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Exploitation of gene action and combining ability for high yielding and good fruit quality characters of brinjal in different environments of Gujarat

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Abstract
Hybrids of the brinjal (*Solanum melongena* L.) are gaining popularity in the past few decades. Meanwhile, heterosis breeding provides much scope to obtain such hybrids with great yielding potential and outstanding fruit quality (size-shape, pest-free and rich in beneficial biochemicals). These facts motivated us to get inside into the combining ability and gene actions of 8 lines, 6 testers and their resultant 48 hybrids for 15 yield and its attributing traits by adopting Line × Tester analysis at 3 research stations of the S.D.A.U.; located in 3 different districts, during late rabi 2021-22 in RBD. For the majority of the traits, there were significant variations caused by environments, parents, and hybrids, suggesting the material's high degree of variability. Analysis of gene action showed a preponderance of both non-additive and additive gene actions for various traits. Ph-9, PPL, and ISD-006 were the good general combining parents for major yield and its attributed traits. For fruit yield per plant, the top five good specific combiners were Arka Komal × GRB 5, Ph-6 × P. Anupam, Ph-9 × GAOB 2, Ph-9 × Arka Harshita and ISD-006 × GRB 5. Also, for at least one yield component, they showed a highly significant sca value. High × High gca combinations didn't show high sca effects every time. Incorporating ISD-006 × GRB 5 hybrid with its good combining parents into the breeding programme would certainly improve the quantity and quality of fruits in brinjal.

Keywords: GCA, line × tester, multi-locations, SCA, *Solanum melongena*

Introduction
Brinjal (*Solanum melongena* L.) is a widely consumed vegetable, grown in the *kharif*, *rabi* and spring-summer seasons. It has a high nutritive value (Thamburaj and Singh, 2004) [1] and is a boon for diabetes, asthma, cholera and bronchitis patients. Many Indian states including Gujarat are leading in brinjal production. Brinjal is an annual herbaceous crop of the Solanaceae family (2n = 24). It is photo-insensitive and has berry-shaped, singly or clustery-borne fruits. With a view of Grubben (1997) [2], it is highly self-pollinated but wind and insects accelerate crossing up to 20%. Various agro-climatic localities are demanding to create high-yielding hybrids with a range of qualities to meet local demand. Quality traits like fruit colour and shape preferences vary from locality to locality, but high soluble sugar and pest-free fruits are liked everywhere. Gujarat used these facts to release several brinjal hybrids. To obtain such hybrids, emphasis on combining ability variances and effects should be given on each trait. Also, the nature of gene action is mandatory to know the heritance of characters and then for selecting the proper breeding plan. Considering these, the experiment was carried out to decide the gene action as well as good combining parents and hybrids for high-yielding and good fruit quality characters by adopting the line × tester design at 3 locations.

Materials and Methods
The materials were comprised of 8 lines [Arka Komal (L_1), Ph-6 (L_2), Ph-9 (L_3), PPL (L_4), JDNB-16-1 (L_5), ISD-006 (L_6), CO_2 (L_7) and ABSR 2 (L_8)], 6 testers [GOB 1 (T_1), GAOB 2 (T_2), GAB 6 (T_3), GRB 5 (T_4), Arka Harshita (T_5) and P. Anupam (T_6)] and its 48 F_1s. The hybrids were prepared by adopting line × tester mating design during *kharif* 2021.The evaluation programme was carried out using RBD with three replications during late *rabi* 2021-22 at three different locations, *viz.* (i) Horticulture Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University (S.D.A.U.), Sardarkrushinagar, District: Banaskantha (E_1) (ii) Seed Spices Research Station, S.D.A.U., Jagudan, District: Mehsana (E_2) (iii) Maize Research Station, S.D.A.U., Bhiloda, District: Aravalli (E_3). Five sample plants from each genotype were marked for recording 15 characters [days to opening of first flower (DOF),

days to first picking (DFP), fruit pedicel length (FPL), fruit length (FL), fruit girth (FG), fruit shape index (FSI), fruit weight (FW), number of fruits per plant (NFP), number of primary branches per plant (NPBP), plant height (PH), plant spread (PS), fruit borer infestation (FBI), total soluble solids (TSS), chlorophyll content index (CCI), fruit yield per plant (FYP)] in each replication and average data were used for statistical analysis. Model of Kempthrone (1957) [3] for L × T was used to get the combining ability estimation.

