, from each plot of all the two replications were tagged and used for recording the

observations and average values were computed. The data recorded for eighteen biometrical traits namely, plant height (cm), number of primary branches per plant, days to first flowering (Days), days to first harvest (Days), fruit length (cm), fruit girth (cm), individual fruit weight (g),calyx length (cm), number of fruits per plant (No's), 1000 seed weight (g), carbohydrate content, moisture content, protein content, ascorbic acid content, total phenol, total sugar (Per cent), polyphenol oxidase and fruit yield per plant (Kg) observed from number of days from transplanting to first flowering in 50 per cent of plants in a entry. Observations on plant height, primary branches per plant, were recorded at last picking and in contrast, data on fruit length, fruit girth, fruit weight, fruits per plant and fruit yield per plant were obtained for each picking and the total was computed. The observations on carbohydrate content, total sugars, polyphenol oxidase and total phenols were recorded on five random fresh fruits, taken from each genotype in each replication and the mean values were calculated. The estimates of combining ability, variances and effects were obtained using Method 2 of Model - I (fixed effect), suggested by Griffings 7.

Results and Discussion

The variances due to general combining ability (gca) and specific combining ability (sca) are described in Table 1. General combining ability (gca) mostly comprises additive gene action. The additive genetic effects are mostly due to polygenes, which act in additive manner, producing fixable effects. It was observed that gca variances were highly significant for almost all the characters except fruit girth, calyx length, ascorbic acid content, moisture content, carbohydrate content and total phenol whereas sca was non-significant for number of branches per plant, fruit length, calyx length, carbohydrate content, moisture content, ascorbic acid content, total phenol and total sugars. This indicated the importance of both additive and non-additive gene action. Further, mean square values for gca was higher than sca for all the traits except days to first harvest, fruit girth,1000 seed weight, protein content and poly phenol oxidase, representative occurrence of wide variability and high degree of additive variance for the earlier traits while dominance for the later. The similar findings were also reported by Rai and Asati, 2011 [16], Umaretiya *et al.,* 2008 [25], Prasad *et al.,* 2010 [15], Thangavel *et al*., 2011 [23], Bhushan *et al*., 2012 [2], Khapte *et al.,* 2013 [9], Mishra *et al.,* 2013 [12], Patel *et al.,* 2013, Shafeeq*et al.,* 2013, Singh *et al.,* 2013, Ansari and Singh, 2014 [1], Choudhary and Didel, 2014 [3] and Venkata *et al.,* 2014 [26].

The ratio of σ^2gca/ σ^2sca revealed that all characters except fruit length manifested less than unity which indicated that preponderance of non-additive genetic variance for inheritance of these characters. Several workers *viz.,* Sao and Mehta, 2010 [8], Sane *et al.,* 2011 [18], Shinde *et al*., 2011 [21], Bhushan *et al*., 2012 [2], Khapte *et al*., 2013 [9], Mishra *et al*., 2013 [12], Deshmukh *et al*., 2014 [4], Patel *et al*., 2013 [13] and Venkata *et al*., 2014 [26] found that preponderance of non-additive genetic variance for inheritance of these characters. Fruit length manifested more than unity which indicated that preponderance of additive genetic variance for inheritance of this character. This result is in parallel with the findings of Bhushan *et al*., 2012 [2] and Singh *et al*., 2013.

The estimates of general combining ability effects and specific combining effects of six parents for eighteen characters (Table 2.)indicated that best combiners were Sevanthampatti local and Manaparai local for plant height, Spiny local, Sevanthampatti local for number of branches, Sevanthampatti local, Seetipulam local for days to first flowering, Sevanthampatti local, Seetipulam local for days to first harvest, Spiny local, Karungal local for fruit length, Karungal local, Marthandam local for fruit girth, Seetipulam local, Karungal local for individual fruit weight, calyx length, spiny local, Marthandam local for number of fruits per plant, Manaparai local, Seetipulam local for 1000 seed weight, Sevanthampatti local, Seetipulam local for carbohydrate content, Karungal local, Seetipulam local for moisture content, Seetipulam local, Marthandam local for protein content, Seetipulam local, Spiny local for ascorbic acid content, Manaparai local, Seetipulam local for total phenol, Spiny local, Karungal local for total sugars and polyphenol oxidase and Marthandam local, Spiny local for yield per plant. For most of the characters studied, the parents high GCA effects observed Spiny local, Sevanthampatti local and Seetipulam local were found as good general combiners because these parents may be exploited to develop productive new recombinations for optimum yield and desirable quality parameter cited by Kumar *et al.,* (2012) [2, 11], Choudhary and Didel, (2014) [3] and by Kumar, (2016). It tells about the favorable gene flow from the parents generates offspring at high frequency Dubey *et al*., (2014) [5, 26]. From the analysis of combining ability estimates, it was observed that both additive and non-additive gene actions were operating for all the characters under study because mean squares due to gca were significant for almost all the characters except fruit girth, calyx length, ascorbic acid content, moisture content, carbohydrate content and total phenol. Similar results were also observed by Uddin *et al.,* 2015 [24].