Results and Discussion

Table 1 showed variation among the environments for all the traits (excluding total soluble solids). Considerable mean square due to testers and lines as well as lines × testers for the majority of the traits indicated their contribution in general combining ability (*gca*) and specific combining ability (*sca*), respectively. GCA and SCA variance were highly affected by environments. Interestingly, hybrids interacted more with environments than that with lines and testers. Non-additive type of gene action ($\sigma^2 gca/\sigma^2 sca < 1$) for days to opening of first flower (Vaddoria and Ramani, 2015) [4], days to first picking, fruit pedicel length (Kaushik, 2019) [5], number of primary branches per plant (Singh and Chaudhary, 2018) [6], plant height (Kaushik, 2019) [5], fruit yield per plant (Vaddoria and Ramani, 2015 [4] and Singh and Chaudhary, 2018) [6], plant spread, total soluble solids (Singh and Chaudhary, 2018) [6] and chlorophyll content index indicated use of heterosis breeding for these traits. The predominance of additive type of gene action ($\sigma^2 gca/\sigma^2 sca > 1$) for the rest of the characters indicated the use of simple selection technique and recombination breeding followed by the pedigree method of selection. Same trends were observed for fruit length by Rai and Asati (2011) [7], and for the number of fruits per plant by Singh and Chaudhary (2018) [6]. Vaddoria and Ramani (2015) [4] also obtained the same trends for days to first picking, fruit girth, fruit weight, plant spread, and fruit borer infestation. Singh and Chaudhary (2018) [6] and Kaushik (2019) [5] obtained different trends for the chlorophyll content index and fruit shape index, respectively.

Good, average and poor combinations meant significant positive, non-significant and significant negative gene actions, respectively (Table 2). Also Figure 1 and Figure 2 is showing graphical representation of general combining ability and specific combining ability effects for hybrids based on pooled over environments for fruit yield per plant in brinjal, respectively. GCA and SCA both are required for the exploitation of heterosis. Desirable parents and hybrids for earliness flowering and picking had significantly negative GCA and SCA, respectively. 'Arka Komal', 'PPL', 'CO_2 × Arka Harshita' and 'PPL × Arka Harshita' were desirable for longer fruit and fruit shape index which are preferred in many Indian regions. Fruit girth and weight had 'Ph-9' and 'ISD-006' as the top good combiners, respectively. Higher fruit girth (desirable top hybrid: 'Ph-9 × GOB-1') results in higher fruit weight (desirable top hybrid: 'ISD-006 × GRB-5') but lower resistance to biotic stress. The range of *gca* effects was from -10.870 to 13.109 for a number of fruits per plant, and -0.152 to 0.221 for a number of primary branches per plant. The *sca* was varied from -0.517 to 0.811, -16.129 to 11.254 and -8.790 to 8.775 for fruit pedicel length, number of fruits per plant and chlorophyll content index, respectively. A total of six, four, two and one parents were found poor general combiners for fruit pedicel length, plant height, plant spread and total soluble solids, respectively. Only 'CO_2 × GAB-6' and 'Ph-9 × GAOB-2' were found significantly positive for *sca* for a number of primary branches per plant and plant height, respectively. 'ABSR-2', 'PPL' and 'P. Anupam' were the top good general combiners for the resistance to fruit borer. Compared to plant spread and total soluble solids; fruit borer infestation had more numbers of desirable specific combiners. Leaves with high chlorophyll content fix more energy. 'Ph-9', 'JDNB-16-1' and 'GAB-6' were found desirable for this trait. Fruit yield per plant is the ultimate character for brinjal improvement, for which some top good general ('ISD-006', 'JDNB-16-1' and 'PPL') and specific ('Arka Komal × GRB-5', 'Ph-6 × P. Anupam' and 'Ph-9 × GAOB-2') combiners were noticed.

Table 1: ANOVA (mean squares) for combining ability and variance components for fifteen characters of brinjal over pooled locations

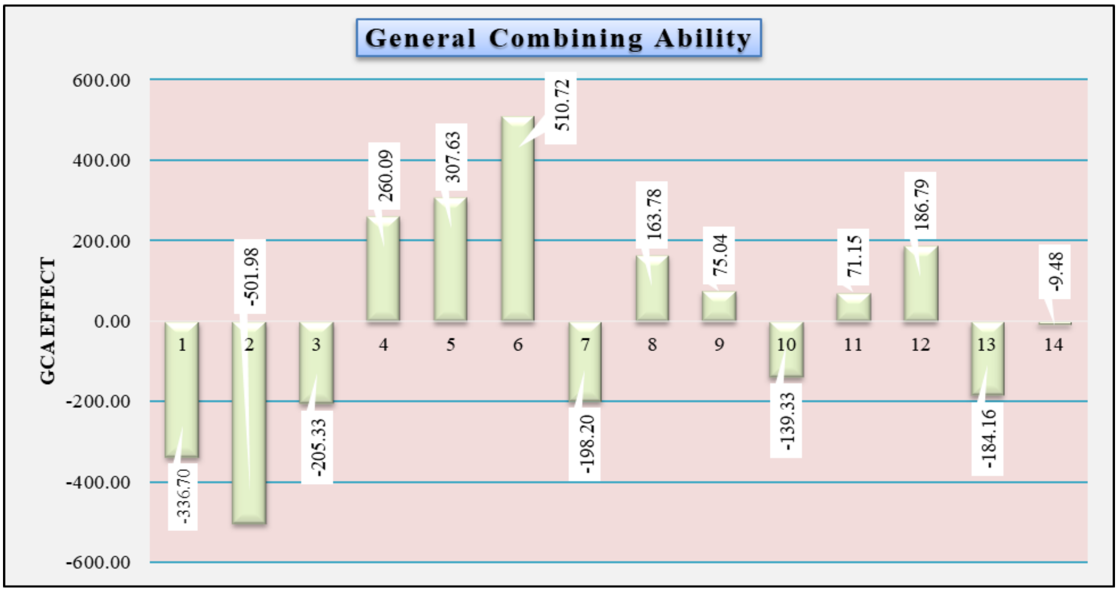
Source of variation	Degrees of freedom	DOF	DFP	FPL	FL	FG	FSI	FW	NFP	NPBP	PH	PS	FBI	TSS	CCI	FYP
Env.	[2]	6580.97**	5186.28**	2.88**	9.26**	39.75**	0.34**	10409.88**	27968.99**	83.24**	24197.34**	14914.85**	591.37**	0.60	13489.95**	170308418.81**
Rep.	[6]	25.87	10.19	0.72**	2.29*	11.87**	0.01	135.69	31.40	0.61	129.13	226.91	1.07**	0.32	47.60	182328.83
Lines	[7]	246.76**	175.15**	5.40**	90.41**	184.24**	1.83**	17491.78**	3694.43**	0.81*	980.31**	1438.17**	42.04**	1.32*	1273.82**	6917623.48**
Testers	[5]	142.08	77.45	4.45**	136.55**	399.99**	3.25**	12068.91**	5004.16**	0.81*	466.78**	72.84	25.04**	0.75	687.62**	1425596.25**
L × T	[35]	65.31**	44.83**	1.18**	6.46**	9.71**	0.14**	735.30**	465.83**	0.65	180.24**	288.28**	17.13	0.42*	235.24*	1820124.37**
L × E	[14]	64.14**	45.67**	0.51	2.45	3.98	0.03	686.88**	603.67**	0.98*	188.40**	506.52**	6.58	0.20	223.56	2595915.07**
T × E	[10]	19.32	10.74	0.42	1.64	5.11	0.04**	251.57	245.63	0.43	72.63	85.28	9.37	0.20	182.24	1057428.60
L × T × E	[70]	19.96	14.15	0.39**	1.64	3.72**	0.01**	202.28**	132.59**	0.48*	88.82	130.41	15.34**	0.22	133.04**	664612.01**
Pooled error	[282]	16.86	18.17	0.20	1.02	2.05	0.01	84.71	26.51	0.32	72.80	128.76	0.25	0.25	22.84	146006.22
σ^2 l		2.54	1.83	0.08**	1.54**	3.23**	0.03**	301.33**	51.07**	-0.01	12.97*	14.33	0.62*	0.02*	17.56**	58633.26
σ^2 t		1.08	0.50	0.05*	1.81**	5.40**	0.04**	156.73**	61.46**	0.002	4.20	-2.37	0.19	0.004	5.60	-10935.34
σ^2 GCA		1.70*	1.07*	0.06**	1.69**	4.47**	0.04**	218.7**	57.01**	-0.001	7.96**	4.79	0.38	0.01*	10.72*	18879.77
σ^2 SCA		5.04**	3.41**	0.09**	0.53**	0.67**	0.01**	59.22**	37.03**	0.02	10.16**	17.54**	0.20	0.02**	11.36*	128390.26**
σ^2 Env.		35.04**	27.66**	0.01*	0.04	0.18*	0.0007	52.01**	146.52**	0.29**	129.16**	51.73**	3.18**	0.002	71.07**	899568.21**
σ^2 l × e		2.46**	1.75**	0.01	0.04	0.01	0.0006	26.92**	26.17**	0.03*	5.53*	20.90**	-0.49	-0.0008	5.03	107294.61**
σ^2 t × e		-0.03	-0.14	0.001	-0.0002	0.06	0.001**	2.05	4.71	-0.001	-0.67	-1.88	-0.25	-0.0008	2.05	16367.36
σ^2 GCA × e		1.04*	0.67*	0.004	0.02	0.04	0.001**	12.71*	13.91**	0.01	1.99	7.88*	-0.35	-0.0008	3.33	55336.18**
σ^2 SCA × e		0.39	-1.34	0.06**	0.21**	0.56**	0.001**	39.19**	35.36**	0.05*	5.34	0.55	5.03**	-0.01	36.73**	172868.60**
σ^2 GCA / σ^2 SCA		0.34	0.31	0.67	3.17	6.72	2.61	3.69	1.54	-0.06	0.78	0.27	1.90	0.45	0.94	0.15