The *sca* variance accounts for non-additive type of gene action which is composed of dominance and epistasis sated that Griffing, 1956 can be equated to dominance variance by Hayman analysis. For specific combining ability effects among thirty F_1 hybrids Marthandam local x Manaparai local, Sevanthampatti local x Seetipulam local were found to be good specific combiners for earliness whereas the parent Manaparai local was positive general combiner for days to first flowering (Table3a). Two hybrids namely Sevanthampatti local x Seetipulam local, Marthandam local x Sevanthampatti local showed significant positive sca effects in desirable direction for fruit length. In present experiment it was observed that in cross combinations, one of the parent was superior in respect to that character exhibiting high gca and sca effects, suggesting the superiority of a hybrids (F_1) of a traits. It may be largely due to interaction of epistasis which is supported by Singh *et al*., 2012. The hybrid Manaparai local x Karungal local showed the maximum positive sca effects followed by Sevanthampatti local x Spiny local for individual fruit weight. The increased fruit weight in the hybrids was because one of the parents has high GCA (Rai and Asati, 2011) [16]. For number of primary branches per plants hybrid Manaparai local x Sevanthampatti local, Spiny local x Sevanthampatti local was best specific combiner. Further the crosses Sevanthampatti Local x Seetipulam local, Spiny local x Sevanthampatti local were found best specific combiner for the character plant height, whereas the hybrid Karungal local x Marthandam local had maximum positive significant sca effect for both carbohydrate content and protein content (Table 3b). The parents Karungal local, Spiny local and Sevanthampatti local involved in these crosses exhibited high gca effects. Similar results were also reported

by Rai and Asati, 2011 [16].

Based on estimation of sca effects the hybrids *viz*., Manaparai local, Spiny local, Seetipulam local x Marthandam local, Karungal local x Marthandam local, Marthandam local x Manaparai local, Manaparai local x Seetipulam local registered high and significant sca effects for fruit yield per plant and also possessed high sca effects for at least one yield contributing component. Such combination may be useful for isolating desirable transgressive segregants. By studying the best parents, best general combiners and best specific cross combinations it was revealed that poor x average, average x good and average x average combinations produced high fruit yielding hybrids and could be exploited for practical breeding which was expected to throw stable performing transgressive segregants carrying fixable genes.

Table 1: Analysis of variance for combining ability in brinjal

Characters	PHT	NBPP	DFF	DFH	FL	FG	IFW	CL	NFPP
GCA (5 d.f.)	1015.416**	4.635**	21.837**	6.993*	2.711*	1.067	33.348**	0.121	31.259**
SCA (15 d.f.)	158.443**	1.016	16.082**	10.577**	1.32	3.236*	15.323**	0.087	14.29**
Reciprocal (15d.f.)	142.239**	2.454**	10.475**	8.759**	1.013	1.669	21.197**	0.079	17.504**
Error (15 d.f.)	16.827	0.74	2.379	2.401	1.266	1.35	5.758	0.082	3.202
sl^2 g	83.216	0.325	1.622	0.383	0.120	-0.024	2.299	0.003	2.338
sl^2 s	141.616	0.276	13.703	8.177	0.054	1.887	9.565	0.005	11.088
GCA/SCA Ratio	0.588	1.175	0.118	0.047	2.230	-0.012	0.240	0.660	0.211
characters	TSW	CHC	MC	PC	AAC	TP	TS	PPO	YPP
GCA (5 d.f.)	0.214**	0.056	1.747	0.712**	1.553	0.083	0.7**	0.027**	0.285**
SCA (15 d.f.)	0.597**	0.043	1.187	1.226**	1.065	0.041	0.122	0.083**	0.125**
Reciprocal (15 d.f.)	0.306**	0.097*	3.473	1.06**	0.834	0.026	0.443**	0.059**	0.047
Error (15 d.f.)	0.003	0.044	2.156	0.059	0.73	0.04	0.146	0	0.032
sl^2 g	0.018	0.001	-0.034	0.054	0.069	0.004	0.046	0.002	0.021
sl^2 s	0.595	-0.001	-0.969	1.167	0.335	0.001	-0.024	0.083	0.093
GCA/SCA Ratio	0.030	-1.387	0.035	0.047	0.205	2.969	-1.946	0.027	0.227