*, ** are significance level at 5% and 1 %, respectively
E: environments

Table 2: SCA and GCA effects for yield and yield attributing characters of pooled over the environments in brinjal

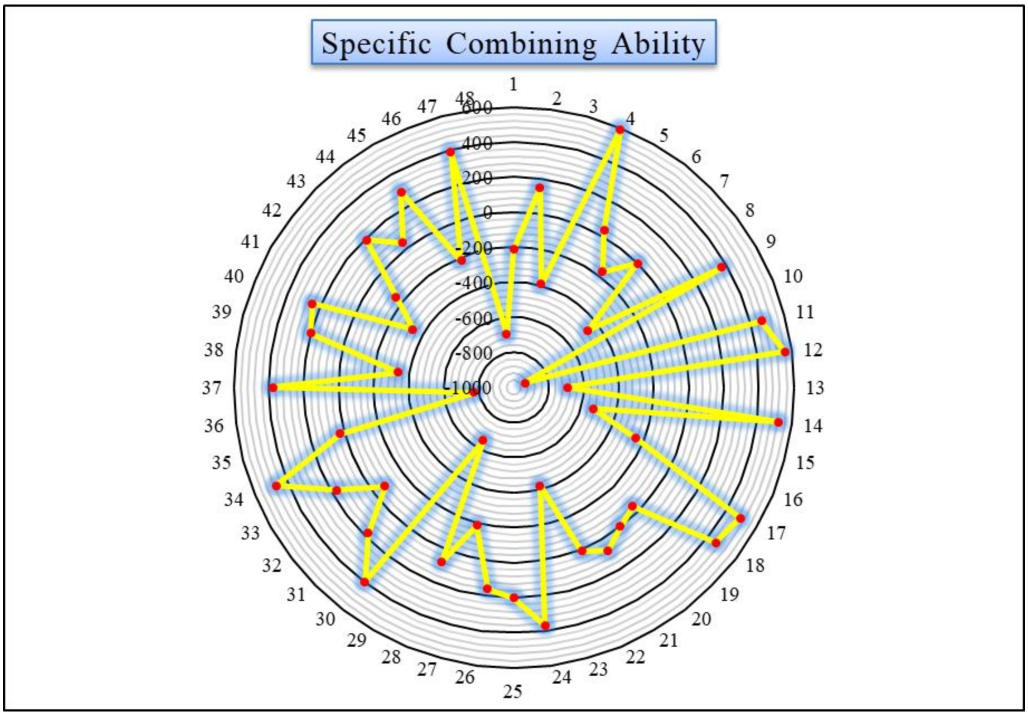
Genotypes	DOF	DFP	FPL	FL	FG	FSI	FW	NFP	NPBP	PH	PS	FBI	TSS	CCI	FYP
L_1	2.197**	1.137	0.266**	2.114**	-2.674**	0.325**	-14.809**	2.079*	-0.046	-3.701*	2.687	-0.628**	-0.062	-0.629	-336.700**
L_2	2.697**	2.785**	-0.222**	-1.079**	0.255	-0.107**	-6.595**	-6.298**	-0.079	-0.713	-8.364**	0.856**	0.289**	-2.160**	-501.980**
L_3	-0.933	-1.363*	-0.365**	-1.274**	2.863**	-0.211**	16.121**	-10.871**	-0.053	-6.334**	-6.550**	1.380**	0.025	6.994**	-205.330**
L_4	-4.044**	-2.197**	0.503**	1.745**	-1.401**	0.207**	-1.347	5.646**	0.221*	-0.895	-0.098	-0.797**	-0.109	-5.020**	260.090**
L_5	-0.544	0.007	-0.169*	-0.836**	-0.230	-0.086**	6.475**	-1.284	-0.057	6.319**	3.775*	0.433**	0.076	5.451**	307.630**
L_6	-0.544	- 1.975**	0.327**	0.090	2.288**	-0.117**	33.723**	-8.558**	-0.139	5.387**	6.856**	0.427**	0.065	-3.260**	510.720**
L_7	-0.248	-0.141	-0.174*	0.082	- 1.103**	0.074**	-17.235**	6.176**	0.006	-1.259	2.198	-0.755**	-0.244**	4.037**	-198.200**
L_8	1.419*	1.748*	-0.166*	-0.841**	0.003	-0.084**	-16.333**	13.109**	0.148	1.196	-0.504	-0.917**	-0.041	-5.413**	163.780*
T_1	-0.706	-0.493	-0.008	-0.486**	2.450**	-0.158**	10.977**	-5.492**	0.058	2.513**	1.657	0.888**	-0.081	2.024**	75.040*
T_2	0.238	0.188	0.087*	-1.278**	1.832**	-0.198**	9.366**	-9.411**	0.127*	0.414	-0.506	0.210**	0.111*	-2.156**	-139.330**
T_3	2.100**	1.535**	0.006	0.881**	-2.060**	0.162**	-15.878**	11.505**	-0.090	1.467	0.712	-0.540**	-0.079	4.252**	71.150
T_4	0.975*	0.813*	-0.419**	-1.787**	2.149**	-0.220**	14.133**	-5.884**	-0.015	1.930*	-0.995	0.114*	0.149**	-1.156*	186.790**
T_5	-1.831**	-1.007*	0.355**	1.539**	-2.166**	0.225**	-7.703**	1.582**	-0.152*	-3.005**	-0.133	0.097*	-0.043	1.274*	-184.160**
T_6	-0.775*	-1.035*	-0.020	1.130**	-2.205**	0.189**	-10.895**	7.700**	0.072	-3.319**	-0.735	-0.769**	-0.057	-4.238**	-9.480
$L_1 \times T_1$	3.762*	1.530	0.811**	0.214	-0.808	-0.040	1.220	-6.749**	0.113	4.435	-4.134	-0.725**	-0.041	-1.588	-213.800
$L_1 \times T_2$	1.928	0.738	-0.302	-0.269	1.242*	-0.164**	2.675	-2.452	0.177	-0.194	4.857	0.134	0.203	0.332	150.670
$L_1 \times T_3$	-1.377	0.391	-0.244	-0.126	-0.556	0.141**	2.011	-6.524**	-0.184	-3.266	-0.173	1.021**	0.173	-1.309	-391.560*
$L_1 \times T_4$	-3.363*	-3.887*	-0.108	0.857*	-0.641	-0.004	-1.953	8.865**	0.341	-1.700	2.772	-0.575**	-0.326	-4.844*	591.170**
$L_1 \times T_5$	0.887	0.711	-0.413*	-1.359**	1.470*	-0.188**	3.639	-0.978	-0.366	3.436	0.750	-0.082	0.076	4.733*	31.980
$L_1 \times T_6$	-1.836	0.516	-0.347*	0.683	-0.707	0.255**	-7.591*	7.837**	-0.079	-2.710	-4.072	0.227	-0.085	2.675	-168.460
$L_2 \times T_1$	0.150	0.882	-0.077	-1.142**	0.282	-0.052	0.178	0.873	0.324	-0.804	2.402	0.394*	0.061	5.548**	1.670
$L_2 \times T_2$	4.984**	1.979	-0.437*	-0.179	-0.667	0.040	-12.297**	-3.941*	0.032	-4.558	-8.077	-0.082	-0.242	1.822	-467.630**
$L_2 \times T_3$	-1.544	-0.479	0.648**	0.809*	-1.677**	0.149**	-0.118	7.743**	-0.284	1.657	6.936	-0.714**	-0.134	-3.653*	371.640*
$L_2 \times T_4$	1.025	2.465	-0.047	0.201	-0.126	0.031	-7.610*	-11.268**	-0.271	-8.032*	-10.014*	0.981**	0.032	-3.600	-932.330**
$L_2 \times T_5$	-2.725	-3.271*	0.023	-0.460	0.865	-0.122**	5.473	2.844	-0.022	5.699	2.741	0.221	-0.139	3.252	464.400**
$L_2 \times T_6$	-1.891	-1.576	-0.110	0.771*	1.324*	-0.047	14.374**	3.748	0.221	6.037	6.012	-0.800**	0.422*	-3.368	562.240**
$L_3 \times T_1$	5.113**	2.697	-0.163	-0.923*	1.985**	-0.026	-3.733	-5.554*	-0.191	-8.441*	-11.673*	5.387**	0.279	8.775**	-694.580**
$L_3 \times T_2$	-4.275*	-2.984	0.052	1.532**	-0.702	0.162**	-1.418	11.254**	-0.083	7.676*	7.280	-1.927**	-0.093	-4.749*	521.770**
$L_3 \times T_3$	3.086	5.002**	-0.214	-1.919**	0.017	-0.187**	0.487	-16.129**	0.023	-4.353	-2.732	0.707**	0.301	4.098*	-530.270**