Table 2: Estimation of general combining ability (gca) effects of parents for various characters in brinjal

Parents /Characters	PHT	NBPP	DFF	DFH	FL	FG	IFW	CL	NFPP
Sevanthampatti local	13.487 *	0.422	-1.469 *	-1.244 *	0.247	0.102	0.213	0.013	-0.611
Marthandam local	-0.567	0.289	0.789	0.297	0.108	0.317	0.197	0.177 *	1.056 *
Settipulam local	-12.145 *	-1.103 *	-1.103 *	-0.386	-0.847 *	-0.337	1.318 *	-0.067	-1.069 *
Manaparai local	6.023 *	-0.003	-0.586	0.097	-0.239	-0.323	0.508	-0.018	0.747
Spiny local	0.724	0.631 *	2.172 *	1.039 *	0.452	-0.088	-3.276 *	-0.118	2.156 *
Karungal local	-7.522 *	-0.236	0.197	0.197	0.279	0.328	1.040	0.013	-2.278 *
Parents /Characters	TSW	CHC	MC	PC	AAC	TP	TS	PPO	YPP
Sevanthampatti local	0.016	0.082	-0.153	-0.051	0.143	0.052	-0.189	0.060 *	0.026
Marthandam local	-0.021	0.025	-0.448	0.292 *	-0.230	0.027	-0.186	0.054 *	0.167 *
Settipulam local	0.057 *	0.065	0.390	0.317 *	0.556 *	-0.007	-0.004	-0.040 *	-0.032
Manaparai local	0.205 *	-0.072	-0.243	-0.221 *	-0.458 *	-0.163 *	-0.128	-0.053 *	0.014
Spiny local	-0.059 *	-0.023	-0.081	-0.132 *	0.160	0.030	0.449 *	-0.013 *	0.104 *
Karungal local	-0.198 *	-0.078	0.534	-0.205 *	-0.171	0.061	0.058	-0.006 *	-0.280 *

PHT – Plant Height, NB – Number of Branches Per Plant, DFF – Days to First Flowering,
DFH - Days to First Harvest, FL – Fruit Length, FG – Fruit Girth, IFW – Individual Fruit Weight, CL – Calyx Length, NFPP – Number of Fruits Per Plant, TSW – Thousand Seed Weight, CHC–Carbohydrate Content, MC – Moisture Content, PC – Protein Content, AAC – Ascorbic Acid Content, TP – Total Phenol, TS – Total Sugars, PPO–Polyphenol Oxidase, YPP – Yield Per Plant

Table 3a: Estimation of specific combining ability (sca) effects of hybrids for various characters in brinjal

Parents /Characters	PHT	NBPP	DFF	DFH	FL	FG	IFW	CL	NFPP
P1xP2	-4.464	-0.364	3.436*	1.761	0.637	-2.141**	2.097	-0.028	0.344
P1xP3	20.851**	0.378	-3.822**	-3.506**	0.979	2.178**	-1.702	0.280	3.569*
P1xP4	-6.730	0.228	-0.889	-0.339	-0.132	0.362	-3.612*	0.101	-5.247**
P1xP5	-11.131**	1.144*	-3.397*	-1.731	-1.100	0.377	4.375**	0.047	-1.156
P1xP6	2.908	0.211	2.728	0.711	0.893	-1.379	-0.166	-0.109	0.628
P2xP1	13.135*	0.200	-2.750	-0.400	0.975	-0.637	3.947*	0.155	-2.550
P2xP3	-5.408	0.211	2.169	3.153*	0.024	-0.494	1.876	-0.058	0.403
P2xP4	8.204*	-0.639	-4.197**	-3.181*	0.058	0.870	-0.661	-0.097	-0.664
P2xP5	-5.637	-0.472	2.044	-0.372	0.737	-0.763	-2.822	0.278	2.228
P2xP6	0.982	0.194	-3.481*	-2.981*	0.688	0.601	0.550	-0.088	0.161
P3xP1	3.377	0.150	0.000	0.750	-1.113	0.133	1.025	-0.100	-1.950
P3xP2	-0.800	1.650*	1.050	1.250	-0.468	2.190**	0.558	-0.065	-3.350*
P3xP4	-5.571	-0.397	0.644	-0.247	-0.859	-1.974*	0.985	-0.074	2.261
P3xP5	-3.715	0.469	0.436	0.761	0.117	1.354	0.645	0.067	-4.747**
P3xP6	3.119	0.386	3.961**	2.853*	-0.197	0.037	-1.026	0.206	-1.264
P4xP1	-1.540	1.800*	1.550	0.700	-0.605	-0.320	4.365*	0.190	-2.450
P4xP2	10.550*	-0.200	1.500	0.700	-0.135	0.358	-0.385	-0.185	-1.200