$L_3 \times T_4$	2.211	0.613	-0.458*	0.389	0.394	0.068	4.776	-1.829	-0.274	-0.601	-4.351	-0.865**	-0.287	0.339	-243.950
$L_3 \times T_5$	-5.317**	-2.123	0.404*	0.168	-0.908	-0.031	-3.198	7.250**	0.308	3.935	7.122	-1.512**	-0.168	-6.856**	493.910**
$L_3 \times T_6$	-0.817	-3.206	0.379*	0.752	-0.787	0.013	3.086	5.009*	0.217	1.784	4.353	-1.789**	-0.032	-1.606	453.120**
$L_4 \times T_1$	-2.442	-0.692	-0.164	0.846*	0.241	-0.029	3.863	-5.116*	-0.021	-5.929	-1.489	-1.492**	-0.183	6.343**	-39.840
$L_4 \times T_2$	-1.609	-1.484	0.362*	-0.602	-0.395	-0.076*	9.932*	-2.196	-0.046	0.295	0.577	0.515*	0.010	-0.274	1.500
$L_4 \times T_3$	2.752	1.280	-0.142	0.747	-0.118	0.086*	-1.738	2.154	0.260	2.679	0.050	0.314	0.091	2.018	76.060
$L_4 \times T_4$	1.322	-0.109	-0.084	-1.382**	0.919	-0.195**	-0.115	-1.102	-0.037	5.409	2.333	0.257	0.161	2.033	11.930
$L_4 \times T_5$	-0.206	1.711	0.042	0.988*	-0.894	0.238**	-11.253**	-2.545	0.100	-3.493	-3.999	-0.018	-0.023	-6.026**	-418.880**
$L_4 \times T_6$	0.183	-0.706	-0.014	-0.597	0.247	-0.024	-0.690	8.804**	-0.257	1.039	2.528	0.424*	-0.056	-4.093*	369.230*
$L_5 \times T_1$	-2.609	-1.563	-0.154	0.684	-0.655	0.087*	0.637	2.792	-0.476*	4.284	11.510*	-1.051**	-0.063	-7.965**	202.290
$L_5 \times T_2$	-1.220	-0.688	-0.517**	0.161	-0.706	0.068	2.545	2.622	0.254	-0.890	-1.378	-0.463*	0.205	-3.696*	159.120
$L_5 \times T_3$	-2.859	-1.479	0.179	0.275	-0.080	0.022	-2.123	-2.139	-0.062	2.223	-3.098	-0.140	-0.156	6.671**	-185.610
$L_5 \times T_4$	0.044	-0.535	0.382*	0.394	-1.059	0.074*	-1.657	1.517	-0.115	0.580	0.914	1.601**	-0.128	-1.734	75.510
$L_5 \times T_5$	5.516**	4.618**	0.032	-1.438**	1.732**	-0.199**	-4.140	-8.037**	0.200	-5.957	-6.191	0.005	0.399*	6.205**	-650.230**
$L_5 \times T_6$	1.127	-0.354	0.078	-0.076	0.767	-0.052	4.739	3.245	0.199	-0.241	-1.756	0.048	-0.256	0.518	398.910*
$L_6 \times T_1$	-1.053	-0.692	-0.319	0.036	-0.833	0.067	3.712	4.799*	0.183	1.125	0.148	-0.876**	0.215	-3.455	178.070
$L_6 \times T_2$	0.447	2.405	-0.051	-0.394	-0.109	0.034	7.103*	0.385	0.225	2.658	5.614	2.593**	-0.257	-1.347	-72.040