P4xP3	-7.458	-1.950*	4.050	3.850*	0.168	-0.630	2.048	-0.045	3.800*
P4xP5	9.577*	-0.281	1.869	1.628	0.794	-0.192	1.720	-0.202	3.986**
P4xP6	3.651	1.036*	-0.806	-1.481	0.149	-0.134	4.786*	0.032	-0.581
P5xP1	20.455*	1.750*	2.400	2.550	0.763	0.105	-4.153*	-0.305	-3.550*
P5xP2	4.120	0.100	-1.500	0.150	-1.345	0.805	2.005	-0.160	3.300*
P5xP3	1.680	-1.950*	-3.900*	-2.100	0.590	-0.663	1.642	0.295	0.700
P5xP4	1.645	-0.400	-1.050	1.350	-0.800	-1.380*	-7.843**	-0.385	4.950**
P5xP6	-4.685	-0.747	-0.614	0.078	-0.247	0.781	1.166	-0.362	2.261
P6xP1	-8.008	-0.350	0.350	-1.850	-0.772	-1.370*	0.708	-0.100	-2.800
P6xP2	-11.798*	0.300	-3.700*	-4.600**	-0.172	-0.860	-4.448*	0.065	1.000
P6xP3	-8.072	-0.600	-2.250	-0.950	0.742	0.688	-3.347	0.075	0.450
P6xP4	-0.868	0.350	1.800	3.000*	0.213	0.540	0.100	-0.180	5.450**
P6xP5	1.672	0.900	1.550	0.600	0.422	0.535	1.295	0.275	-0.800

PHT – Plant Height, NB – Number of Branches Per Plant, DFF – Days to First Flowering,
DFH - Days to First Harvest, FL – Fruit Length, FG – Fruit Girth,
IFW – Individual Fruit Weight, CL–Calyx Length, NFPP – Number of Fruits Per Plant
P1- Sevanthampatti local P2- Marthandam local P3- Seetipulam local
P4- Manaparai local P5- Spiny local P6-Karungal local

Table 3b: Estimation of specific combining ability (sca) effects of hybrids for various characters in brinjal