$L_6 \times T_3$	-1.414	-2.053	-0.230	0.089	0.799	-0.082*	-13.179**	1.780	-0.247	0.597	-0.073	-0.384*	-0.100	4.351*	171.640
$L_6 \times T_4$	-1.734	-0.887	0.024	-0.221	0.986	0.008	21.526**	0.502	0.033	0.214	0.608	-1.974**	0.401*	1.295	468.830**
$L_6 \times T_5$	0.516	-0.623	0.766**	0.680	-0.412	0.009	5.215	-1.497	-0.029	-0.088	-2.471	0.272	-0.234	-3.228	24.710
$L_6 \times T_6$	3.238*	1.850	-0.190	-0.189	-0.431	-0.036	-24.377**	-5.970**	-0.164	-4.507	-3.826	0.368	-0.024	2.383	-771.220**
$L_7 \times T_1$	-2.016	-1.414	0.156	0.011	-0.058	-0.046	2.116	4.422*	0.105	6.273	4.193	-1.023**	-0.038	0.112	375.600*
$L_7 \times T_2$	-0.072	0.350	0.184	-0.077	0.620	-0.063	-14.635**	1.541	-0.631**	-6.948*	-10.890*	-0.258	-0.024	7.236**	-333.400*
$L_7 \times T_3$	1.400	-0.887	-0.348*	0.350	0.381	-0.027	6.666	3.891*	0.453*	-1.157	-0.313	-0.212	-0.189	-8.790**	199.290
$L_7 \times T_4$	0.303	1.169	0.240	-0.266	1.089*	-0.051	-6.884	4.413*	0.066	2.794	7.455	0.081	0.108	5.518**	245.220
$L_7 \times T_5$	0.887	0.766	-0.442*	1.129**	-1.929**	0.288**	2.946	-5.030*	-0.218	-3.902	-1.786	0.808**	0.050	-3.695*	-335.050*
$L_7 \times T_6$	-0.502	0.016	0.211	-1.147**	-0.103	-0.100*	9.790*	-9.237**	0.225	2.941	1.341	0.604**	0.093	-0.380	-151.670
$L_8 \times T_1$	-0.905	-0.748	-0.090	0.274	-0.154	0.038	-7.994*	4.533*	-0.037	-0.944	-0.958	-0.613**	-0.230	-7.769**	190.580
$L_8 \times T_2$	-0.183	-0.317	0.107	-0.172	0.717	-0.001	6.096	-7.215**	0.071	1.961	2.017	-0.510*	0.198	0.675	40.020
$L_8 \times T_3$	-0.044	-1.775	0.350*	-0.224	1.234*	-0.102*	7.992*	9.224**	0.043	1.620	-0.597	-0.593**	0.015	-3.387	288.790*
$L_8 \times T_4$	0.192	1.169	0.052	0.028	-1.563**	0.069	-8.082*	-1.098	0.257	1.335	0.284	0.494*	0.040	0.993	-216.390
$L_8 \times T_5$	0.442	-1.789	-0.412*	0.292	0.077	0.005	1.319	7.992**	0.028	0.370	3.834	0.304	0.040	5.615**	389.160*
$L_8 \times T_6$	0.498	3.461*	-0.006	-0.197	-0.310	-0.008	0.670	-13.437**	-0.362	-4.342	-4.579	0.917**	-0.063	3.872*	-692.150**

*, ** are significance level at 5% and 1%, respectively



1. Arka Komal 2. Ph-6 3. Ph-9 4. PPL	5. JDNB-16-1 6. ISD-006 7. CO_2 8. ABSR-2	9. GOB-1 10. GAOB-2 11. GAB-6	12. GRB-5 13. Arka Harshita 14. P. Anupam

Fig 1: Graphical representation of general combining ability effects for lines and testers based on pooled over environments for fruit yield per plant in brinjal



Checkerboard of 1 to 48 hybrids developed through L × T mating

Lines / Testers	Arka Komal	Ph-6	Ph-9	PPL	JDNB-16-1	ISD-006	CO2	ABSR-2
GOB-1	1	7	13	19	25	31	37	43
GAOB-2	2	8	14	20	26	32	38	44
GAB-6	3	9	15	21	27	33	39	45
GRB-5	4	10	16	22	28	34	40	46
Arka Harshita	5	11	17	23	29	35	41	47
P. Anupam	6	12	18	24	30	36	42	48

Fig 2: Graphical representation of specific combining ability effects for hybrids based on pooled over environments for fruit yield per plant in brinjal

The pedigree method is applicable for good × good general combiners and, heterosis is for the crosses with only one parent with a good *gca*. High *sca* effects don't mean a combination of good general combiners, and *vice versa*. That's why, any combination of either poor × poor, average × average, good × good, or average × good, may give high *sca* effects (Ingale *et al*., 1997 [8]; Singh *et al*., 2002 [9] and Naresh *et al*., 2014 [10]). The main prerequisite for beginning the hybridization is the presence of non-additive genetic variance (Cockerham, 1961) [11]. But no specific combiner was found constantly good for all traits (Aswani and Khandelwal, 2005) [12].

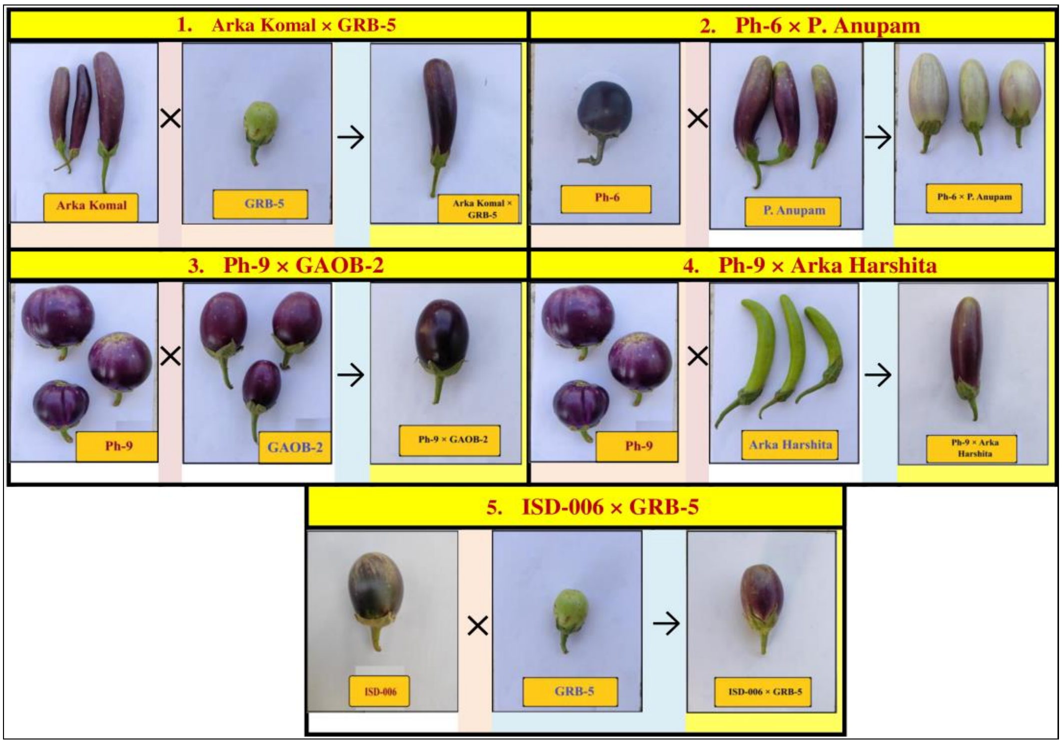


Fig 3: Top five hybrids and their parents based on fruit yield per plant (pooled)

Conclusion

After observing the *sca* effects of pooled data, crosses *viz.* 'Arka Komal × GRB 5', 'Ph-6 × P. Anupam', 'Ph-9 × GAOB 2', 'Ph-9 × Arka Harshita' and 'ISD-006 × GRB 5' appeared as the crosses of choice for fruit yield per plant and some other traits (Figure 3). They became the good specific combiner for at least one trait. In addition, the best general combiners may not always create the best specific combinations for all the characters. Although, in some cases, good × good combinations showed a high specific combining ability effect. One example of such a combination in pooled analysis for fruit yield per plant is 'ISD-006 × GRB 5'. Incorporating this hybrid with its good combining parents into a breeding programme could be a useful plan for enhancing the quantity and quality of brinjal.

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