Parents /Characters	TSW	CHC	MC	PC	AAC	TP	TS	PPO	YPP
P1xP2	0.524**	-0.051	-0.109	1.093*	0.152	-0.266**	0.199	0.032**	0.136
P1xP3	0.793**	0.274*	-0.377	-0.205	-0.711**	-0.014	0.147	0.226**	0.250*
P1xP4	-0.479**	0.051	1.326*	0.984*	0.511*	0.146	0.268	0.129**	-0.601**
P1xP5	-0.917**	-0.057	0.284	-0.338	0.210	0.127	-0.228	-0.320**	0.207*
P1xP6	0.212**	-0.276*	-0.497	-0.845*	-0.291	0.040	-0.018	-0.089**	0.131
P2xP1	-0.340	0.263	-2.293*	0.015	0.575	0.077	-0.195	0.203**	0.080
P2xP3	-0.382**	-0.134	-1.139	-0.748*	0.067	0.219*	0.136	0.195**	0.111
P2xP4	-0.205**	0.013	0.569	-1.262*	-1.114**	-0.056	-0.328	-0.157**	-0.030
P2xP5	0.052	-0.085	-0.165	1.079*	-0.207	0.087	-0.057	-0.033**	-0.089
P2xP6	-0.016	0.054	0.229	-0.626*	1.487**	-0.037	0.281	-0.317**	-0.008
P3xP1	-0.003	0.073	-2.288*	-0.743*	0.598	0.025	0.030	-0.069**	-0.025
P3xP2	0.120	0.117	-0.030	-0.188	0.198	-0.027	-0.383	-0.050**	-0.232*
P3xP4	0.412*	-0.029	0.630	0.703*	0.250	0.099	0.051	-0.265**	0.097
P3xP5	-0.141	0.080	0.226	-0.584*	1.167**	-0.131	-0.171	-0.051**	-0.132
P3xP6	-0.342**	-0.164	-0.482	0.414	-0.757	0.035	-0.276	0.199**	-0.404**
P4xP1	-0.973**	0.347*	-1.177	0.863*	0.525	-0.050	0.288	-0.381**	-0.185
P4xP2	0.505**	-0.058	-1.715	1.335**	0.493	-0.023	-0.580	0.088**	-0.082
P4xP3	-0.030	0.345*	1.710	-0.160	0.677	-0.063	0.190	0.112**	0.090
P4xP5	0.951**	0.094	-0.269	-0.808*	-0.176	-0.041	-0.115	0.196**	0.344*
P4xP6	-0.722**	0.063	-0.824	0.212	-0.603	-0.250**	-0.265	0.150**	0.115
P5xP1	0.375**	0.263	0.732	0.625*	0.563	-0.092	-0.282	-0.127**	-0.257*
P5xP2	0.158	0.202	0.442	0.150	-1.587**	0.048	-0.138	-0.267**	0.258*
P5xP3	0.258	0.013	0.382	-0.903*	-0.118	0.145	-0.810**	-0.061**	-0.265*
P5xP4	-0.037	0.170	-1.440	-0.540*	0.050	-0.175	-0.553	0.008	-0.043
P5xP6	-0.083	0.018	0.879	0.288	-0.073	0.041	0.061	0.112**	0.028
P6xP1	-0.475**	0.010	-1.468	0.085	-0.355	-0.178	-0.818**	-0.149**	-0.078
P6xP2	-0.420**	0.383*	-0.412	1.683*	-0.850*	0.032	-0.480	-0.208**	0.100
P6xP3	0.088	-0.230	-1.275	0.372	-0.068	-0.222*	-0.600*	-0.004	-0.015
P6xP4	0.540**	-0.095	-1.135	-0.088	0.903*	-0.168	-0.172	-0.137**	-0.120
P6xP5	0.175	-0.227	-0.340	0.553*	0.165	-0.095	0.575	-0.225**	0.063

TSW – Thousand Seed Weight, CHC – Carbohydrate Content, MC – Moisture Content,
PC – Protein Content, AAC – Ascorbic Acid Content, TP – Total Phenol,
TS – Total Sugars, PPO – Polyphenol Oxidase, YPP – Yield Per Plant
P1- Sevanthampatti local P2- Marthandam local P3- Seetipulam local
P4- Manaparai local P5- Spiny local P6-Karungal local

Conclusion

The parent Sevanthampatti local and Seetipulam local were identified as good general combiner for earliness days to first flowering, days to first harvesting and Spiny local, Karungal local for fruit length, fruit girth. Average fruit weight for Seetipulam local, yield per plant for Marthandam local and spiny local. Based on SCA effects the cross combination with Sevanthampatti local x Seetipulam local better performed for earliness while Manaparai local and Spiny local for number of fruits and yield per plant.

References

1. Ansari AM, Singh YV. Combining ability analysis for vegetative, physiological and yield components in brinjal (*Solanum melongena* L.). International Sci. J. 2014; 1(2):53-59.
2. Bhushan B, Sidhu AS, Dhatt AS, Kumar A. Studies on combining ability for yield and quality traits in brinjal (*Solanum melongena* L.). J. Hortl. Sci., 2012; 7(2):145-151.
3. Choudhary S, Didel RP. Combining ability analysis for

growth and yield components in brinjal (*Solanum melongena* L.). Asian J. Bio. Sci. 2014; 9(1):88-92.
4. Deshmukh SB, Sawant SN, Narkhede GW, Dod VN. Gene Action studies in brinjal (*Solanum melongena*). Middle-East Journal of Scientific Research, 2014; 21(11):2177-2181.
5. Dubey R, Das A, Ojha MD, Saha B, Ranjan A, Singh PK. Heterosis and combining ability studies for yield and yield attributing traits in brinjal (*Solanum melongena* L.). The Bioscan. 2014; 9(2):889-894.
6. Griffing B. Concept of general and specific combining ability in relation to diallel crossing systems. Aust. J. Biol. Sci., 1956; 9:463-493.
7. Hayman B. The theory and analysis of diallel crosses. Genetics. 1954; 39:789-809.
8. Hedges LJ, Lister CE. Nutritional attributes of spinach, silver beet and eggplant. Crop Food Res Confidential Rep No. 2007, 1928.
9. Khapte PS, Singh TH, Sadashiva AT, Reddy KM. Combining ability for yield and yield related traits in Manjarigota type brinjal (*Solanum melongena* L.). J. Horti. Sci. 2013; 8(2):176-180.
10. Kumar R. Heterosis and combining ability analysis for productivity and its related traits in round brinjal (*Solanum melongena*. L). MSc thesis, Bihar Agricultural University. 2016, 36-37.
11. Kumar SR, Arumugam T, Anandakumar CR, Balakrishnan S. Rajavel DS. Estimation of Heterosis and Specific Combining Ability for Yield, Quality, Pest and Disease Incidence in eggplant (*Solanum melongena* L.). Bull. Env. Pharmacol. Life Sci. 2012; 2(1):03-15.
12. Mishra R, Singh AK, Vani VM, Singh BK, Kumar H, Rajkumar BV. Combining ability studies in elite breeding lines of brinjal (*Solanum melongena* L.) for plant characters. Asian J. Biol. Life Sci. 2013; 2(3):275-278.
13. Patel JP, Singh U, Kashyap SP, Singh DK, Goswami A, Tiwari SK *et al.* Combining ability for yield and other quantitative traits in eggplant (*Solanum melongena* L.). Veg. Sci. 2013; 40(1):61-64.
14. Pramanik P, Palash M, Monilal C. Studies on biology of brinjal fruit and shoot borer, *Leucinodes orbonalis* (Guenee) under laboratory condition. International Journal of Bio-Resource & Stress Management. 2012; 3(3):336-340.
15. Prasad V, Dwiwedi VK, Deshpande AA, Singh BK. Gene action of economic traits in brinjal (*Solanum melongena* L.). Veg. Sci., 2010; 37(1):97-99.
16. Rai N, Asati BS. Combining ability and gene action studies for fruit yield and yield contributing traits in brinjal. Indian J Hort. 2011; 68(2):212-215.
17. Ramireddy SRK, Lingaiah HB, Reddy VK, Naresh P, Kuchi VS. Combining ability studies for yield and yield attributing characters in brinjal (*Solanum melongena* L.). Plant archives. 2011; 11(2):849-852.
18. Sane SC, Bhalekar MN, Patil BT, Dhumal SS, Gaikwad AN, Kshirsagar DB. Combining ability for yield and yield contributing characters in brinjal (*Solanum melongena* L.). Asian J. Hort. 2011; 6(1):215-217.
19. Sao A Mehta, N. Heterosis in relation to combining ability for fruit yield and quality attributes in brinjal (*Solanum melongena* L.). Electron. J. Plant Breed. 2010; 1(4):783-788.
20. Shafeeq A, Rao M, Hanchinal RR, Kolakar SS. General and specific combining ability studies in brinjall. Int. J. of Pl. Sci. 2013; 8(2):354-359.
21. Shinde KG, Bhalekar MN, Patil BT. Combining ability of quantitative characters in brinjal. Veg. Sci. 2011; 38(2):231-234.
22. Singh O, Singh B, Singh KV, Pooran Chand. Vaishali. Studies on genetic variability in brinjal (*Solanum melongena* l.). Annals of Horticulture. 2013; 6(2):279-283.
23. Thangavel P, Thirugnanakumar S, Baradhan G. Studies on genetic variability, heritability and genetic advance in segregating generations of brinjal (*Solanum melongena* L.). Plant Archives. 2011; 11(1):453-456.
24. Uddin MS, Rahman MM, Hossain MM, MianKhaleque MA. Combining ability of yield and yield components in eggplant (*Solanum melongena* L.) during summer. Universal J Plant Sci. 2015; 3(4):59-66.
25. Umaretiya PP, Bhatia VJ, Poshiya VK, Mehta DR. Chovatia VP. Combining ability studies in brinjal (*Solanum melongena* L.). Natnl. J. Pl. lmprov. 2008; 10(2):163-167.
26. Venkata BN, Dubey AK, Tiwari PK, Dabbas MR. Line x Tester analysis for yield components and cercospora leaf spot resistance in brinjal (*Solanum melongena* L.). Electron. J. Plant Breed. 2014; 5(2):230-235.